



Wyoming Region 6 Hazard Mitigation Plan Public Review Draft

Washakie, Hot Springs, Park and Big Horn Counties

2022-2027

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Executive Summary

This plan is the product of a 2021 planning process undertaken by the four counties in the Big Horn Basin in Wyoming Region 6 – Big Horn, Park, Hot Springs and Washakie. The purpose is to meet the requirements of the Disaster Mitigation Act of 2000 (PL 106-390), and thereby maintain continued eligibility for certain Hazard Mitigation – or disaster loss reduction – programs from the Federal Emergency Management Agency (FEMA). This plan updates the 2016 Region 6 Hazard Mitigation Plan including each county annex for Big Horn, Hot Springs, Washakie and Park counties and sets priorities for mitigation in the Region for the time period of 2022-2027.

The process followed a methodology that adheres to FEMA guidance. It consisted of two levels of planning teams; a coordinating planning team comprised of the County Emergency Manager Coordinators, and four County Planning Teams (CPT) consiting of local governmentreprsentatives – one in each county. Every municipality within each county was invited to participate.

The planning process examined the recorded history of losses resulting from natural hazards, and analyzed the future risks posed to each county by these hazards. A hazard identification and risk assessment was updated for the following hazards: avalanche, dam failure, drought, earthquake, expansive soils, extreme cold, flood, hailstorm, hazardous materials, high winds, landslide, lightning, mine subsidence, tornadoes, severe winter storms, wildfire, volcano and epidemic/pandemic. Two new hazards, volcano and epidemic/pandemic, were added in the 2021 plan to align with the hazards in 2020 State of Wyoming Hazard Mitigation Plan and the ongoing COVID-19 pandemic during the 2021 planning process. Where applicable, these profiles were built on existing information found in the 2016 plan. The hazards were assessed for geographic extent, potential magnitude probability, vulnerability and given a rating for overall significance. Drought, wildfire, floods and winter storms tend to cause the most damage or economic loss in the Region.

The plan's mitigation strategy includes goals for each county in the entire planning area. The plan also puts forth county-specific recommendations for mitigation, based on the risk assessment, that are designed to reduce future losses in each county and ultimately, in the Region.

1 Introduction

1.1 Purpose

The counties of Wyoming Region 6 including Big Horn, Hot Springs, Park, and Washakie prepared this regional hazard mitigation plan 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 planning area's eligibility for certain federal disaster assistance under the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grant programs including the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) and Building Resilient Infrastructure and Communities (BRIC) program, as well as to make the region more disaster resistant. This plan demonstrates the region and each county's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources.

1.2 Background and Scope

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

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society 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 determined, 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 County and 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 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 act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the 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 the community and its property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. The planning area has been affected by hazards in the past and is thus committed to reducing future disaster impacts and maintaining eligibility for federal funding.

1.3 Plan Organization

Wyoming Region 6 Regional Hazard Mitigation Plan is organized in alignment with the DMA planning requirements and the FEMA plan review crosswalk as follows:

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption, Implementation, and Maintenance
- County Annexes
- Appendices

1.3.1 County Annexes

Each county participating in this plan developed its own annex, which provides a more detailed assessment of the county and respective jurisdiction’s unique risks as well as their mitigation strategy to reduce long-term losses. Each county annex contains the following:

- Community profile summarizing geography and climate, history, economy, and population
- More detailed hazard vulnerability information and unique risks by jurisdiction, where applicable, for geographically specific hazards
- Hazard map(s) at an appropriate scale for the jurisdiction, if available
- Number and value of buildings, critical facilities, and other community assets located in hazard areas, if available
- A capability assessment describing existing regulatory, administrative, and technical resources
- Mitigation actions specific to the county and municipalities

1.4 Multi-Jurisdictional Planning

This plan was prepared as a regional, multi-jurisdictional plan. The planning region is comprised four counties in Wyoming Region 6 (Region), established by the Wyoming Office of Homeland Security (WYOHS); the region includes Big Horn, Hot Springs, Park and Washakie counties. All local units of government in each county were invited to participate in the planning process. The decision whether or not to participate in this process was a local decision, based on local community needs. Communities have the options to not prepare a plan, to prepare a stand-alone plan for their jurisdiction, or to participate in a multi-jurisdiction or county-wide plan. All of the counties and municipalities in the Region adopted it in 2016. The following table lists counties and their local governments that have opted to participate in this effort and are seeking FEMA approval of the 2021 version of this plan. There were no changes in participation since the 2016. Additional details about participation can be referenced in Chapter 3 and the county annexes.

Table 1-1 Multi-Jurisdictional Participation 2021

Jurisdiction	Participation Status
Big Horn County	Continuing from 2016
Town of Basin	Continuing from 2016
Town of Burlington	Continuing from 2016

Jurisdiction	Participation Status
Town of Byron	Continuing from 2016
Town of Cowley	Continuing from 2016
Town of Deaver	Continuing from 2016
Town of Frannie	Continuing from 2016
Town of Greybull	Continuing from 2016
Town of Lovell	Continuing from 2016
Town of Manderson	Continuing from 2016
Hot Springs County	Continuing from 2016
Town of East Thermopolis	Continuing from 2016
Town of Kirby	Continuing from 2016
Town of Thermopolis	Continuing from 2016
Park County	Continuing from 2016
City of Cody	Continuing from 2016
City of Powell	Continuing from 2016
Town of Frannie	Continuing from 2016
Town of Meeteetse	Continuing from 2016
Washakie County	Continuing from 2016
City of Worland	Continuing from 2016
Town of Ten Sleep	Continuing from 2016

2 Community Profile

This section provides a brief overview of the geography of the planning area. Additional geographic profiles of the participating counties are provided in the county annexes.

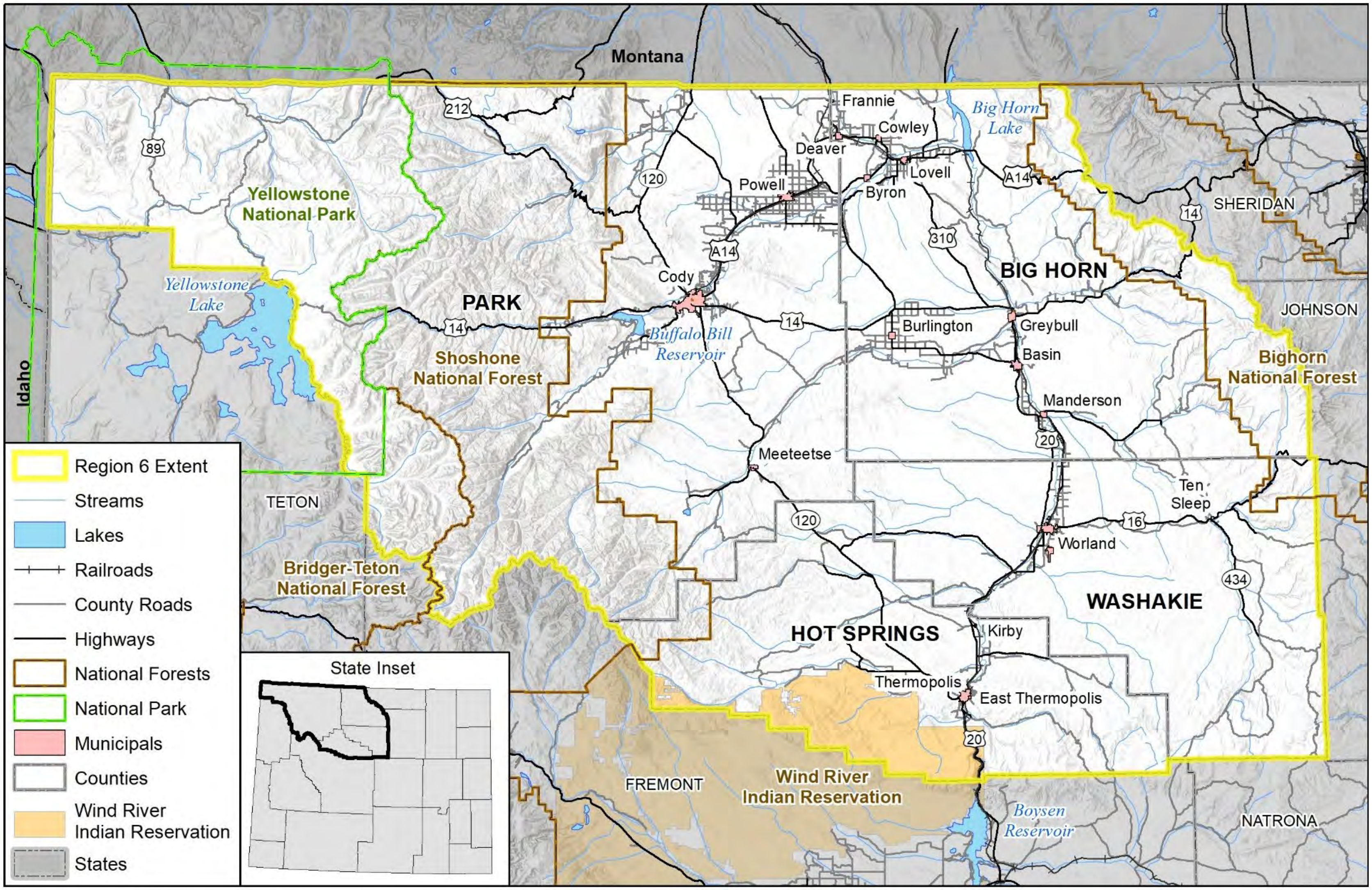
2.1 Geography and Climate

Wyoming Region 6 is comprised of four counties in northwestern Wyoming in the Big Horn River Basin. Member counties include Big Horn, Hot Springs, Park, and Washakie. It is bounded by the Absaroka Range on the west, the Bighorn Mountains on the east, and the Owl Creek Mountains and Bridger Mountains on the south. It is drained to the north by tributaries of the Bighorn River.

The region covers some 14,375 square miles and elevations range between 3,000 and 11,372 feet. Eagle Peak is the highest point in Region 6, located in Yellowstone National Park in Park County. The major rivers in the region include the Bighorn River, the Shoshone River, the Greybull River, the Yellowstone River, and the Nowood River. Major roadways include Highway 14, Highway 20, Highway 16, and Highway 310. A base map of the planning region is illustrated in Figure 2-1. A large percentage of the Region's land is public or federally managed as shown in the land stewardship designations on the base map.

The climate of the Big Horn Basin region varies depending on location and time of year. The region is semi-arid, receiving only 6-10 inches of rain annually. The Big Horn Basin can experience both some of the warmest and coldest temperatures within the state of Wyoming. The highest recorded temperature in the state was 114 °F on July 12, 1900, at Basin in Big Horn County. Protecting mountain ranges prevent the wind from stirring the air, and the colder heavier air settles into the valleys often sending readings well below zeros. Mean January temperatures in the Big Horn Basin show the variation between temperatures in the lower part of the valley and those higher up. In the lower portion of the basin, the mean minimum temperature for January is zero, while Cody has a mean January minimum of 11 °F. Winters are usually long and cold. Precipitation is also dependent on location in the basin. Mountain ranges block the flow of moisture laden air from the east as well as the west. The lower portion of the basin receives 5 to 8 inches of precipitation a year, while areas like Cody and Thermopolis receive 10 to 12 inches annually. Total annual snowfall also varies considerably. In areas of the Basin where elevations range from 5,000 to 6,000 feet, annual averages can be 20 to 40 inches. In the higher regions, snowfall averages often reach 200 inches.

Figure 2-1 Wyoming Region 6



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Map compiled 5/2021;
intended for planning purposes only.
Data Source: WY Geospatial Hub, WYDOT

2.2 Population Trends

Table 2-1 describes the population and estimated population change for the planning region as a whole and each individual county. Estimates beyond 2010 are based on the American Community Survey data from the US Census Bureau. As a whole, the Region is decreasing slightly in population, but percent decrease varies by county within the region.

Table 2-1 Region 6 Population Estimates

	2014 Estimate	2015 Estimate	2016 Estimate	2017 Estimate	2018 Estimate	2019 Estimate	Change 2015 to 2019	% Change 2015 to 2019
Region 6	54,154	54,319	54,146	54,190	53,831	53,664	-490	-0.90%
Big Horn	11,919	12,022	11,931	11,920	11,901	11,882	-37	-0.31%
Hot Springs	4,793	4,741	4,781	4,741	4,680	4,607	-186	-3.88%
Park	29,126	29,228	29,083	29,276	29,121	29,148	22	0.08%
Washakie	8,316	8,328	8,351	8,253	8,129	8,027	-289	-3.48%

Source: US Census Bureau ACS 5-Year Estimates, 2015-2019

2.3 Development Trends

While the population of Region 6 as a whole has been slowly declining over the past 5 years, the Wyoming Department of Administration and Information projects that statewide the population will grow slightly through the year 2040, as well as the overall population of Region 6. Below is listed the total projected 2040 populations of each county within Region 6:

- Big Horn County – 12,230
- Hot Springs County – 4,370
- Park County – 31,780
- Washakie County – 7,440

According to the Wyoming Department of Administration and Information, Hot Springs and Washakie Counties are both expected to lose population while Big Horn and Park Counties are both expected to add to their current populations. While two of the four counties in Region 6 are expected to lose population, these losses will be counteracted by the growth of the other two counties which will raise the total population of the Region over what it is today.

2.4 Economy

Region 6 is located in the northwestern corner of Wyoming. Historically, the primary industry in Region 6 was oil and gas. The Bighorn Basin forms a geologic structural basin filled with more than 20,000 feet of sedimentary rocks. Since the early 20th century, the basin has been a significant source of petroleum and has produced more than 1,400,000,000 barrels of oil. Some uranium has been mined in the northern part of the basin. Region 6 is losing ground in the oil and gas and mining industries for a variety of reasons. Big Horn County created an Economic Development Plan that explains that many of the reasons for loss can be corrected with targeted supported (which may include workforce training, marketing, recruitment, research and education). Yet, some of these industries have struggled due to commodity prices and other market conditions. Wyoming's second highest earning industry is tourism. Park County is home to Yellowstone National Park, the world's first national park and the fourth most visited park. In addition to tourism and energy extraction agriculture is a major industry in the Region including row crops, farming, and ranching. Soft drinks and the bottled water industry are another important part of the economy particularly in Washakie County due to the presence of high-quality aquifers.

The ACS 5-Year data profiles also provide estimates for total employment by industry sector. These employment trends are shown below in

Table 2-2 Region 6 Employment by County and Industry Sector

Industry Sector	Big Horn % of Workforce	Hot Springs % of Workforce	Park % of Workforce	Washakie % of Workforce
Agriculture, forestry, fishing and hunting, and mining	15.6%	17.1%	9.7%	10.2%
Construction	10.4%	6.7%	9.5%	8.1%
Manufacturing	10.1%	2.3%	5.0%	8.7%
Wholesale trade	1.5%	1.4%	0.8%	3.7%
Retail trade	11.6%	7.1%	11.8%	10.1%
Transportation and warehousing, and utilities	4.3%	6.1%	3.7%	6.9%
Information	2.0%	0.8%	2.0%	0.8%
Finance and insurance, and real estate and rental and leasing	2.5%	6.0%	3.6%	4.5%
Professional, scientific, and management, and administrative and waste management services	4.2%	3.5%	6.3%	5.1%
Educational services, and health care and social assistance	21.7%	29.1%	24.7%	22.2%
Arts, entertainment, and recreation, and accommodation and food services	8.3%	11.4%	13.3%	8.8%
Other services, except public administration	4.1%	3.7%	4.7%	6.4%
Public administration	3.8%	4.9%	4.9%	4.6%

Source: U.S. Census Bureau ACS 2015-2019 5-Year Data Profile

Select 2019 economic characteristics estimated for the counties of Region 6 by the U.S. Census Bureau American Community Survey (ACS) are shown in Table 2-2.

Table 2-3 Region 6 Economic Characteristics

	Big Horn County	Hot Springs County	Park County	Washakie County
Families Below Poverty Level	8.8%	10.2%	4.5%	5.7%
Individuals Below Poverty Level	12.7%	15.2%	8.4%	10.5%
Median Home Value	$163,400	$147,300	$268,500	$165,800
Median Household Income	$52,804	$51,413	$63,582	$54,158
Per Capita Income	$24,693	$30,643	$35,147	$28,101
Population >16 Years Old in Labor Force	5,498	2,285	14,376	3,939
Population Employed	5,081	2,217	13,922	3,777

Source: U.S. Census Bureau ACS 2015-2019 5-Year Data Profile

3 Planning Process

DMA 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.*

3.1 Background on Mitigation Planning in Region 6

The 2016 Region 6 Hazard Mitigation Plan was the first regional hazard mitigation plan for Park, Washakie, Big Horn and Hot Springs County. The plan underwent a comprehensive update in 2021 to comply with the five-year update cycle required by the DMA 2000 and to reflect mitigation priorities for the five-year span between 2022-2027.

Prior to 2016, multiple counties in the region had adopted county-specific hazard mitigation plans over the years. Big Horn, Park and Washakie each had county-specific plans and this Regional Plan builds upon and updates those efforts. The following is a short description of those efforts by county.

Washakie County. Washakie County has been a leader statewide in mitigation planning and had one of the first approved local mitigation plans in the State. The Washakie County components of this Regional Plan had its roots in meetings and activities that began in August of 2002 and continued through June 2005. Washakie's plan underwent a major update in 2010-2011 under the coordination of the Washakie County Homeland Security Coordinator, as part of the required 5-year update cycle.

Park County. Park County has had a county hazard mitigation plan in place for 10 years, including the initial plan developed in 2006 and a comprehensive update in 2011. The planning process and development of this Regional Plan builds on this previous effort.

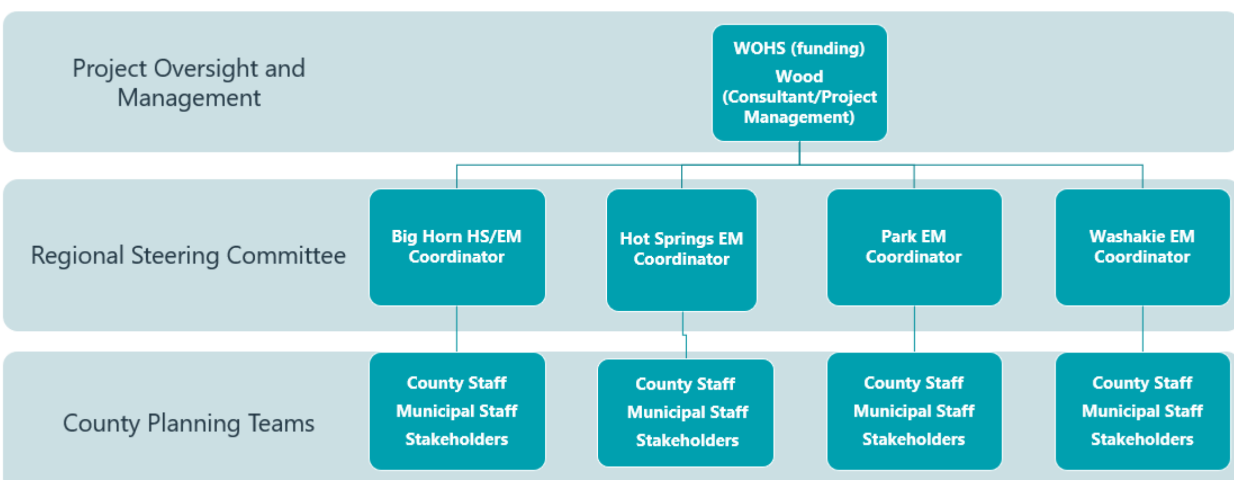
Big Horn County. Big Horn County and the incorporated communities of Basin, Burlington, Byron, Cowley, Deaver, Frannie, Greybull, Lovell, and Manderson prepared and adopted a Pre-Disaster Mitigation Plan (PDM Plan) in 2010. In 2015 the 2010 plan underwent a comprehensive update with consultant assistance. The plan was approved by FEMA pending adoption in February of 2016 and received final approval from FEMA on May 24, 2016. Due to the coinciding of adoption of an updated plan during the 2016 Regional Plan development the 2015 Big Horn County Hazard Mitigation Plan was included as an annex in its entirety. During 2021 this annex has been revised to be more consistent with the other county annexes.

Hot Springs County. Hot Springs County did not have an adopted local hazard mitigation plan prior to the development of the 2016 Regional Plan. Some components existed however, including a Hazard Identification and Risk Assessment developed with assistance by WYOHS in 2005 and a Public Health Risk Assessment completed in 2016.

Regional Planning. In Wyoming, the Wyoming Office of Homeland Security (WYOHS) utilizes a regional support structure to assist the counties with all aspects of emergency management, including planning. Each county has an emergency management coordinator. The counties in the Big Horn River basin, Park, Hot Springs, Washakie and Big Horn, comprise Region 6. In 2016 the WYOHS began the process of initiating the development of regional hazard mitigation plans statewide. This initiative recognized that actual process of facilitating and developing or updating multi-jurisdictional hazard mitigation plans compliant with the DMA 2000 was often beyond local capabilities and expertise. Instead of each county hiring consultants the WYOHS took the lead in procuring and funding a professional hazard mitigation planning consultant through a competitive bid process. Due to the timing of plan updates Regions 6 and 4 were chosen as the first regions in the state to develop regional plans. Wood Environment and Infrastructure Solutions, Inc. (Wood) of Denver, Colorado was selected in in both 2016 and 2019 (under a multi-year, multiple region contract) to provide assistance to Region 6.

Prior to initiating the update of this regional multi-jurisdictional Hazard Mitigation Plan in 2021 a substantial coordination effort took place to ensure the participation of all four counties within Region 6. Each county designated a primary point of contact as the emergency management coordinator to be part of the Regional Steering Committee. 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 Region 6 Hazard Mitigation Plan. Every incorporated community within the four counties chose to participate in the update of the Regional Plan. A graphic illustrating the Hazard Mitigation Planning Committee (HMPC) / regional planning framework is shown below.

Figure 3-1 Region 6 Hazard Mitigation Planning Committee Framework



Each emergency management coordinator led county-level Planning Teams (CPTs) working in concert with the hazard mitigation planning consultant. As the planning consultant Wood's role was to:

- Provide guidance on a planning organization for the entire planning area representative of the participants;

- Meet all of 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 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 WYOHS and FEMA Region VIII

3.2 What's New in the Plan Update

DMA Requirement §201.6(d)(3):	*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 5 years in order to continue to be eligible for mitigation project grant funding.*

The updated HMP complies with Federal Emergency Management Agency (FEMA) guidance for Local Hazard Mitigation Plans. The update followed the requirements noted in the Disaster Mitigation Act (DMA) of 2000 and FEMA's 2013 Local Hazard Mitigation Planning Handbook.

This HMP update involved a comprehensive review and update of each section of the 2016 plan and includes an assessment of the progress in evaluating, monitoring, and implementing the mitigation strategy outlined in the previous plan. The planning process provided an opportunity to review jurisdictional priorities related to hazard significance and mitigation action, and revisions were made where applicable to the plan. Only the information and data still valid from the 2016 plan was carried forward as applicable into this HMP update.

3.2.1 Plan Section Review and Analysis – 2021 Update

During the 2021 plan update, the HMPC updated each of the sections of the previously approved plan to include new information. Wood developed a summary of each section in the plan and guided the HMPT through the elements that needed updating during the kickoff webinar in January 2021. This included analyzing each section using FEMA's local plan update guidance (2013) to ensure that the plan met the latest requirements. In addition, the FEMA Local Mitigation Plan Review Tool that was provided with the approval of the 2016 version of this plan was referenced, in particular the 2016 FEMA comments on opportunities for improvement, were considered and addressed in the 2021 update. The HMPC and Wood determined that nearly every section of the plan would need revision to align the plan with the latest FEMA planning guidance. A summary of the changes in this plan update is highlighted in the table below.

Table 3-1 Wyoming Region 6 Hazard Mitigation Plan Update Highlights

Plan Section	Summary of Plan Review, Analysis, and Updates
0. Executive Summary	Revised to reflect 2021 planning process
1. Introduction	Revised to reflect updated plan and 2021 planning process
2. County Profile	Updated with recent census data and current economy description Updated land use and development trends
3. Planning Process	Describes and documents the planning process for the 2021 update, including coordination among agencies

Plan Section	Summary of Plan Review, Analysis, and Updates
	Describes how 2021 plan was integrated with/into other planning efforts Removed 2016 planning process info Describes changes to jurisdictional participation Describes 2021 public participation process Describes the Hazard Mitigation Planning Committee (HMPC) including Regional Steering Committee and County Planning Teams (CPT) Describes the 10-step process followed for the update
4. Hazard Identification and Risk Assessment	Added volcano and epidemic/pandemic hazards Considerations on future climate impact information has been added to each hazard profile Updated list of disaster declarations to include recent data Updated tables to include recent National Center for Environmental Information data. Updated past occurrences for each hazard to include recent data. Updated critical facilities identified from the 2016 plan. Updated growth and development trends to include recent Census and local data sources. Updated property values for vulnerability and exposure analysis, using updated building information based on assessor's data. Updated estimate flood losses using the latest Digital Flood Insurance Rate Map (DFIRM) and assessor's data. Updated National Flood Insurance Program (NFIP) data and Repetitive Loss structure data from the previous plan. Incorporated new hazard loss estimates since 2016, as applicable. Used updated GIS inventory data for vulnerability analysis Updated information regarding specific vulnerabilities to hazards, including maps and tables of specific assets at risk, specific critical facilities at risk, and specific populations at risk. Updated maps in plan where appropriate.
5. Mitigation Strategy	Indicated what actions have been implemented that may reduce previously identified vulnerabilities. Updated mitigation strategy based on the results of the updated risk assessment, completed mitigation actions, and implementation obstacles and opportunities since the completion of the 2016 plan. Reviewed and updated goals and objectives based on HMPC input. Included updated information on how actions are prioritized, or how priorities changed. Reviewed mitigation actions from the 2016 plan and developed a status report for each; identified if actions have been completed, deleted, or deferred/carried forward. Updated priorities on actions. Identify examples of successful implementation to highlight positive movement on actions identified in 2016 plan. Identified new mitigation actions proposed by each CPT with more detail on implementation than the previous plan. Developed a summary table of mitigation actions for all participating jurisdictions.
6. Adoption, Implementation and Maintenance	Update to reflect 2021 process. Reviewed and updated procedures for monitoring, evaluating, and updating the plan. Revised to reflect current methods.

Plan Section	Summary of Plan Review, Analysis, and Updates
	Updated the system for monitoring progress of mitigation activities by identifying additional criteria for plan monitoring and maintenance. Updated process for incorporation of the HMP into existing mechanisms
Jurisdictional Annexes	Updated previous participants' annexes with recent Census data. Updated past event history and hazard loss estimates. Updated capabilities assessments. Added new maps and updated old maps as needed. Updated mitigation actions from 2016 and added new mitigation actions; standardized the format of mitigation actions across the annexes. Updated and standardized format of annexes: • Big Horn County • Hot Springs County • Park County • Washakie County
Appendices	Appendix A – County Hazard Mitigation Planning Committee Members Appendix B - Planning Process Documentation Appendix C – Records of Adoption Appendix D – Critical Facility Details (electronic)

3.3 Local Government Participation

The Disaster Mitigation Act (DMA) planning regulations and guidance stress that each local 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 Hazard Mitigation Planning Committee (HMPC),
- 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 Region 6 Multi-Hazard Mitigation Plan's HMPC, "participation" meant:

- Attending and participating in HMPC meetings;
- Establishing/reconvening a local steering committee;
- Providing available data requested by the County Planning Team (CPT) coordinator/ Wood;
- 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 all counties and the municipalities in Region 6 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, and more.

3.4 The 10-Step Planning Process

Wood established the planning process for the Region 6 plan 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 Progress

Into this four-phase process, Wood integrated a more detailed 10-step planning process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance (FMA) programs. Thus, the modified 10-step process used for this plan meets the requirements of six major programs: FEMA's Hazard Mitigation Grant Program, Pre-Disaster Mitigation program, Community Rating System (CRS), Flood Mitigation Assistance Program, Severe Repetitive Loss program, and new flood control projects authorized by the U.S. Army Corps of Engineers. FEMA's March 2013 Local Mitigation Planning Handbook recommends a nine-step process within the four-phase process. Table 3-1summarizes the four-phase DMA process, the detailed CRS planning steps and workplan used to develop the plan, the nine handbook planning tasks from FEMA's 2013 Local Mitigation Planning Handbook, and where the results are captured in the Plan. 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	Community Rating System (CRS) Planning Steps (Activity 510) and Wood Workplan Tasks	FEMA Local Mitigation Planning Handbook Tasks (44 CFR Part 201)	Location in Plan
Phase I: Organize Resources	Task 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
	Task 2. Involve the public	3: Create an Outreach Strategy y 44 CFR 201.6(b)(1)	Chapter 3, Section 3.3.1
	Task 3. Coordinate with Other Agencies	4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)	Chapter 3, Section 3.3.1 and county annexes
Phase II: Assess Risks	Task 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 county annexes
	Task 5. Assess the problem		Chapter 4 and county annexes
Phase III: Develop the Mitigation Strategy	Task 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
	Task 7. Review possible activities		Chapter 5, Section 5.3
	Task 8. Draft an action plan		Chapter 5, Section 5.4 and county annexes
Phase IV: Adopt and Implement the Plan	Task 9. Adopt the plan	8: Review and Adopt the Plan	Chapter 6

FEMA 4 Phase Guidance	Community Rating System (CRS) Planning Steps (Activity 510) and Wood Workplan Tasks	FEMA Local Mitigation Planning Handbook Tasks (44 CFR Part 201)	Location in Plan
	Task 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

3.4.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

Wood worked with WYOHS and the Regional Steering Committee 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 hazard mitigation plan. During the update of this Regional Plan, the planning process was directed through a regional steering committee comprised of Big Horn County Emergency Management, Hot Springs County Emergency Management, Park County Emergency Management and, Washakie County Emergency Management. The planning consultant held an initial conference call through Microsoft Teams (Teams) to discuss the organizational aspects of the planning process with the county coordinators. Using FEMA planning guidance representatives for each county's CPT base membership was established, with additional invitations extended as appropriate to other federal, state, tribal, and local stakeholders and the public throughout the planning process. This included agencies that have the authority to regulate development (county and local government), as well as businesses, academia (school districts), and other private and non-profit interests to be involved in the planning process. Neighboring jurisdictions included the participating counties themselves and certain special districts. The list of agencies and departments invited to participate is listed in the following table. More details are included in Appendix A with documentation of participation included in Appendix B.

Table 3-3 HMPC Members and Stakeholders by County

Hot Springs County	
Jurisdictions and Stakeholders	**Department/Representatives**
Jurisdictions	
Hot Springs County (HSC)	HSC Emergency Management
	HSC Commission Chairman
	HSC Attorney
	HSC Sheriff
	HSC Clerk
	HSC Assessor
	HSC Treasurer
	HSC Planner
	HSC Road & Bridge
	HSC Public Health - Nurse Manager
	HSC Public Health - PH Response Coordinator
	HSC Memorial Hospital - CEO
	HSC Memorial Hospital - Emergency Planner
	HSC Museum
	HSC LEPC - Chairman
	HSC Fire District #1
	HSC Senior Citizens Center
	HSC Counseling Services
	HSC Weed & Pest

Hot Springs County	
Jurisdictions and Stakeholders	**Department/Representatives**
Town of East Thermopolis	East Thermopolis Mayor
Town of Kirby	Kirby Mayor
Town of Thermopolis	Thermopolis Mayor
	Assistant to Mayor, Codes Administrator
	Thermopolis Police Chief
	Thermopolis Police Dept., Sergeant
	Thermopolis Police Dept./Communications
	Thermopolis Vol. Fire Department - Chief
	Thermopolis Public Works
	Public Citizen - Member at Large
Stakeholders	
HSC School District #1	Superintendent
	Administrative Assistant to Superintendent
	Transportation Department (Bus Barn)
Thermopolis Independent Record (Newspaper/Local Press)	Publisher/Editor
	Reporter
Local Utilities	High Plains Power
	Wyoming Gas
	RT Communications
	TCT Telephone
HOPE Agency	
Thermopolis Hot Springs Chamber of Commerce	
Big Horn Enterprises	
Thermopolis Rehab & Wellness	
Mortimore Ambulance Service	
Risen Son Christian School	Principal
Northwest Boces School	
Community Home Health	

Park County	
Jurisdictions and Stakeholders	**Department/Representatives**
Jurisdictions	
Park County	Homeland Security Director
	Public Health
	County Commissioners
	Dispatch-Supervisor
	Public Works -County Engineer
	Fire District #2 – Administrative Supervisor
	Fire District # 2 – Fire Marshal
	Planning and Zoning
	Sheriff
City of Cody	Chief of Police
	Administrator
	Parks & Recreation Director
City of Powell	Emergency Coordinator
	Public Works Director
	Mayor
	Administrator
	Chief of Police

Park County	
Jurisdictions and Stakeholders	**Department/Representatives**
Town of Meeteetse	Emergency Coordinator/Town Council
	Town Clerk/Treasurer
Stakeholders	
Northwest Rural Water	Manager
Rocky Mountain Power	Regional Business Manager
Grizzly Energy (Contango)	EHS Specialist
Shoshone Municipal Pipeline	Manager
Legacy Reserves	
Merit Energy	
Cody Regional Health EMS	
Powell Valley Healthcare EMS	
Washakie County	
Jurisdictions and Stakeholders	**Department/Representatives**
Jurisdictions	
Washakie County	Emergency Management
	Clerk
	Attorney
	Treasurer
	Planning
	GIS
	Road and Bridge
	Extension Office
	Public Health
	Ambulance – Director
	Ambulance – Assistant
	Sheriff's Office
	Coroner
City of Worland	Mayor and Council
	GIS/Planning
	City Engineer
	Clerk/Treasurer
	Public Works
	Police Department
Town of Ten Sleep	Town Administration
	Ambulance
	Mayor
Stakeholders	
Special Districts	Ten Sleep Rural Fire District
	Worland Fire Protection District/RERT6
	County School District #1
	County School District #2
	Weed and Pest
	Conservation District
Local Businesses	Chamber of Commerce
	Admiral Beverage
	Washakie Development Association
	Wyoming Sugar Company
	Washakie Medical Center
	KWOR AM/FM Local Radio

	Northern Wyoming Daily News
	Guardian Flight
Local Elected Officials and Public	County Commissioners
	Member-at-Large Worland/Citizen
Washakie County	
Jurisdictions and Stakeholders	**Department/Representatives**
Other	Worland Community Center
	WYDOT
	National Weather Service – Riverton
	Big Horn Basin Healthcare Coalition
	American Red Cross
Big Horn County	
Jurisdictions and Stakeholders	**Department/Representatives**
Jurisdictions	
County	County Emergency Management
	Land Planning – Planner/GIS Manager
	Road & Bridge – North Foreman
	Road & Bridge – South Foreman
	County Engineer
	County Buildings & Grounds – Supervisor
	Weed & Pest – Supervisor
	County Coroner
	Commissioner – Chairman
	Commissioner
	Commissioner – Elect
	County Clerk
	Sheriff
Town of Basin	Mayor
	Public Works
	Clerk/Treasurer
	Council Member
Town of Burlington	Mayor
	Public Works
	Clerk/Treasurer
Town of Byron	Mayor
	Public Works
	Clerk
Town of Cowley	Mayor
	Public Works
	Facilities – Manager
	Emergency Management
	Clerk/Treasurer
Town of Deaver	Mayor
	Public Works
	Clerk/Treasurer
Town of Frannie	Mayor
	Public Works

	Clerk/Treasurer
City of Greybull	Mayor
	Public Works
	City Administration and Emergency Management
	Clerk/Treasurer
Town of Lovell	Mayor
	Public Works
	Town Administration and Emergency Management
	Clerk/Treasurer
Town of Maderson	Mayor
	Water Commissioner
	Chief of Police
	Clerk/Treasurer
Stakeholders	
Unincorporated Communities	Hyattville – Fire Chief/Medicine Lodge State Park
	Hyattville – Asst. Fire Chief/Medicine Lodge State Park
	Shell – Fire Chief/EMT
	Shell – High Water
School Districts	BHC School District #1 – Superintendent
	BHC School District #1 – Buildings and Grounds
	BHC School District #3 – Superintendent
	BHC School District #1 – Buildings and Grounds
	BCH School District #4– Superintendent
	BHC School District #4 – Buildings and Grounds
Fire Districts	Big Horn County Fire Warden
	BHC District #1 – Chief
	BHC District #1 – Dispatcher
	BHC District #1 – Training Officer
	BHC District #2 – Chief
	BHC District #2 – Training Officer
	BHC District #3 – Chief/Training Officer
	BHC District #4 – Chief/Training Officer
	BHC District #5 – Chief
	Greybull Volunteer Fire Department – Chief
Healthcare	NBHH Ambulance – Director
	Three Rivers Health – EMS Director
	Big Horn Basin Healthcare Coalition
Neighboring Counties, Federal and State Stakeholders	
Organization/Agency	**Representatives**
Fremont County	Emergency Management
American Red Cross	Disaster Program Manager
	Local Volunteer
State Agencies	Office of Homeland Security
	Department of Transportation
	Highway Patrol
	Game and Fish

	Pioneer Home
	WY House of Representative – Big Horn/Park
	WY Senate – Big Horn/Park
Federal Agencies	National Weather Service – Riverton
	U.S. Forest Service
	U.S. Bureau of Reclamation

Wood and each county's Emergency Management Coordinator identified key county, municipal, and other local government and stakeholder representatives. An email invitation was sent from each county coordinator requesting identified jurisdictions and stakeholders to participate as members of the CPT and to attend a series of planning workshops. During the plan development process communication amongst the county planning teams occurred through a combination of face-to-face meetings, conference calls, Teams Meetings and email correspondence. Following the initial kickoff using Teams on January 12, 2021, two in-person planning workshops with each county's CPT were held during the plan's development between May 2021 and July 2021. The meeting schedule and topics are listed below. In addition, monthly conference calls were held with the county coordinators and Wood to discuss the process including upcoming milestones and information needs. The sign-in sheets and agendas for each of the meetings are documented in Appendix B.

The County CPT meetings were scheduled as follows.

Workshop #2: Hazard Identification and Risk Assessment and Goals update

- May 18, 2021 – Park County
- May 19, 2021 – Big Horn County
- May 20, 2021 – Washakie County
- May 20, 2021 – Hot Springs County

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

- June 23, 2021 – Hot Springs County
- June 23, 2021 – Washakie County
- June 24, 2021 – Big Horn County
- June 24, 2021 – Park County

This workshop was aimed to update the mitigation strategy and brainstorm new mitigation actions to include in the HMP. These meetings were all followed by a public meeting.

During the kickoff webinar through Teams, Wood presented information on the scope and purpose of the plan update, participation requirements of HMPC members, and the proposed project work plan and schedule. A plan for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. The HMPC reviewed the hazard identification information for each county and the Region and refined the list of identified hazards to mirror that of the Wyoming Hazard Mitigation Plan. In follow-up to the meeting participants were provided worksheets to facilitate the collection of information needed to support the plan update, such as data on historic hazard events, values at risk, and current capabilities.

Planning Step 2: Involve the Public

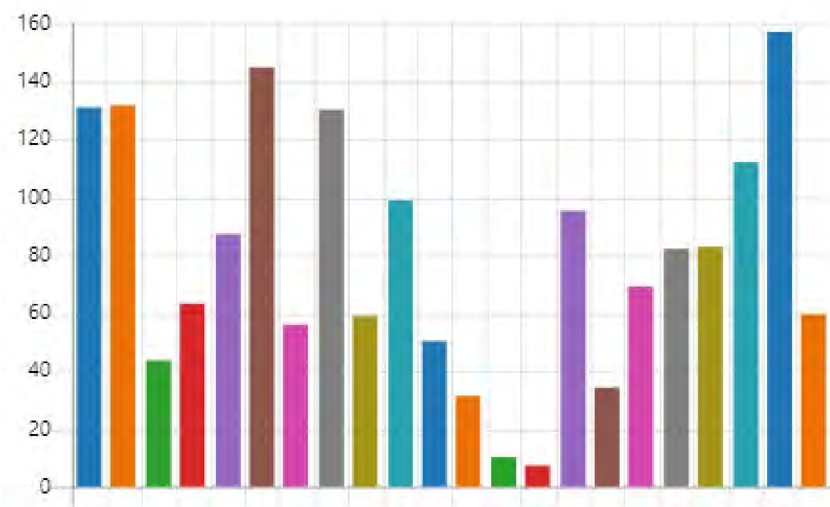
At the kickoff meeting, the HMPC discussed options for soliciting public input on the mitigation plan and developed an outreach strategy by consensus. Public and stakeholder input was done through a combination of a public meeting and an on-line survey. During the plan update's drafting stage, the HMPC provided links to a public survey via Microsoft Forms. The survey was advertised by each County and participating jurisdictions through social media and posted to the County's website.

The survey was for the public to provide feedback to the county planning teams on topics related to hazard concerns and reducing hazard impacts. The survey provided an opportunity for public input during the planning process, prior to finalization of the plan update. The survey gathered public feedback on concerns about wildfires, floods, winter storms and other hazards and solicited input on strategies to reduce their impacts. The survey was opened on May 7, 2021, in each county and closed on June 14, 2021. The counties provided links to the public survey by distributing it using social media, email, and posting the link on websites. A total of 271 responses were received and shared with the county planning committees to inform the process.

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 wind, drought, winter storm, wildfire, extreme cold and lightning as being the most significant. The following graph is a display of the results from Question 5. Question 5 read: The following types of mitigation actions may be considered in Wyoming Region 6. Please indicate all the types of mitigation actions that you think should have the highest priority in the Wyoming Region 6 Hazard Mitigation Plan. These results will be considered during the planning process. The results indicate that improving reliability of communication systems, generators for critical facilities and wildfire fuels treatment projects were popular with the public (Figure 3-1). Additional results of the survey are included in Appendix B Planning Process Documentation.

Figure 3-2 Region 6 Public Survey Results, Question 5

Indoor/Outdoor Warning	131
Wildfire Fuels Treatment proje...	132
Assistance with Defensible Sp...	44
Continued Participation in the ...	63
Critical Facilities Protection	87
Generators for Critical Facilities	145
Planning/Zoning	56
Public Education/Awareness	130
Stormwater Drainage Improve...	59
Forest Health/Watershed Prot...	99
Flood Mitigation	50
Education and Discounts on Fl...	31
Floodprone Property Buyout	10
Avalanche Mitigation	7
Water Conservation	95
Landslide/mudslide mitigation	34
Rockfall mitigation	69
Evacuation route development	82
Dam safety	83
Public health incident prepare...	112
Improve reliability of commun...	157
Lightning protection for critica...	60



Prior to finalizing, a draft of the regional plan was made available to the public for review and comment. The plan was placed on each county's web page and a press release and social media were used to announce the public comment period. A feedback form was provided to collect specific comments. **[...pending input from public review draft]**

This accomplished task three (3) in the FEMA Local Mitigation Planning Handbook (Create an outreach strategy).

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 organizations to participate in the process. Based on their involvement in hazard mitigation activities or their role in land stewardship in the Region, representatives from several state and federal agencies, local businesses were invited to participate on the HMPC in 2021 and are noted in Table 3-2.

Many of these stakeholders participated in the process by attending HMPC meetings or providing data and information that was used to update hazard profiles in the plan. WYDOT was in attendance for the kickoff meeting to initiate the plan update process, as well as planning the Washakie Risk Assessment meeting. Other stakeholders who participated in the planning process include the Wyoming Office of Homeland Security, Wyoming Pioneer Home, American Red Cross, US Bureau of Reclamation, and Grizzly Energy (Contango). Stakeholders were also given an opportunity to review and comment on the draft plan.

Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is an important aspect mitigation planning. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability from natural hazards. Each county 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
- Wyoming Hazard Mitigation 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.

3.4.2 Phase 2: Assess Risks

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

Wood led the HMPC in a process to identify and update all the hazards that have, or could, impact the planning area. Data collection worksheets were used in this effort to aid in determining hazards and vulnerabilities and where risk varies across the planning area. The 2016 Region 6 Hazard Mitigation Plan, and Wyoming Hazard Mitigation Plan provided a basis for many of the hazard profiles. The HMPC decided to focus on certain hazard chapters most relevant to the County instead of looking at all of the State of Wyoming Hazard Mitigation Plan hazard chapters. Where data permitted, Geographic Information Systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. Sophisticated analyses for flood, landslide and wildfire hazards were performed by Wood that included an analysis of flood risk based on the recent Digital Flood Insurance Rate Maps (DFIRMs).

Also included in the 2021 plan update is a capability assessment to review and document the planning area's current capabilities to mitigate risk and vulnerability from natural 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 this assessment are captured in each county annex. A more detailed description of the risk assessment process and the results are included in Chapter 4 Risk Assessment.

3.4.3 Phase 3: Develop the Mitigation Plan

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

Wood facilitated discussion sessions with the HMPC's 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, which is the essence of the planning process and one of the most important outcomes of this effort. The action plans are detailed in each county annex; the process used to identify and prioritize mitigation actions are described in greater detail in Chapter 5 Mitigation Strategy.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC's regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, Wood produced a complete first draft of the Regional Plan. This complete draft was posted for HMPC review and comment on the project ftp site. Other agencies were invited to comment on this draft as well. HMPC and agency comments were integrated into the second draft, which was advertised and distributed to collect public input and comments. Wood integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a final draft for the Wyoming Office of Homeland Security and FEMA Region VIII to review and approve, contingent upon final re-adoption by the governing boards of each participating jurisdiction.

3.4.4 Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

In order 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 C Records of Adoption.

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

The true worth of any mitigation plan is in the effectiveness of its implementation. Up to this point in the planning process, all of the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing/updating appropriate mitigation actions. 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. This process was revisited during the update process.

Finally, there are numerous organizations within the Region 6 planning area whose goals and interests interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning

Step 3, is paramount to the ongoing success of this plan and mitigation in Region 6 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.

4 Hazard Analysis 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.

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, with more detailed maps.

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.

The County Planning Teams (CPTs) from each county in the Region conducted a hazard identification study to determine the hazards that threaten the planning area.

4.1.1 Results and Methodology

Using existing hazards data, plans from participating jurisdictions, and input gained through planning and public meetings, the CPTs of each county agreed upon a list of hazards that could affect the Region. Hazards data from FEMA, the Wyoming Office of Homeland Security (including the 2020 State of Wyoming Multi-Hazard Mitigation Plan), the National Oceanic and Atmospheric Administration, 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 2021 Region 6 Multi-Hazard Mitigation Plan includes:

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Expansive Soils
- Extreme Cold
- Flood
- Hail
- Hazardous Materials
- High Winds and Downbursts
- Landslide/Rockfall/Debris Flow
- Lightning
- Mine Subsidence
- Severe Winter Weather
- Tornado
- Wildland Fire
- Pandemic/Epidemic*
- Volcano*

*New Hazards in 2021

Members of each county's planning team 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 of the event, past occurrences, spatial extent, 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. The Regional Steering Committee determined volcano should be added to the hazard identified in 2021 to be consistent with the 2020 State Plan update as well as adding epidemic/pandemic due to the continuing impacts of the COVID-19 Pandemic. Changes in the hazard significance ratings are noted with an asterisk in the table below.*

Table 4-1 Region 6 Hazard Significance Summary Table

Hazard	Big Horn	Hot Springs	Park	Washakie
Avalanche	L	L	L	L
Dam Failure	H	H	L	M
Drought	H	H	H	H
Earthquake	L	M	M	M
Expansive Soils	L	L	L	L
Extreme Cold	H	M	M	H
Flood	M	M	M	H
Hail	H	H*	H	M
Landslide	L	H	M	L
Lightning	L	M	M	L
Mine Subsidence	H	L	L	L
Tornado	M	M*	M	M

Hazard	Big Horn	Hot Springs	Park	Washakie
Wildfire	H	H	H	H
High Wind and Downbursts	H	M*	M	L
Severe Winter Weather	M	M	H	M
Hazardous Materials	H	L	M	M
Pandemic/Epidemic	L	M	M	M
Volcano	H	H	H	H

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 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.
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.

Significance based on a combination of Geographic Extent, Potential Magnitude/Severity and Probability as defined below. An asterisk indicates hazard was not identified prior to 2016 in County.

Hazards considered but not profiled further include potable water threat, power outages, cyber security breach, and violent extremism. Each of the four counties have Threat Hazard Identification Risk Assessment (THIRA) plans that are regularly updated and address some of these human caused hazards. In addition, power outages are noted as consequences of some of the natural hazards listed in the table above are discussed further within the vulnerability assessments for extreme cold, lightning, high wind, and winter weather hazards.

4.1.2 Disaster Declaration History

As part of the hazard identification process, the Regional Steering Committee and CPTs 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 Wyoming between 1963 and 2020.

Table 4-2 Federal Declarations in Wyoming: 1963 – 2020

Event/ Hazard	Year	Declaration Type	Remarks/Description
Heavy rains, flooding	1963	Presidential – Major Disaster Declaration	
Drought	1977	Presidential - Emergency Declaration	
Severe storms, flooding, mudslides	1978	Presidential – Major Disaster Declaration	
Severe storms, tornadoes	1979	Presidential – Major Disaster Declaration	
Severe storms, hail, flooding	1985	Presidential – Major Disaster Declaration	
Methane gas seepage	1987	Presidential - Emergency Declaration	
Severe winter storm	1999	Presidential – Major Disaster Declaration	
Winter storm	2000	Presidential – Major Disaster Declaration	
Hensel Fire	2002	Fire Mgmt Assistance Declaration	
Reese Mountain Fire	2002	Fire Mgmt Assistance Declaration	
Commissary Ridge Fire	2002	Fire Mgmt Assistance Declaration	
Tongue River Fire	2003	Fire Mgmt Assistance Declaration	

Event/ Hazard	Year	Declaration Type	Remarks/Description
Tornado	2005	Presidential – Major Disaster Declaration	
Drought	2006	USDA Declaration	Statewide drought affecting Washakie County
Thorn Divide Fire Complex	2006	Fire Mgmt Assistance Declaration	
Jackson Canyon Fire	2006	Fire Mgmt Assistance Declaration	
Drought	2007	USDA Declaration	Statewide drought affecting Washakie County
Little Goose Fire	2007	Fire Mgmt Assistance Declaration	
Drought	2009	USDA Declaration	Drought affecting Johnson, Big Horn, Campbell, Converse, Natrona, Sheridan, and Washakie Counties
Severe freeze	2009	USDA Declaration	Severe freezes affecting Big Horn, Park, Fremont, Hot Springs, Johnson, Sheridan, Teton, and Washakie Counties
Flooding	2010	Presidential – Major Disaster Declaration	Rain and snowmelt flooding in Fremont County
Severe Storms, Flooding, and Landslides	2011	Presidential-Major Disaster Declaration	
Arapahoe Fire	2012	Fire Mgmt Assistance Declaration	
Squirrel Creek Fire	2012	Fire Mgmt Assistance Declaration	
Oil Creek Fire	2012	Fire Mgmt Assistance Declaration	
Sheep Herder Hill Fire	2012	Fire Mgmt Assistance Declaration	
Combined effects of excessive heat, high winds, drought, wildfires, and freezes	2012	USDA	Big Horn, Hot Springs, Park, Washakie
Drought	2012	USDA	Hot Springs, Park, Washakie
Drought – FAST TRACK	2012	USDA	Big Horn, Hot Springs, Park, Washakie
Drought – FAST TRACK	2013	USDA	Big Horn, Hot Springs, Park, Washakie
Hail, High Winds, Severe Storms	2013	USDA	Park
Hailstorm	2013	USDA	Park
Freeze	2014	USDA	Big Horn, Park, Washakie
Drought – FAST TRACK	2015	USDA	Park
Severe Storms and Flooding	2015	Presidential-Major Disaster Declaration	
Station Fire	2015	Fire Mgmt Assistance Declaration	
Lava Mountain Fire	2016	Fire Mgmt Assistance Declaration	

Event/ Hazard	Year	Declaration Type	Remarks/Description
Tokawana Fire	2016	Fire Mgmt Assistance Declaration	
Drought – FAST Track	2016	USDA	Big Horn, Hot Springs, Park, Washakie
Drought - FAST Track	2017	USDA	Big Horn
Flooding	2017	Presidential – Major Disaster Declaration	Park, Fremont, Washakie
Hailstorm and High Winds	2018	USDA	Big Horn, Park, Washakie
Flooding	2019	USDA	Big Horn
Freeze	2019	USDA	Big Horn, Hot Springs, Park, Washakie
Excessive Snow and Freeze	2019	USDA	Big Horn, Park, Washakie
Drought- FAST TRACK	2020	USDA	Big Horn, Hot Springs, Park, Washakie
Covid-19 Pandemic	2020	Emergency Declaration	Statewide
Covid-19 Pandemic	2020	Presidential – Major Disaster Declaration	Statewide

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 Identifying Hazards 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.

Limited: Less than 10 percent of the planning area

Significant: 10 to 50 percent of the planning area

Extensive: 50 to 100 percent of the planning area

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. 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**—Near 100 percent chance of occurrence in next year or happens every year.
- **Likely**—Between 10 and 100 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.

Changing Future Conditions

This subsection to the Frequency/Likelihood of Occurrence section discusses the potential impacts of future changing conditions in the climate and how those changes may increase or decrease natural hazards frequency and intensity.

Potential Magnitude (Extent)

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

- **Catastrophic**—More than 50 percent of property severely damaged, and/or facilities are inoperable or closed for more than 30 days. More than 50 percent agricultural losses. Multiple fatalities and injuries. Critical indirect impacts.
- **Critical**—25 to 50 percent of property severely damaged, and/or facilities are inoperable or closed for at least 2 weeks. 10-50 percent agricultural losses. Injuries and/or illnesses result in permanent disability and some fatalities. Moderate indirect impacts.
- **Limited**—10 to 25 percent of area affected. Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged.
- **Negligible**—Less than 10 percent of area affected. Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities or populations relative to the risk of the hazard. For most hazards, vulnerability is a best estimate. Some hazards, such as flood, affect specific areas so that exposure can be quantified, and vulnerability assessments result in a more specific approximation. Other hazards, such as tornadoes, are random and unpredictable in location and duration that only approximate methods can be applied. The assessment was conducted through the study of potential impacts to the following specific sectors:

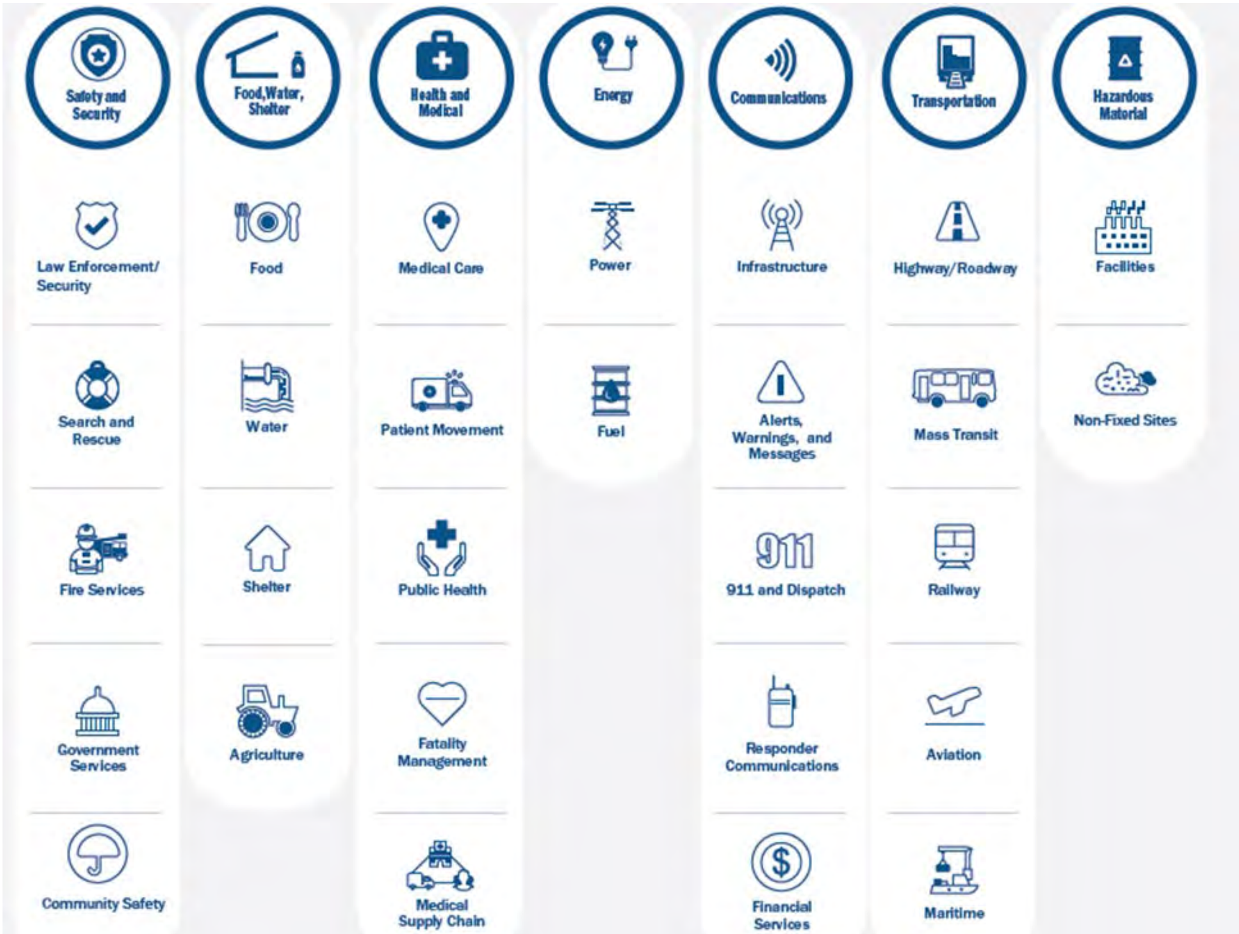
- People
- Property
- Critical Facilities and Infrastructure
- Economy
- Historic, Cultural, and Natural Resources

Assets Summary

Assets inventoried for the purpose of determining vulnerability include people, structures, 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 2020 Parcel and Assessor Data was obtained through the Wyoming Cama website which is maintained by the Wyoming Department of Revenue. This information provided the basis for building exposure and property types. The available data is annually updated on the site and contains all counties within Wyoming. Data current as of 2020 was downloaded for all the counties within the Region and joined by Parcel Number in a separate database for analysis using GIS. 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 2020 Homeland Infrastructure Foundation-Level Data (HIFLD) datasets and the critical State Assets from the 2021-2026 Wyoming State Hazard Mitigation Plan. Where applicable, this information was used in an overlay analysis for hazards such as flood and landslide. 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 4-1.

Figure 4-1 FEMA Lifeline Categories



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.

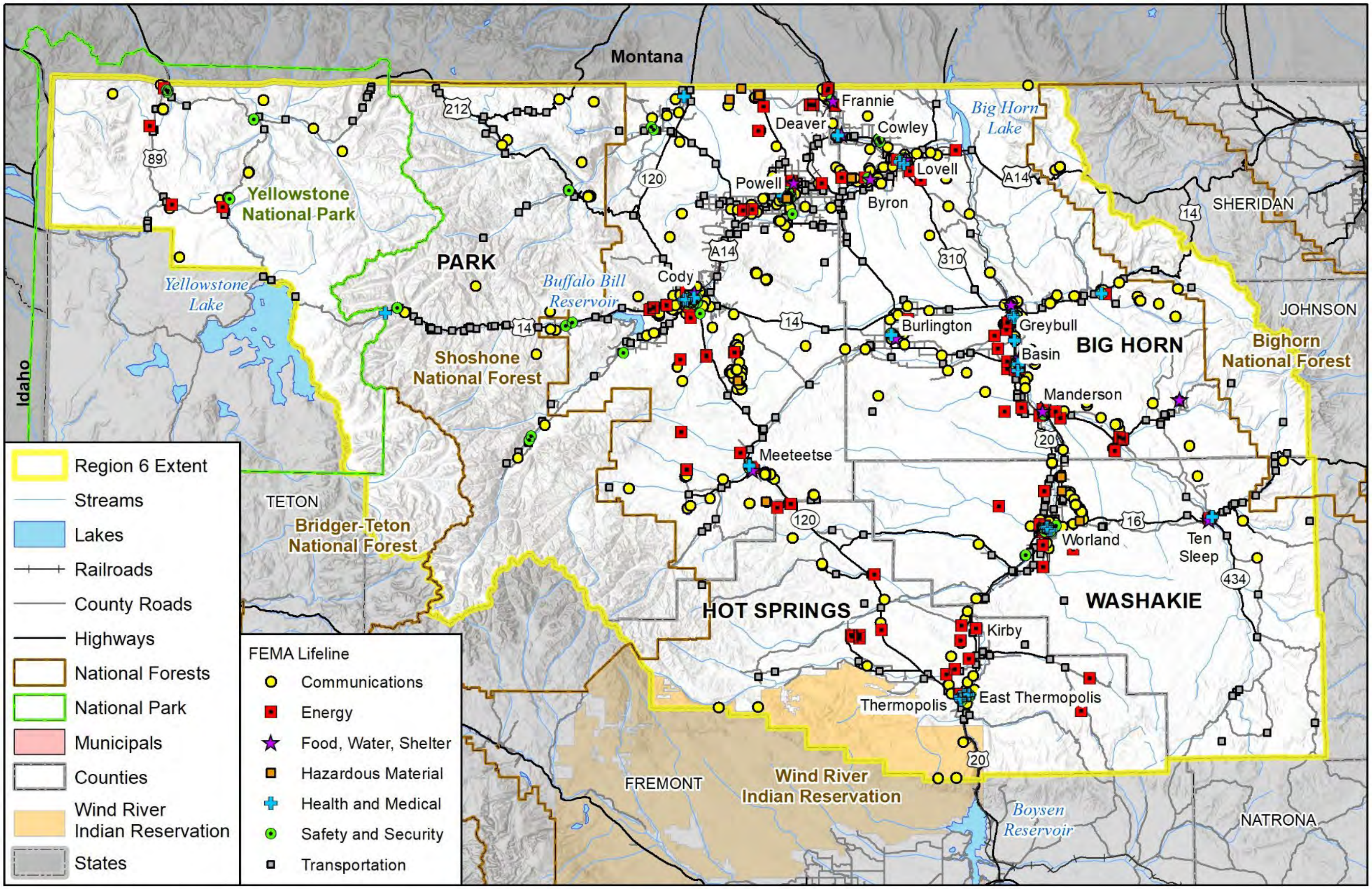
A summary of the critical facilities exposure analysis can be found in Table 4-3 and Figure 4-2 illustrates the location of critical facilities in Region 6.

Table 4-3 Summary of Critical Facility Exposure Summarized by Lifelines

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn County	243	34	17	1	13	40	93	441
Hot Springs County	73	20	-	-	7	12	38	150
Park County	470	44	6	6	11	63	195	795
Washakie County	94	18	2	3	5	21	63	206
Total	880	116	25	10	36	136	389	1,592

Source: Region 6 Counites, HIFLD

Figure 4-2 Region 6 Critical Facilities



wood.

Map compiled 5/2021;
intended for planning purposes only.
Data Source: WY Geospatial Hub, WYDOT, National Bridge Inventory, HIFLD

Development Trends

This section describes how the hazard could impact future development. Specific trends can be found in each County annex.

Risk Summary and Overall Significance by Jurisdiction

This section summarizes risk by county according to the area affected, likelihood, and magnitude of impacts. If the hazard has impacts on specific towns or cities in the region, they are noted here, where applicable.

4.2.2 Avalanche

Hazard/Problem Description

An avalanche is a mass of snow sliding down a mountainside. The vast majority of avalanches occur during and shortly after storms. Avalanches occur when loading of new snow on a slope increases stress at a rate faster than strength develops, and the slope fails. There are four factors that contribute to an avalanche: a steep slope, a snow cover, a weak layer in the snow cover, and a trigger. About 90 percent of all avalanches start on slopes of 30-45 degrees; about 98 percent of all avalanches occur on slopes of 25-50 degrees. Avalanches release most often on slopes above timberline that face away from prevailing winds (leeward slopes collect snow blowing from the windward sides of ridges). Nevertheless, avalanches can run on small slopes well below timberline, such as gullies, road cuts, and small openings in the trees. Very dense trees can anchor the snow to steep slopes and prevent avalanches from starting; however, avalanches can release and travel through a moderately dense forest.

This hazard generally affects a small number of people, such as snowboarders, skiers, and hikers, who venture into backcountry areas during or after winter storms. Roads and highway closures, damaged structures, and destruction of forests are also a direct result of avalanches. Areas prone to avalanche hazards include hard to access areas deep in the backcountry.

Geographical Area Affected

Avalanches affect a limited spatial area in the Region. Most avalanches occur in the western part of the state along the Teton Range. However, a few fatalities have occurred in the Big Horn Range in Big Horn County over the past several decades, and avalanches are possible in the Absaroka Range in Park County.

Past Occurrences

Historically, avalanches occur within the Region between the months of December and April, following snowstorms. According to the CPTs, there has been some historical avalanche activity involving people, but specific details are unknown. Additional details were not available from SHELDUS. Washakie Homeland Security records indicate that avalanches also occurred on December 1, 2000; December 9, 2000; December 25, 2000; and February 23, 2001.

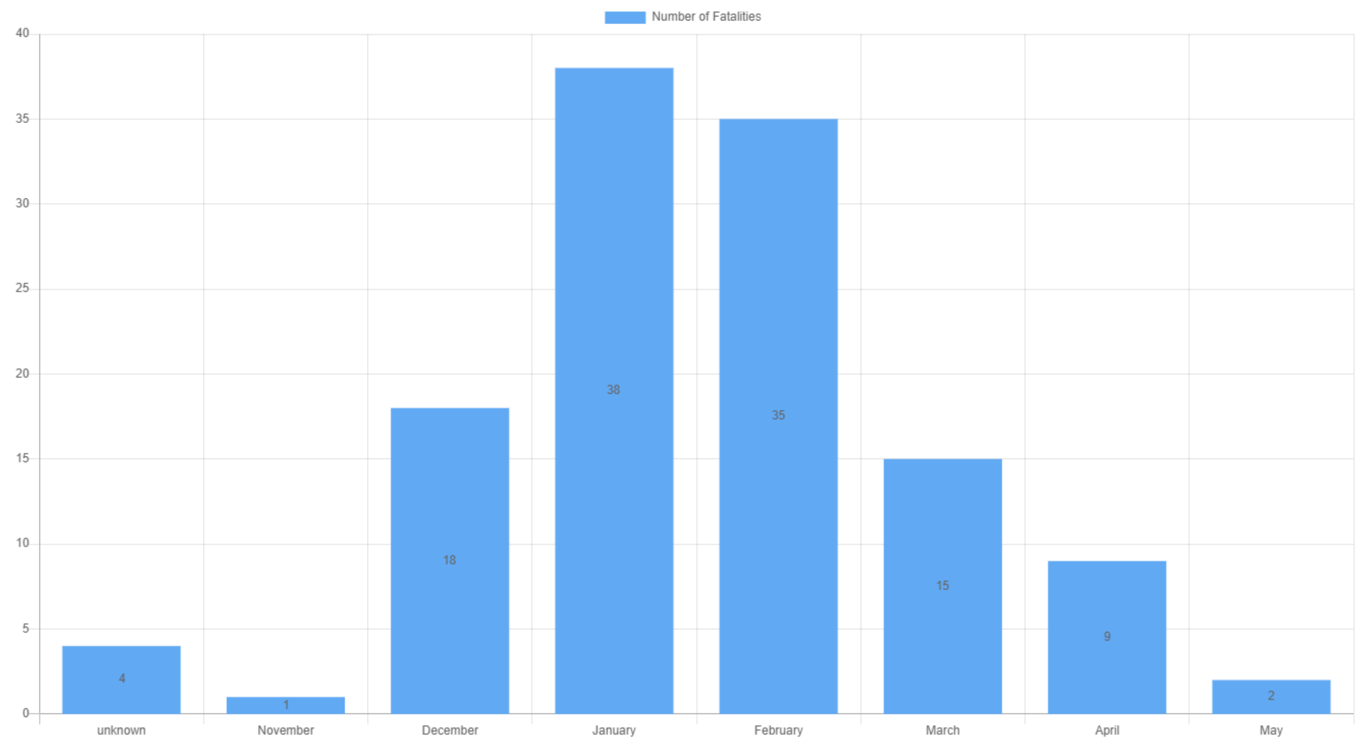
According to the Bridger-Teton Avalanche Center fatalities in the region include two in the Big Horn Range near the Big Horn-Sheridan County border:

- 02/19/2016 Hunt Mountain Road Area, Big Horn Range 39-year-old male, Snowmobiling
- 01/19/1975 Near Owen Creek, Big Horn Range, 24-year-old male, Backcountry skiing

Frequency/Likelihood of Future Occurrences

The probability that an avalanche will occur in the Region in any given year can be determined by using the formula described in Section 4.2.1. According to local records, 8 events occurred between 2000 and March 2019. This yields a 42% occurrence probability. Therefore, the likelihood rating for avalanches in the Region is likely. Although few records exist of avalanches in the Region, it is important to remember that many avalanches go unreported or undocumented when no fatalities or injuries are involved. Given the terrain and weather conditions in the mountainous areas of the Region, avalanches are likely to occur, but the damages should continue to be limited. Injuries and loss of life from an avalanche are usually due to people recreating in remote areas at the wrong time. Many residents and visitors to the Region avidly enjoy outdoor recreation, so it is likely that people will continue to be exposed to avalanche hazards in the Big Horn Mountains and Absoraka Range. The figure below lists the distribution of avalanche fatalities by month based on statewide statistics, with January and February being the most likely time of year for avalanche accidents.

Figure 4-3 Wyoming Avalanche Fatalities by Month: 1913-2016



Source: Bridger-Teton Avalanche Center, www.jhavalanche.org

Changing Future Conditions

The frequency and severity of avalanches is likely to be altered in the future due to changing climate conditions but more studies are needed. In the last decade many experts in western states have pointed out increased avalanche risk associated with a changing snow, precipitation, accumulation, and overall warmer winter patterns. Snow may fall early in the winter and is then followed by a long period without snow. This creates a thin snowpack that becomes structurally weaker as winter goes on. New layers of snow may not bond well to the weak base layer, creating prime conditions for avalanches. Periods of sporadic snowfall in early and mid-spring also contribute to this process of creating structurally weaker snowpack, which can lead to avalanche activity as snow accumulation has already begun to thaw with the warmer season. Extreme snowfalls in short time periods may also contribute to larger avalanches or changes in avalanche cycles.

Potential Magnitude (Extent)

A number of weather and terrain factors determine avalanche severity and danger:

- Weather:
  - Storms—A large percentage of all snow avalanches occur during and shortly after storms.
  - Rate of snowfall—Snow falling at a rate of 1 inch or more per hour rapidly increases avalanche danger.

  - Temperature—Storms starting with low temperatures and dry snow, followed by rising temperatures and wetter snow, are more likely to cause avalanches than storms that start warm and then cool with snowfall.
  - Wet snow—Rainstorms or spring weather with warm, moist winds and cloudy nights can warm the snow cover, resulting in wet snow avalanches. Wet snow avalanches are more likely on sun-exposed terrain (south-facing slopes) and under exposed rocks or cliffs.

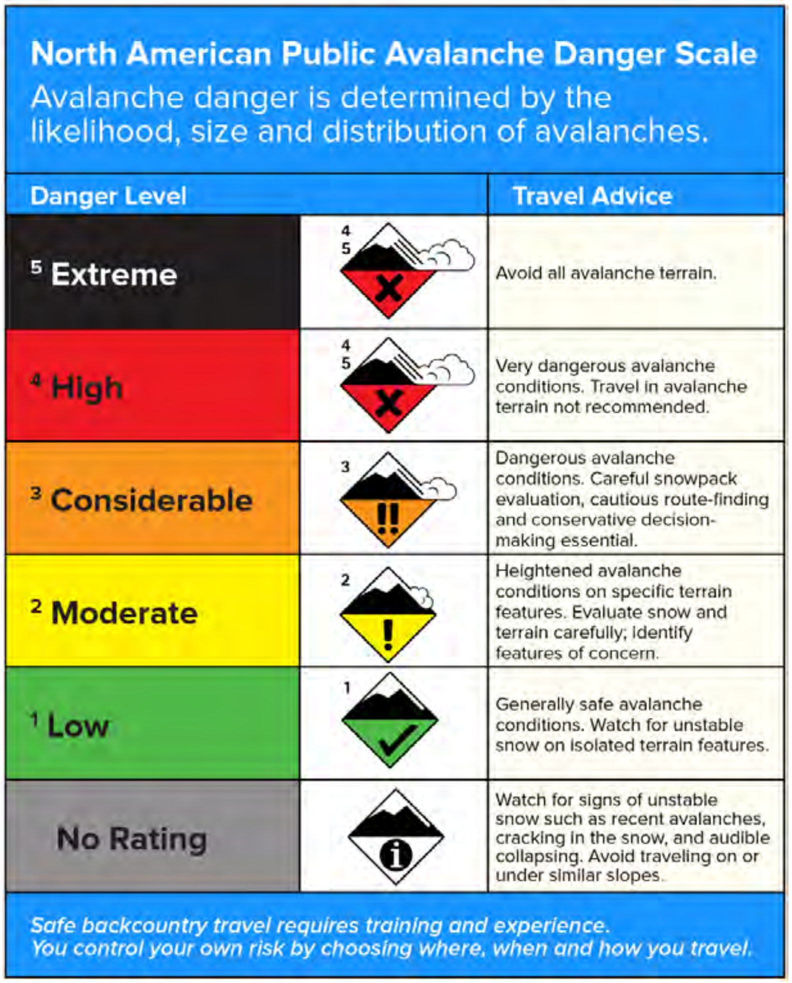
- Terrain:

  - Ground cover—Large rocks, trees, and heavy shrubs help anchor snow.
  - Slope profile—Dangerous slab avalanches are more likely to occur on convex slopes.
  - Slope aspect—Leeward slopes are dangerous because windblown snow adds depth and creates dense slabs. South-facing slopes are more dangerous in the springtime.
  - Slope steepness—Snow avalanches are most common on slopes of 30 to 45 degrees.

The common factors contributing to the avalanche hazard are old snow depth, old snow surface, new snow depth, new snow type, density, snowfall intensity, precipitation intensity, settlement, wind direction and speed, temperature, and subsurface snow crystal structure.

The Bridger-Teton Avalanche Center issues advisories for different regions in Wyoming. The North American Danger Scale, which ranges from low to extreme danger is shown in Figure 4-5 as an example of an extent scale.

Figure 4-4 Avalanche Danger Scale



Source: American Avalanche Association. https://avalanche.org/avalanche-encyclopedia/danger-scale/

In order 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. In some cases, the event of record represents an anticipated worst-case scenario, and in others, it is a reflection of a common occurrence.

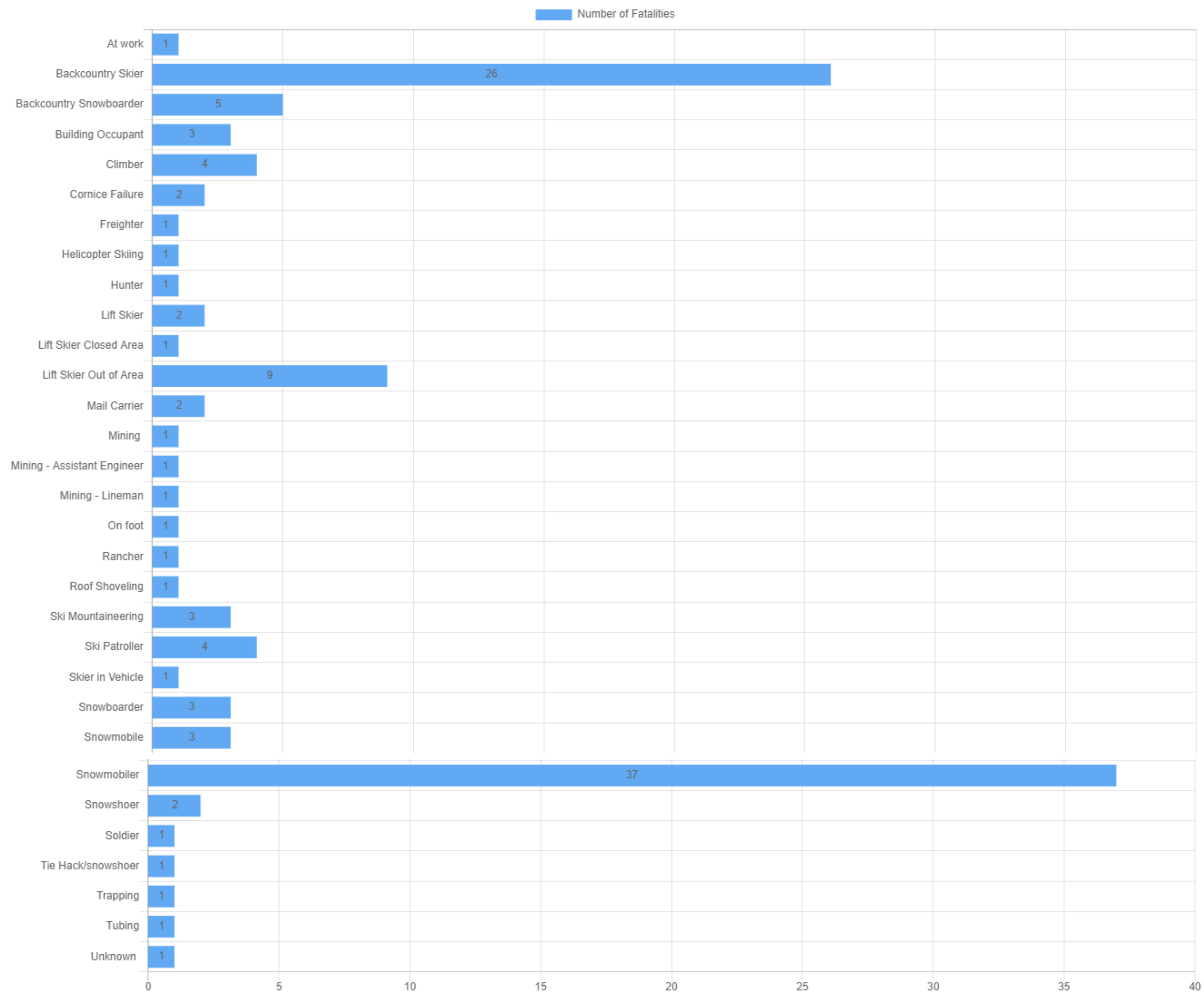
Overall, avalanche impacts would likely be negligible in all counties in the Region. However, a road closure due to avalanche activity could result in transportation disruptions due to the limited number of roads region wide. Apart from backcountry skiers, snowshoers, snowmobilers and snowboarders, the threat to life and safety is minimal.

Vulnerability Assessment

People

Public safety is most threatened by this hazard. Outdoor recreationalists who travel into backcountry areas are most at risk. The following is an analysis of statewide fatalities by activity, based on statistics through 2021, which shows snowmobilers and backcountry skiers involved in the most incidents.

Figure 4-5 Wyoming Avalanche Fatalities by Activity: 1913-2021



Source: www.jhavalanche.org

Backcountry avalanche incidents involve search and rescue teams and resources, which can put these personnel at risk. The key actions to limiting impacts to individuals recreating in hazardous areas include spreading knowledge and awareness of the hazard and being properly equipped for self-rescue, if necessary, with tools such as locater beacons, shovels, GPS units and other communication tools and probes. The keys to limiting impacts to individuals recreating in the area are knowledge and awareness of the hazard and being properly equipped for self-rescue, if necessary, with tools such as locator beacons, shovels, and probes.

While backcountry avalanche incidents are by far the most common, heavy snow can also lead to “roof avalanches” that can sometimes be deadly.

Property

Roads could be obstructed or shut down, causing issues with transportation of goods, commuting, and emergency response and service provision.

Critical Facilities and Lifelines

Avalanches can cause several types of secondary effects, such as blocking roads, which can isolate residents and businesses and delay commercial, public, and private transportation. While road closures help to mitigate impacts to travellers in avalanche-prone areas, snowplow drivers can still be exposed while clearing roads of snow or avalanche debris. Other potential problems resulting from avalanches are power and communication failures. It is unlikely that there are critical facilities exposed to avalanche hazards, although there may be some facilities in particular the possibility of disruption to the electrical grid network. Other potential problems resulting from avalanches are power and communication failures.

Economy

Avalanche activity inside or outside the Region (along connecting roadways) can disrupt transportation in and out of the local communities, which could result in temporary economic impacts. Closures of transportation routes into or out of the Region could prevent the import and export of goods and services, as well as disrupt tourism.

Environment and Cultural Resources

Avalanches are a natural event, but they can negatively affect the environment. This includes trees located on steep slopes. A large avalanche can knock down many trees and kill the wildlife that live in them. In spring, this loss of vegetation on the mountains may weaken the soil, causing landslides and mudflows. If significant woody debris reaches the valley bottoms this could cause a potential for ponding and flooding. The impact on historic or cultural resources in the Region is unknown.

Development Trends

Avalanche vulnerability could increase with future development and population growth as there will be a higher number of people driving on roadways and taking part in backcountry recreation. It is unlikely that risk to structures will increase as long as future development is planned outside of mapped or suspected avalanche hazard zones.

Risk Summary and Overall Significance by Jurisdiction

Overall, avalanches are a low significance hazard to counties in the Region. Impacts are isolated to backcountry users and possibly first responders.

Table 4-4 Avalanche Hazard Risk Summary

County	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/ Severity	Overall Significance
Big Horn	Limited	Likely	Negligible	Low
Hot Springs	Limited	Likely	Negligible	Low
Park	Limited	Likely	Negligible	Low
Washakie	Limited	Likely	Negligible	Low

4.2.3 Dam Failure

Hazard/Problem Description

Dams are man-made structures built for a variety of uses, including flood protection, power, agriculture, water supply, and recreation. Dams typically are constructed of earth, rock, concrete, or mine tailings. Dams and reservoirs serve a very important role for Wyoming residents and industry. Rarely, however, the dams fail, either completely or partially, and become a significant hazard for those downstream. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, which can affect 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 development and infrastructure located downstream.

Dam failure occurs when the retention function of the dam is compromised, in part or in its entirety. Damage to a dam structure that may result in a failure may be caused by many sources:

- Prolonged periods of rainfall and flooding, which result in overtopping
- Earthquake
- Inadequate spillway capacity resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping or rodent activity
- Improper design
- Age
- Improper maintenance
- Negligent operation
- Failure of upstream dams on the same waterway
- Vandalism or terrorism

A dam failure is not the only type of emergency associated with dams. Spillway discharges that are large enough to cause flooding in downstream areas or flooding upstream of dams due to backwater effects or high pool levels are both considered dam emergencies and may cause significant property damage and loss of life. (Source: US Army Corps of Engineers *Flood Emergency Plans: Guidelines for Corps Dams. Hydrologic Engineering Center*, (June 1980) p 4.)

Dam failures can be broken into four classifications: overtopping, foundation failure, structural failure, and other unforeseen failures. Overtopping failures result from the uncontrolled flow of water over, around, and adjacent to the dam. Earthen dams are most susceptible to this type of failure. Hydraulic failures account for approximately 28% of all dam failures. Foundation and structural failures are usually tied to seepage through the foundation of the main structure of the dam. Deformation of the foundation or settling of the embankment can also result in dam failure. Structural failures account for approximately 28% of all dam failures, and foundation problems account for another 25%. Earthquakes or sabotage account for 12% of all dam failures, while inadequate design and construction account for the remaining 7% of failures.

Dam failures result in a unique source of flash flooding, when a large amount of previously detained water is suddenly released into a previously dry area due to a failure in some way of the dam. Dams are classified into three classes. The State of Wyoming has adopted FEMA's risk classifications as set forth in FEMA's *Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams*. These guidelines define High Hazard (Class I) dams as those rated based on an expected loss of human life, should the dam fail, and Significant Hazard (Class II) dams as those rated based on expected significant damage, but not loss of human life. Significant damage refers to structural damage where humans live, work, or recreate, or public or private facilities exclusive of unpaved roads and picnic areas. Damage refers to making the structures inhabitable or inoperable. Low hazard dams would have minimal downstream impacts from a failure.

Geographical Area Affected

In 1981, the U.S. Army Corps of Engineers completed an inspection program for nonfederal dams under the National Dam Inspection Act (P.L. 92-367). This was a four-year work effort and included compiling an inventory of about 50,000 dams and conducting a review of each state's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of dams. Part of the inspection included evaluating the dams and assigning a hazard potential based on the effects downstream should one of the dams fail. The dams were rated (1) High, (2) Significant, and (3) Low hazard. The Corps of Engineers based the hazard potential designation on such items as acre-feet capacity of the dam, distance from nearest community downstream, population density of the community, and age of the dam.

As of 2021, there were 1,613 dams in Wyoming that were reviewed by the Corps of Engineers. Of that statewide number 99 were rated high hazard, 101 were rated significant hazard, and the remaining 1,413 were rated low hazard. The Wyoming State Engineers Office (WSEO) inspects dams over 20 feet high or with a storage capacity of 50 acre-feet or more, although smaller dams are also inspected in highly populated areas.

Table 4-4 lists the dams specifically located in Region 6. According to the National Inventory of Dams database, 11 are classified as High Hazard (Class I) and 10 are classified as Significant Hazard (Class II). Many dams upstream of Big Horn, Hot Springs and Washakie counties are located in Fremont County. Table 4-4 below provides details of the High and Significant Hazard Dams sorted by the county where they are located.

Figure 4-6 Locations of High and Significant Hazard Dams Affecting Region 6

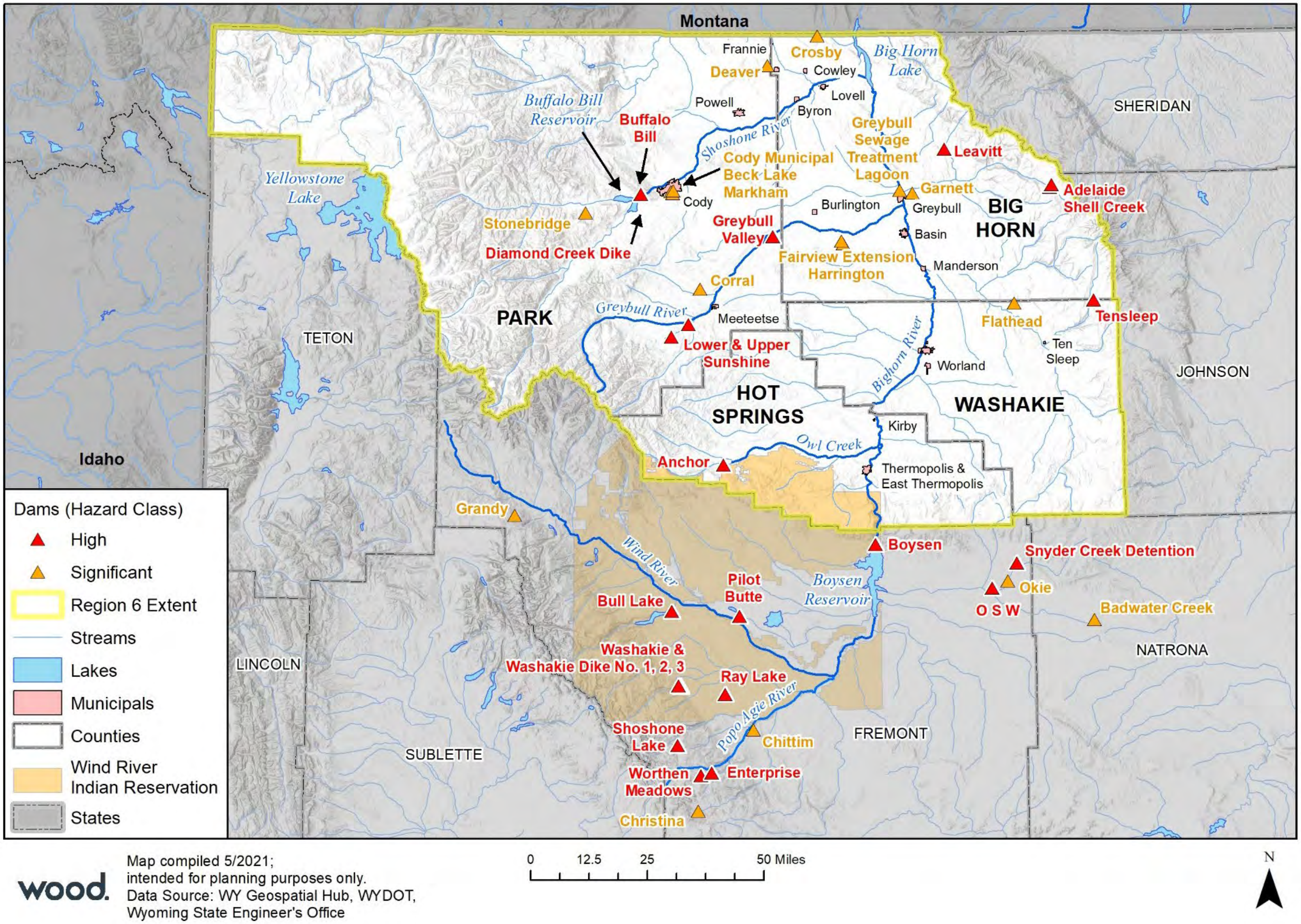


Table 4-5 High and Significant Hazard Dams in Region 6

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Fremont County (Upstream of Hot Springs, Washakie And Big Horn)						
Boysen	DOI Br	Wind River	H	Boysen	2.0	Y
O S W	Lysite Utilities Association	Badwater Creek	H	Lysite	1.0	Y
Enterprise	Enterprise Ditch Company (Jeff Hamilton)	Townsend Creek	H	Lander	14.0	Y
Pilot Butte	Bureau of Reclamation	Wyoming Canal	H	Riverton	25.0	Y
Ray Lake	BIA	Mill Creek Tr Os	H	Lander	15.0	Y
Washakie	BIA	S Fk Little Wind River	H	Ft. Washakie	11.0	Y
Washakie Dike No. 3	USDI BIA	South Fork Little Wind River	H	Ft Washakie	11.0	Y
Bull Lake	Bureau of Reclamation	Bull Lake Creek	H	Riverton	40.0	Y
Washakie Dike No. 2	USDI BIA	South Fork Little Wind River	H	Ft Washakie	11.0	Y
Washakie Dike No. 1	Usdi Bia	South Fork Little Wind River	H	Ft Washakie	11.0	Y
Worthen Meadows	City of Lander	Roaring Fork Creek	H	Lander	15.0	Y
Shoshone Lake	Shoshone Lake Reservoir Company	Shoshone Creek	H	Milford	16.0	Y
Chittim	Wyo. State Training School	Chittim Gulch	S	Hwy. 789	0.5	N
Okie	Conoco Phillips Company (Zane Fross)	Badwater Creek	S	Lost Cabin	1.0	N
Christina	Little Popo Agie Irrigation District	Little Popo Agie River	S	Lander	50.0	N
Grandy	Mike Houck, Todd Dewitt	Little Warm Springs Creek-Off	S	Dubois	5.0	N
Big Horn County						
Shell Creek	Shell Valley Watershed Imp. District	Shell Creek	H	Shell	6.0	Y
Adelaide	Shell Valley Watershed Improvement Dist.	Adelaide Creek	H	Shell	8.0	Y
Leavitt	Frank Schmidt	Davis Draw, Trib. Beaver Creek	H	Shell	15.0	N

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Garnett	Gene and Louise Powers	Shell Creek Trib Bighorn River	S	Greybull	1.0	N
Fairview Extension	Fairview Extension Reservoir Co.	Wardell Draw	S	Greybull	16.0	N
Harrington	Kohn's Ranch	Manny Draw	S	Greybull	17	N
Crosby	Tim Woods & Samantha Wright	Gypsum Creek	S	N/A	N/A	N
Hot Springs County						
Anchor	Bureau of Reclamation	South Fork Owl Creek	H	Embar	8.0	Y
Park County						
Greybull Valley	Greybull Valley Irrigation District	Red Clay Draw	H	Unnamed Ranch	0.3	Y
Buffalo Bill - Diamond Creek Dike	Bureau of Reclamation	Shoshone River	H	Cody	0.0	Y
Buffalo Bill	Bureau of Reclamation	Shoshone River	H	Cody	7.0	Y
Buffalo Bill - North Fork Dike	Bureau of Reclamation	Shoshone River	H	Cody	0.0	Y
Upper Sunshine	Greybull Valley Irrigation District	Greybull	H	Meeteetse	11.0	Y
Lower Sunshine	Greybull Valley Irrigation District	Sunshine Creek Offstream	H	Meeteetse	6.0	Y
Diamond Creek Dike	USBR	Diamond Creek	H	Cody	6.0	N
Deaver	USBR	Shoshone River Offstream	S	Deaver	3.0	N
Beck Lake	Cody Canal Assn. (Aka Cody Canal, Inc.)	South Fork of Shoshone	S	Cody	0.0	N
Cody Municipal	City of Cody	S Fork Shoshone Offstream	S	Cody	36.0	Y
Corral	M C Land & Cattle Co	Corral Draw, Trib. Snyder Draw	S	Burlington	28.0	N
Stonebridge	Pierre Williams	Whit Creek Offstream	S	Wapati	2.0	N
Markham	City of Cody	S Fork Shoshone Offstream	S	Cody	1.0	Y
Washakie County						

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Ten Sleep	USDA Forest Service	East Tensleep Creek	H	Ten Sleep	15.0	N
Flathead	Ken Tanner, (Flathead Ranch)	Gomer Gulch	S	Manderson	25.0	N

Source: National Inventory of Dams

Buffalo Bill Dam is a concrete arch-gravity dam on the Shoshone River about 6 miles upstream of Cody in Park County. It is operated by the U.S. Federal Bureau of Reclamation and is designated a High Hazard Dam. The dam was last inspected on August 15, 2017. Impacts from a failure of this dam would be greatest outside of Park County as the canyon is deeply incised as it passes by Cody. Big Horn County could have substantial impacts, particularly areas along the Shoshone River including towns of Byron and Lovell.

A High Hazard Dam whose failure would have potentially the biggest impact on Hot Springs, Big Horn, and Washakie counties lies outside the Region's boundaries to the south. Boysen Dam and Reservoir is an earthen dam located on the Wind River, approximately 20 miles south of Thermopolis in Fremont County. The dam is operated by the U.S. Federal Bureau of Reclamation and is an earth-filled dam with a structural height of 220 feet. The dam does provide downstream flood protection and one study estimates that total flood damages reduced by the reservoir since construction totaled about $75.0 million by the end of 1998. This dam was last inspected on October 27, 2017.

Downstream Emergency Action Plans (EAPs) for both Boysen and Buffalo Bill dams include inundation maps and downstream warning and notification plans, including local emergency services agencies and municipal contacts to be used in the event of a breach or imminent threat. Given the geographical extent and number of High and Significant dams in the Region the rating is Significant for the Region.

Past Occurrences

There have been no documented dam failures in Region 6, however, there have been a number of dam failures elsewhere in Wyoming, some of which resulted in loss of life and damage to property. In 1906, snow melt flooding along the North Platte caused the failure of a diversion dam. The flooding destroyed a railroad embankment and resulted in a train wreck that claimed 12 lives. Snow melt flooding caused another dam to fail in 1984. Dozens of residences, businesses, and farms were impacted for a total of $5 million in damages to the area.

Dam incidents can also occur which do not involve the total failure of the dam. According to the Dam Incident Database from the National Inventory of Dams, which was most recently updated August 19, 2020, there have been no dam incidents involving dams in Region 6.

Frequency/Likelihood of Future Occurrences

It is estimated that it is occasional Region 6 will be affected by dam failure in the future. The structural integrity of dams depends on regular inspections and maintenance, which do not always happen. Additionally, a number of the dam failures in Wyoming and other Rocky Mountain states occurred because of snow melt flooding that exceeded the capacity and strength of levees and dams. Wyoming's dams will continue to be tested by snow melt, heavy rains, and other types of floods every year. Thus, dam failures could possibly threaten Wyoming and Region 6 counties.

Changing Future Conditions

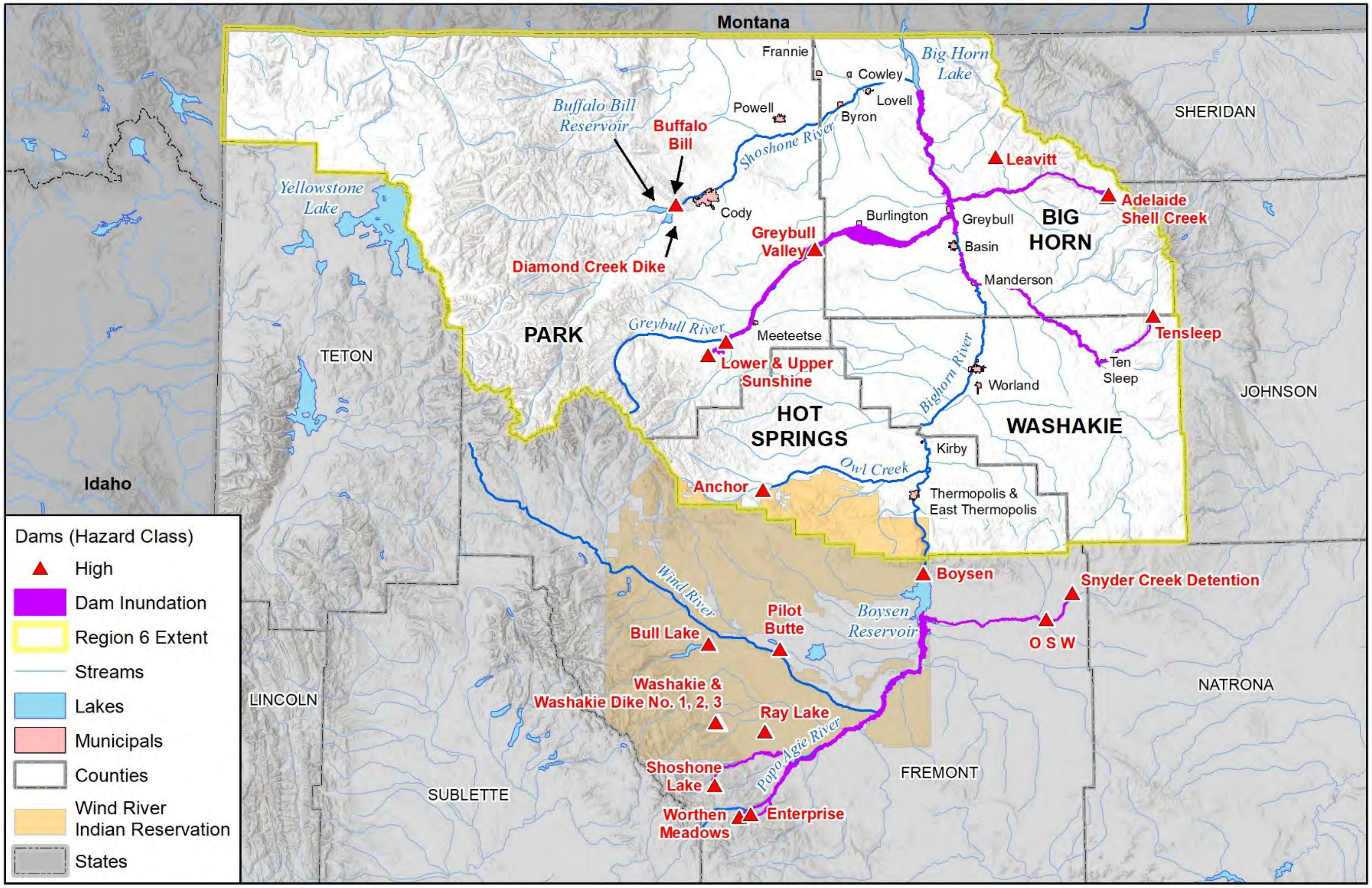
With changes in the occurrence of extreme precipitation events, dam failure and dam incidents could become a larger issue if increased rainfall events result in large floods that stress dam infrastructure. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hydrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams have historically experienced increases in stream flows from earlier dam releases.

Potential Magnitude (Extent)

Potential impacts could include injury and loss of life, property damage, damage to infrastructure, drinking water contamination, loss of crops and livestock, evacuations and sheltering and associated costs, interruption of commerce and transportation, search and rescue, and clean-up costs. In addition, dam failure and associated flooding can cause damage to and loss of irrigation structures such as headgates and ditches. Loss or damage to water structures negatively impacts agricultural producers of crops and livestock—and can be costly to repair. Areas of possible inundation from dam failures in Region 6 are shown below in Figure 4-5; this inundation is limited to a study from the State Engineer's Office on privately owned high hazard dams and does not include federal dams such as Boysen and Buffalo Bill.

The severity and magnitude of a given dam failure will vary on a county basis and case-by-case basis. This information is considered sensitive and is not detailed due to Homeland Security concerns. Emergency management coordinators have access to inundation maps contained in the emergency action plans for the High Hazard dams in the State. High Hazard (Class I) dams, by definition, would merit a magnitude/severity rating of catastrophic, whereas Significant Hazard (Class II) dams rate as critical and Low Hazard dams fall into the limited rating. The magnitude/severity rating for the hazard in Region 6 is considered mostly critical, mostly due to the number of Class I dams that could impact communities in the Region.

Figure 4-7 Wyoming Region 6 Dam Inundation Risk from Privately Owned High Hazard Dams



wood.

Map compiled 5/2021;
intended for planning purposes only.
Data Source: WY Geospatial Hub, WYDOT,
Wyoming State Engineer's Office

Vulnerability Assessment

The failure of Boysen Reservoir or Buffalo Bill Cody dam could result in hundreds of millions of dollars of damage in downstream communities, although the probability of such an event is low. Active faults lie very close to both Boysen and Buffalo Bill dams (see earthquake section). Each county has emergency action plans on file for Boysen and Buffalo Bill dams. These emergency action plans include specific information on flood damages if either of these dams failed. However, if Boysen Dam failed, Thermopolis, East Thermopolis, Kirby, and Worland would be significantly impacted. The failure of Boysen dam could result in millions of dollars of damage in the Thermopolis area. Several lives could be lost as well. The probability of such an event is low.

People

The population impacted by dam failure was estimated using the structure count of buildings within the dam inundation area and applying the U.S. Census values of 2.6 persons per household for Big Horn County, 2.13 for Hot Springs County, 2.33 for Park County, and 2.34 for Washakie County. Approximately 2,482 people are exposed within the dam inundation areas in Region 6.

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable timeframe. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system.

Low head dams pose a risk to even the most experienced recreational users of rivers due to the difficultly to detect the dams when approaching from upstream and risk of becoming trapped in the low head dam's recirculating currents. As the number of visitors partaking in river-based recreation increases in Wyoming and in Region 6 there is the potential for increased fatalities from low head dams.

Property

Vulnerable properties are those within and close to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect.

Communities located below a high or significant hazard dam and along a waterway are potentially exposed to the impacts of a dam failure. High hazard dams threaten lives and property, while significant hazard dams threaten property only. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) have been produced for privately owned high hazard dams; federal dams inundation is considered sensitive and not included in this public document. Table 4-5 displays the number of structures in dam inundation areas within the county and their values.

Table 4-6 Region 6 Structures within Inundation Areas, By Jurisdiction and Property Type

County	Jurisdiction	Improved Parcels	Population
Big Horn County	Greybull	771	1,747
	Manderson	4	10
	Big Horn Unincorporated	155	304
	Total	**930**	**2,062**
Park County	Meeteetse	116	247
	Park Unincorporated	45	96
	Total	**161**	**343**
	Ten Sleep	2	5

Washakie County	Washakie Unincorporated	37	73
	Total	**39**	**77**
	Grand Total	**1,130**	**2,482**

Source: County Assessor Data, Wood GIS Analysis (Note: Wood was unable to obtain inundation data for federal dams affecting Park and Hot Springs County)

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 wiped out, creating isolation issues. Roads closed due to floods caused by dam failure or incident could result in serious transportation disruptions due to the limited number of roads in the county. 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 and intersected with the dam inundation extents available, 73 critical facilities were found to be at risk in Region 6. These at-risk facilities are listed in Table 4-6 through Table 4-8 below by jurisdiction and critical facility classification as based on the FEMA Lifeline categories (FEMA Community Lifelines, 2019). Hot Springs County would also be impacted by dam failure, but inundation maps for federal dams was not publicly available.

Table 4-7 Big Horn County Critical Facilities at Risk to Dam Inundation by Jurisdiction and FEMA Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Greybull	13	1	-	-	2	7	-	**23**
Unincorporated	10	-	4	-	-	-	16	**30**
Total	**23**	**1**	**4**	**0**	**2**	**7**	**16**	**53**

Table 4-8 Park County Critical Facilities at Risk to Dam Inundation by Jurisdiction and FEMA Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Meeteetse	-	-	-	-	1	1	1	**3**
Unincorporated	1	-	-	-	-	-	6	**7**
Total	**1**	**0**	**0**	**0**	**1**	**1**	**7**	**10**

Table 4-9 Washakie Critical Facilities at Risk to Dam Inundation by Jurisdiction and FEMA Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Unincorporated	-	-	-	-	-	-	10	**10**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**10**

Economy

Extensive and long-lasting economic impacts could result from a major dam failure or inundation event, including the long-term loss of water in a reservoir, which may be critical for potable water needs. A major dam failure and loss of water from a key structure could bring about direct business and industry damages and potential indirect disruption of the local economy. A dam failure can have long lasting economic impacts and could deter visitors for a period of time.

Environmental and Cultural Resources

Reservoirs held behind dams affect many ecological aspects of a river. River topography and dynamics depend on a wide range of flows, but rivers below dams often experience long periods of very stable flow conditions or saw-tooth flow patterns caused by releases followed by no releases. Water releases from dams usually contain very little suspended sediment; this can lead to scouring of riverbeds and banks.

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways, potentially causing the destruction of downstream habitats.

Development Trends

As communities or unincorporated areas grow, previously lower-classified dams may pose greater risks, which could elevate their hazard classification. Inundation maps and emergency action plans should be consulted in the planning of new development, where applicable. Growth rates in the region do not indicate that risk is increasing substantially.

Risk Summary and Overall Significance by Jurisdiction

Overall, dam failure significance ranges from high to low dependent upon location in the Region. The probability of such an event is low, but impacts could be significant depending upon the dam involved and where it occurred in the region.

Table 4-10 Dam Failure Hazard Risk Summary

County	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/ Severity	Overall Significance
Big Horn	Significant	Unlikely	Catastrophic	High
Hot Springs	Significant	Occasional	Critical	High
Park	Limited	Occasional	Critical	Low
Washakie	Limited	Occasional	Critical	Medium

4.2.4 Drought

Hazard/Problem Description

Drought is described as a protracted period of deficient precipitation resulting in extensive damage to vegetation. Of all the natural weather-related disasters, drought is by far the costliest to our society. It indirectly kills more people and animals than the combined effects of hurricanes, floods, tornadoes, blizzards, and wildfires. And, unlike other disasters that quickly come and go, drought's long-term unrelenting destruction has been responsible in the past for mass migrations and lost civilizations. The 1980 and 1988 droughts in the US resulted in approximately 17,500 heat-related deaths and an economic cost of over $100 billion. Drought occurs in four stages and is defined as a function of its magnitude (dryness), duration, and regional extent. Severity, the most commonly used term for measuring drought, is a combination of magnitude and duration.

The first stage of drought is known as a meteorological drought. The conditions at this stage include any precipitation shortfall of 75% of normal for three months or longer. The second stage is known as agricultural drought. Soil moisture is deficient to the point where plants are stressed, and biomass (yield) is reduced. The third stage is the hydrological drought. Reduced stream flow (inflow) to reservoirs and lakes is the most obvious sign that a serious drought is in progress. The fourth stage is the socioeconomic drought. This final stage refers to the situation that occurs when physical water shortage begins to affect people.

As these stages evolve over time, the impacts to the economy, society, and environment converge into an emergency situation. Without reservoir water to irrigate farms, food supplies are in jeopardy. Without spring rains for the prairie grasslands, open range grazing is compromised. Without groundwater for municipalities, the hardships to communities result in increases in mental and physical stress as well as conflicts over the use of whatever limited water is available. Without water, wetlands disappear. The quality of any remaining water decreases due to its higher salinity concentration. There is also an increased risk of fires, and air quality degrades as a result of increased soil erosion particles in strong winds (blowing dust).

Geographical Area Affected

According to estimates by the Region 6 Hazard Mitigation Plan Committee, the Region is at high risk to drought events over an extensive spatial area. Droughts are often regional events, impacting multiple counties and states simultaneously. Therefore, as the climate of the planning area is fairly contiguous, it is reasonable to assume that a drought will impact the entire planning region. According to the Wyoming State Climate Office, Wyoming is the 5th driest state in the U.S., thus drought can be a normal occurrence in Wyoming due to the State's natural climate. Based on this information, the geographic extent rating for drought in Region 6 is extensive.

Past Occurrences

The planning area has experienced several multi-year droughts over the past several decades. The most recent statewide drought started in 1999 but began in earnest in the spring of 2000 and endured through 2004. The following year, 2005, was a wetter year, technically signifying the end of the drought period. Dry conditions returned in the following years and became especially severe between 2006 and 2007. According to the Wyoming State Climate Office, "conditions have eased somewhat in mid-2008, but a near decade with warm temperatures and relatively little precipitation has left [Wyoming] very vulnerable" (http://www.wrds.uwyo.edu/sco/drought/drought.html). Another particularly dry year occurred in 2012.

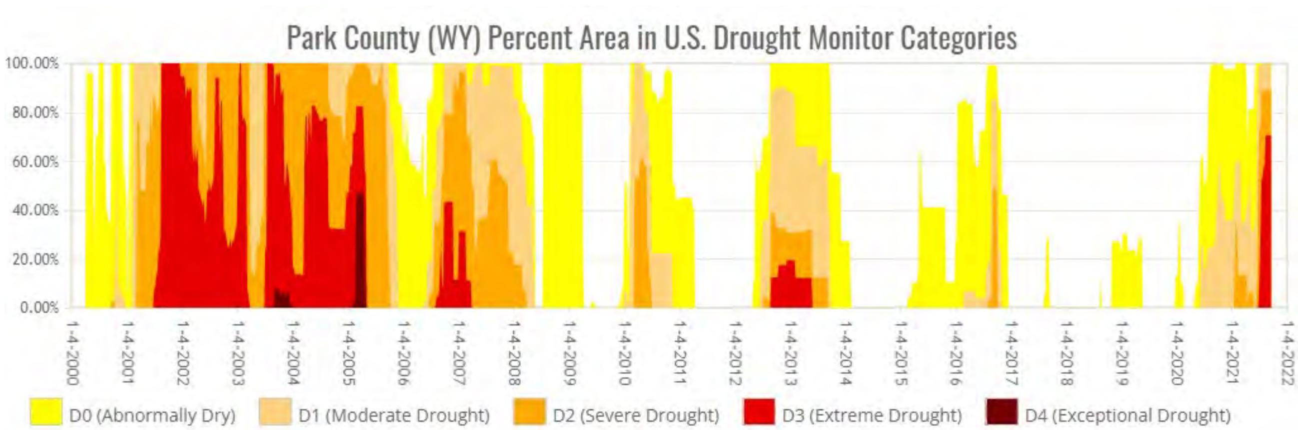
The 1999-2004 drought is considered by many to be the most severe in collective memory. However, some old timers have indicated that they remember streams drying up in the 1930s and 1950s. According to instrument records, since 1895 there have been only seven multi-year (three years or longer) statewide droughts. Based on deficit precipitation totals (negative departures from the long-term average), they are ranked statewide.

Table 4-11 Significant Multi-Year Wyoming Droughts of the Modern Instrumented Era

Years	Average Annual Precipitation (inches)	Percent of 1985-2006 Average Annual Precipitation (13.04")
1952-1956	10.65	81.69%
1900-1903	10.76	82.52%
1999-2004	11.07	84.89%
1987-1990	11.12	85.28%
1958-1964	11.67	89.49%
1974-1977	11.77	90.26%
1931-1936	11.79	90.41%

Widespread droughts in Wyoming, as determined from stream flow records, were most notable during three periods: 1929-1942, 1948-1962, and 1976-1982. Figure 4-8 illustrates the time series of drought conditions in Park County from January 2000 and August 31, 2021.

Figure 4-8 Park County Drought Intensity, 2000 to August 31, 2021



Source: U.S. Drought Monitor

Drought Disaster Declarations

All counties in Region 6 have, at various times, been included in regional USDA disaster declarations for droughts. As shown in Table 4-2, Region 6 has had a total of 11 USDA Disaster Designations for drought between 2007 and 2020. Of these, 6 were Fast-Track designations, which according to the Secretary of Agriculture, a Fast-Track designation is for a severe drought and provides an automatic designation when, during the growing season, any portion of the county meets the severe drought intensity (D2) value for eight consecutive weeks or more.

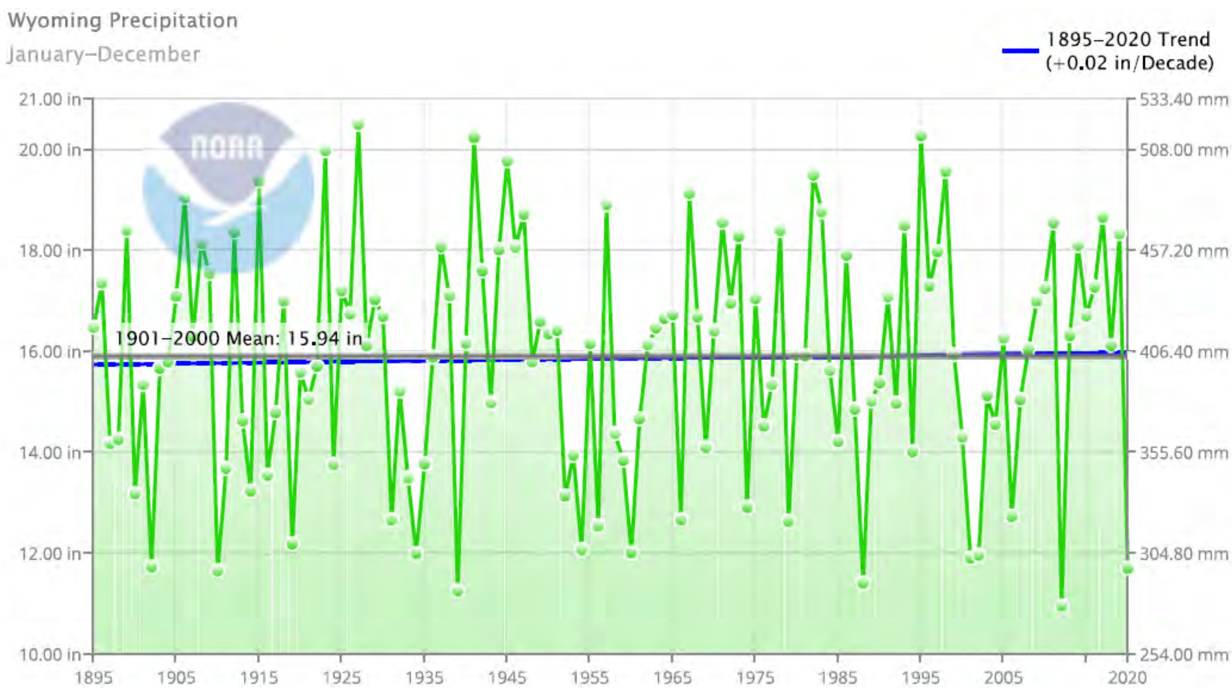
In November 2007, the USDA designated 11 counties as natural disaster areas for drought including Big Horn, Converse, Fremont, Hot Springs, Lincoln, Niobrara, Platte, Sublette, Sweetwater, Washakie and Weston. An ongoing drought declaration was made in December 2007 for Wyoming. Originally, this declaration was directed at Park County but was extended to the contiguous counties of Big Horn, Fremont, Hot Springs, Teton, and Washakie. In May 2009, Johnson County was designated as a natural disaster area for drought. Farm operators in Washakie, Big Horn, Campbell, Converse, Natrona, and

Sheridan, the six counties contiguous with Johnson County, also qualified for disaster assistance. The six contiguous counties were designated as natural disaster areas in December 2009.

In June 2012 the USDA declared farmers in Hot Springs, Fremont, Park and Washakie counties in Wyoming eligible for disaster assistance due to drought that started March 1, 2012. On September 12, 2012, the USDA designated 12 counties in Montana as primary natural disaster areas. Big Horn and Park Counties were designated as a contiguous county in the same designation. On April 10, 2013, the USDA designated 20 counties in Wyoming as primary natural disaster areas due to damages and losses caused by the recent drought. The counties included Hot Springs, Big Horn, Park, and Washakie. On June 3, 2016, Big Horn and Washakie counties were designated as primary natural disaster areas due to damage and losses caused by a recent drought. The counties of Park and Hot Springs were designated as contiguous counties in the same designation.

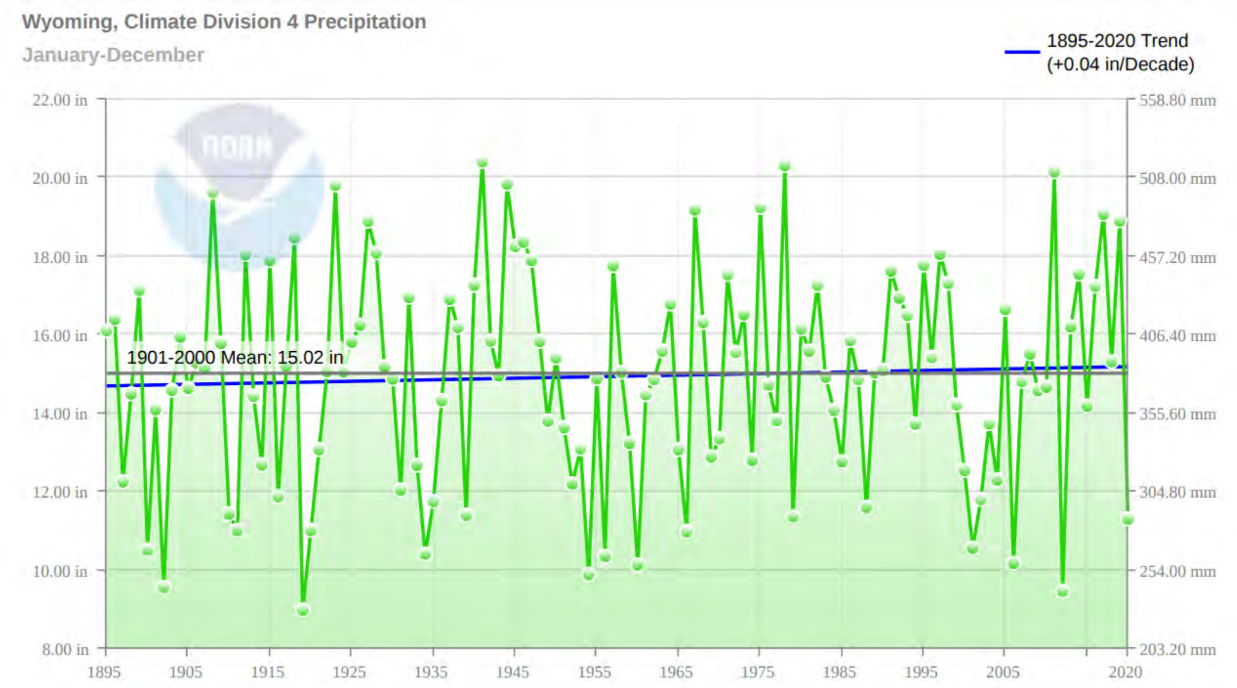
As a whole, Wyoming's precipitation record from 1895-2020 reveals that, for the first half of the 20th century (except for the Dust Bowl years of the 1930s), there was generally a surplus of moisture. During the second half of the 20th century and into the 21st century there was an increasing trend of increased periods of drought (Figure 4.6).

Figure 4-9 Wyoming Annual Precipitation: 1895-2020



Source: NOAA, NCEI, Climate at a Glance: Statewide Time Series, https://www.ncdc.noaa.gov/cag/

Figure 4-10 Big Horn River Basin Annual Precipitation: 1895-2020

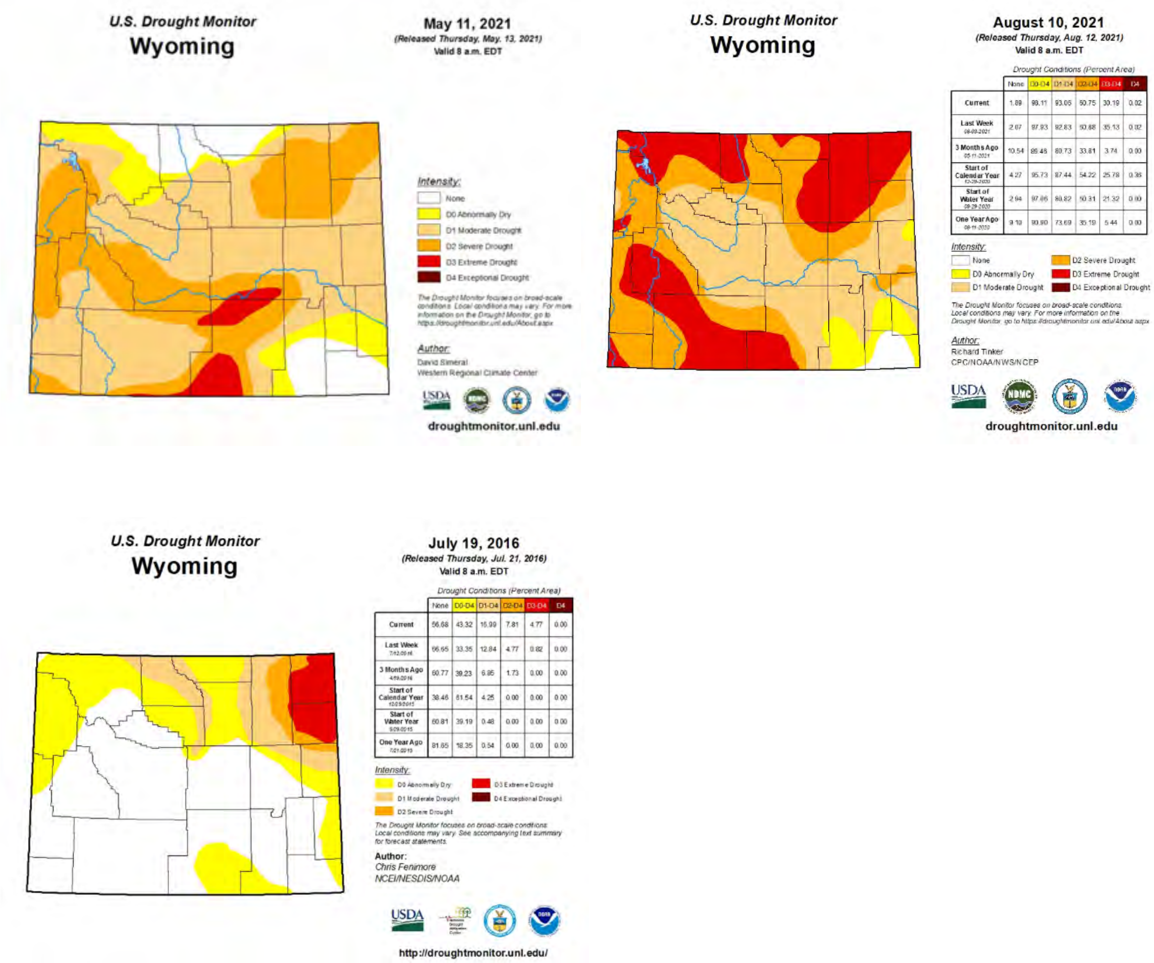


Source: NOAA NCEI, Climate at a Glance: Divisional Time Series, https://www.ncdc.noaa.gov/cag/

The U.S. Drought Monitor provides a general summary of drought conditions updated on a weekly basis. The U.S. Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA), and the National Drought Mitigation Center (University of Nebraska-Lincoln) collaborate on this weekly product, which is released each Thursday. Multiple drought indicators, including various indices, outlooks, field reports, and news accounts are reviewed and synthesized. In addition, numerous experts from other agencies and offices across the country are consulted. The result is the consensus assessment presented on the USDM map. The image is color-coded for four levels of drought intensity. An additional category, “Abnormally Dry,” is used to show areas that might be moving into a drought, as well as those that have recently come out of one. The dominant type of drought is also indicated (i.e. agricultural and/or hydrological). (Source: http://www.drought.unl.edu/dm/index.html)

In May 11, 2021, Moderate Drought to Abnormally Dry drought conditions were identified entirely in Hot Springs and Washakie counties and partially in Park and Big Horn counties. By August 10, 2021 drought conditions intensified including Extreme Drought conditions in Park and Big Horn counties and Moderate to Severe drought conditions in Hot Springs and Washakie counites. The following drought monitor drought monitor graphics show how intensity and coverage varies over the region and how drought conditions changed in that period of time.

Figure 4-11 U.S. Drought Monitor ((May 2021, July 2021, August 2021)



Another useful resource to determine the impacts of drought is the Drought Impact Reporter (DIR), launched by the National Drought Mitigation Center in July 2005 as the nation's first comprehensive database of drought impacts. The Drought Impact Reporter is an interactive web-based mapping tool designed to compile and display impact information across the United States in near real-time from a variety of sources such as media, government agencies, and the public. Information within the Drought Impact Reporter is collected from a variety of sources including the media, government agencies and reports, and citizen observers. Each of these sources provides different types of information at different spatial and temporal scales. (Source: http://drought.unl.edu/monitoringtools/droughtimpactreporter.aspx)

A search of the database for Region 6 from 1980 to 2020 (which includes the most recent severe droughts) shows a total of 67 reported impacts. Figure 4-10 through Figure 4-13 show the breakdown of reported impacts by county. The most reported impacts (59) are in the Relief, Response & Restriction and Agriculture categories. Drought effects associated with agriculture include damage to crop quality; income loss for farmers due to reduced crop yields; reduced productivity of cropland; reduced productivity of rangeland; forced reduction of foundation stock; and closure/limitation of public lands to grazing, among others. The Relief, Response & Recovery category refers to drought effects associated with disaster declarations, aid programs, requests for disaster declaration or aid, water restrictions, or fire restrictions.

Figure 4-12 Number of Reported Drought Impacts 1980-2020 Big Horn County

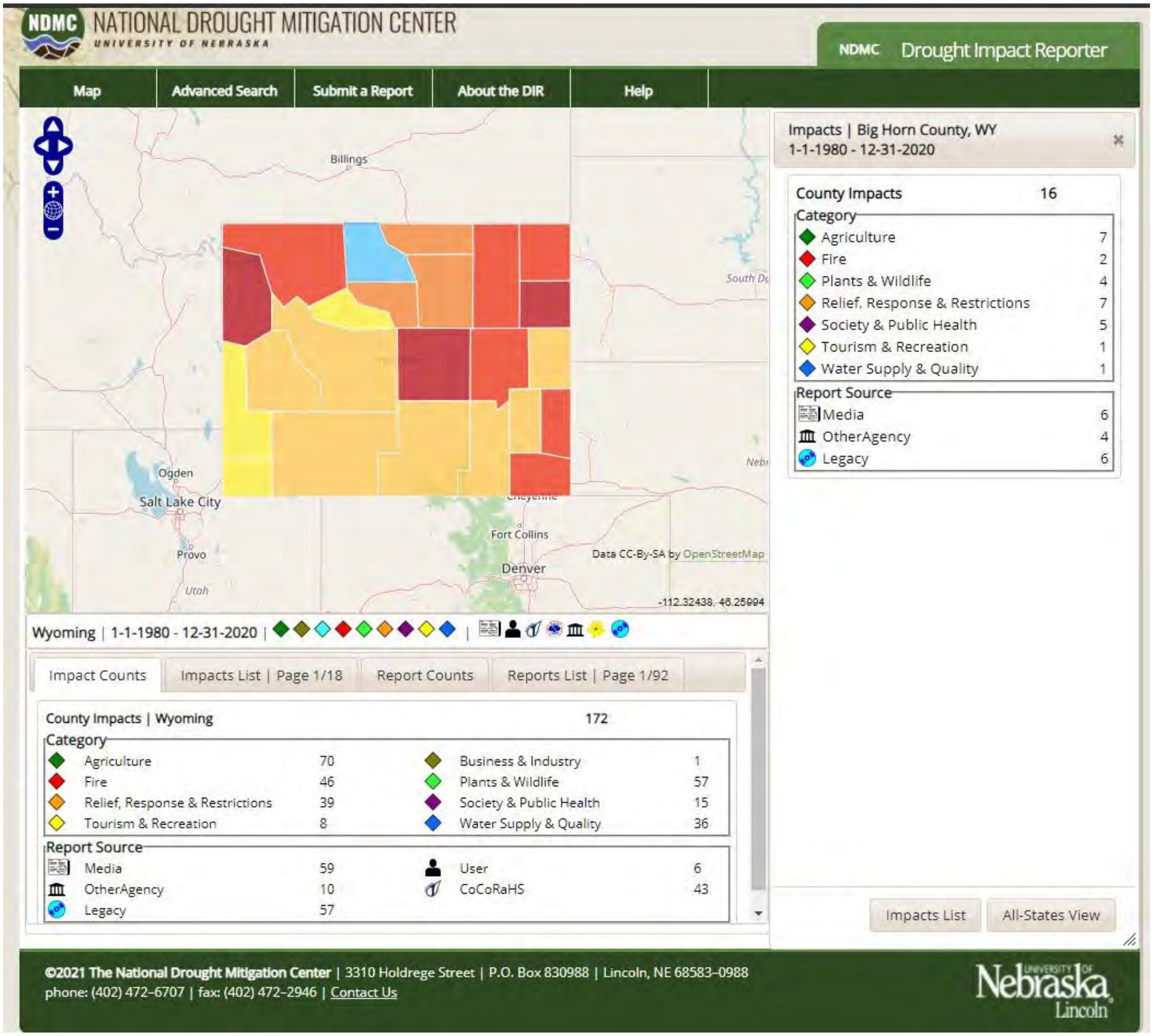


Figure 4-13 Number of Reported Drought Impacts 1980-2020 Hot Springs County

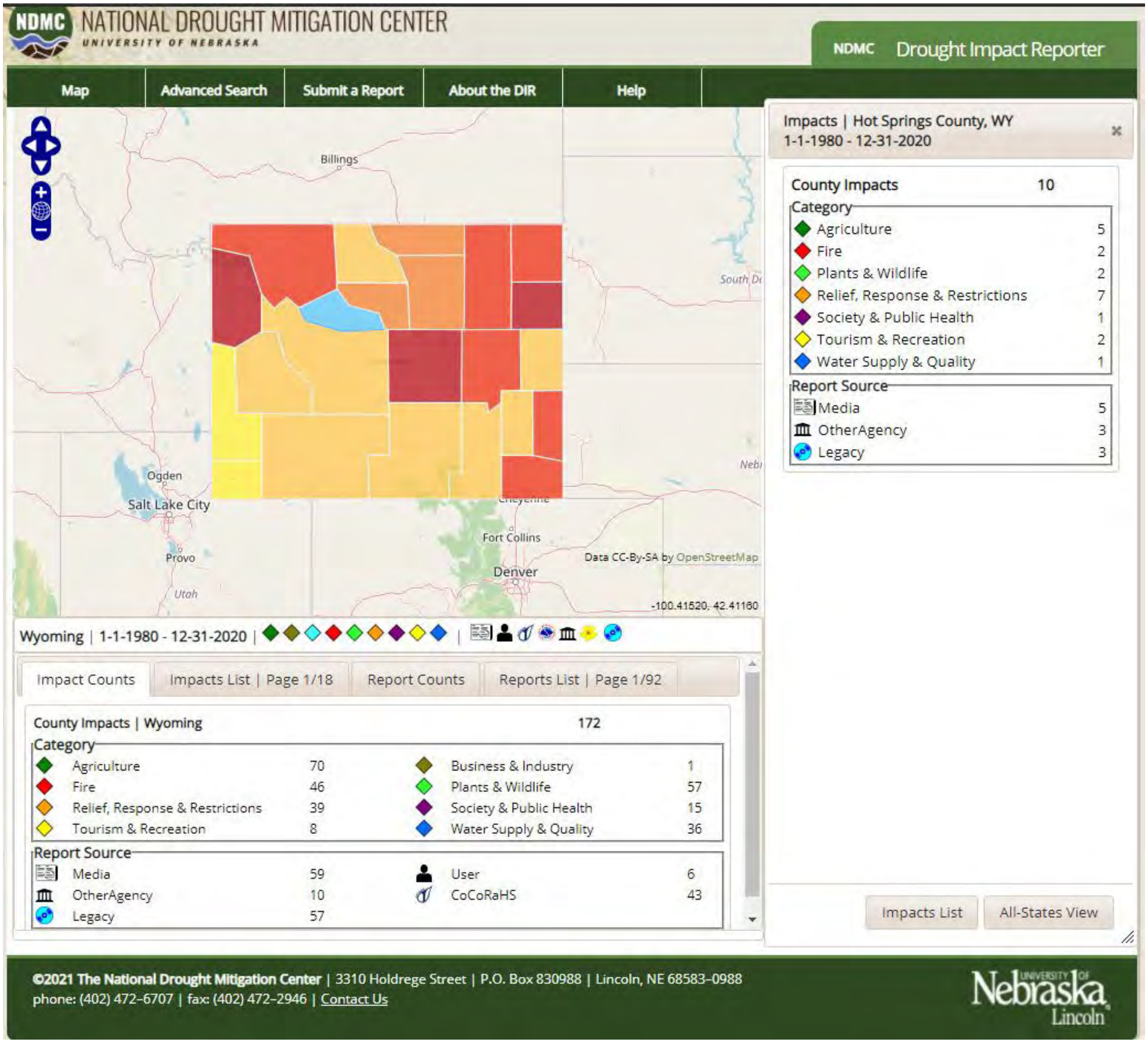


Figure 4-14 Number of Reported Drought Impacts 1980-2020 Washakie County

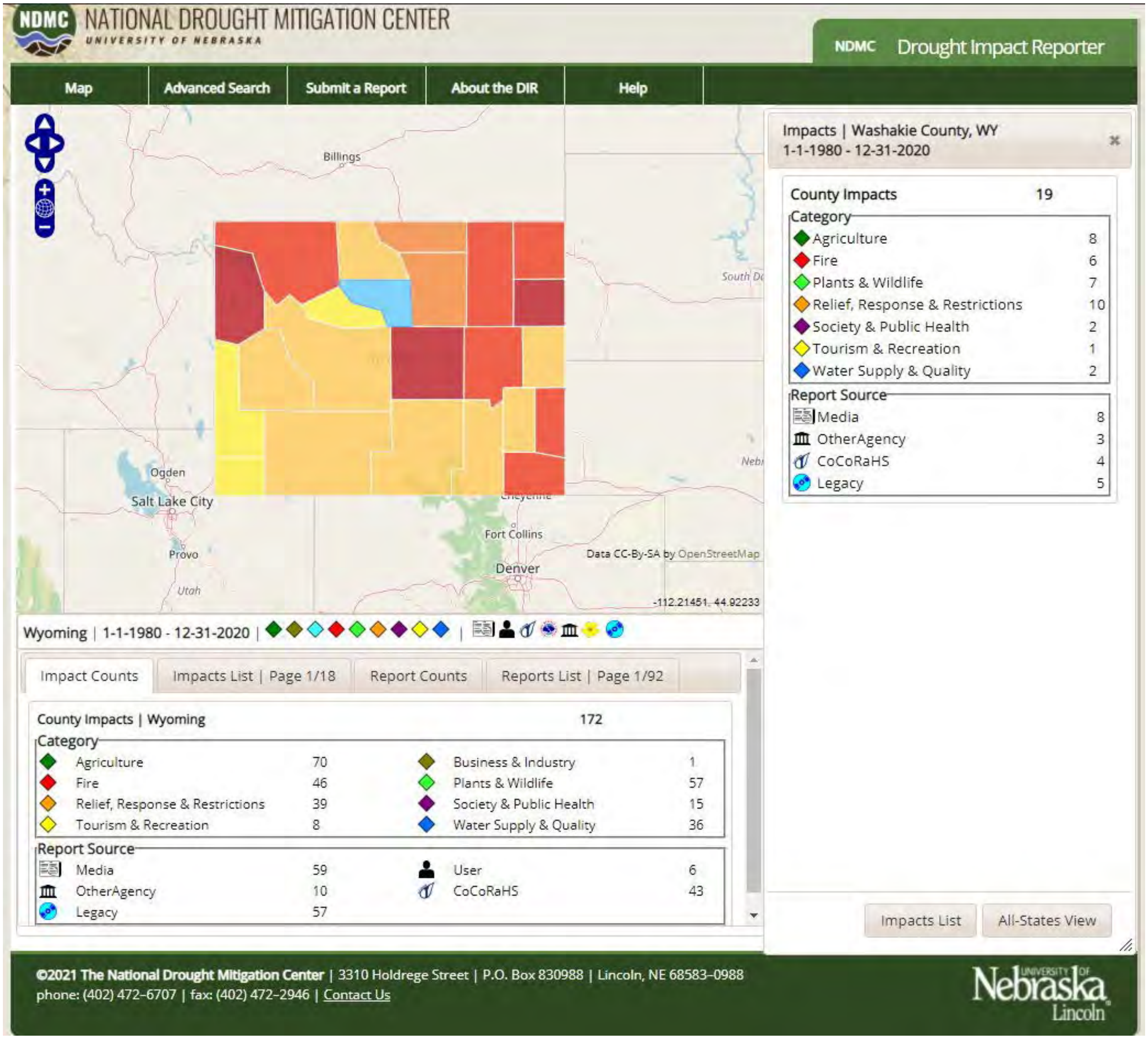
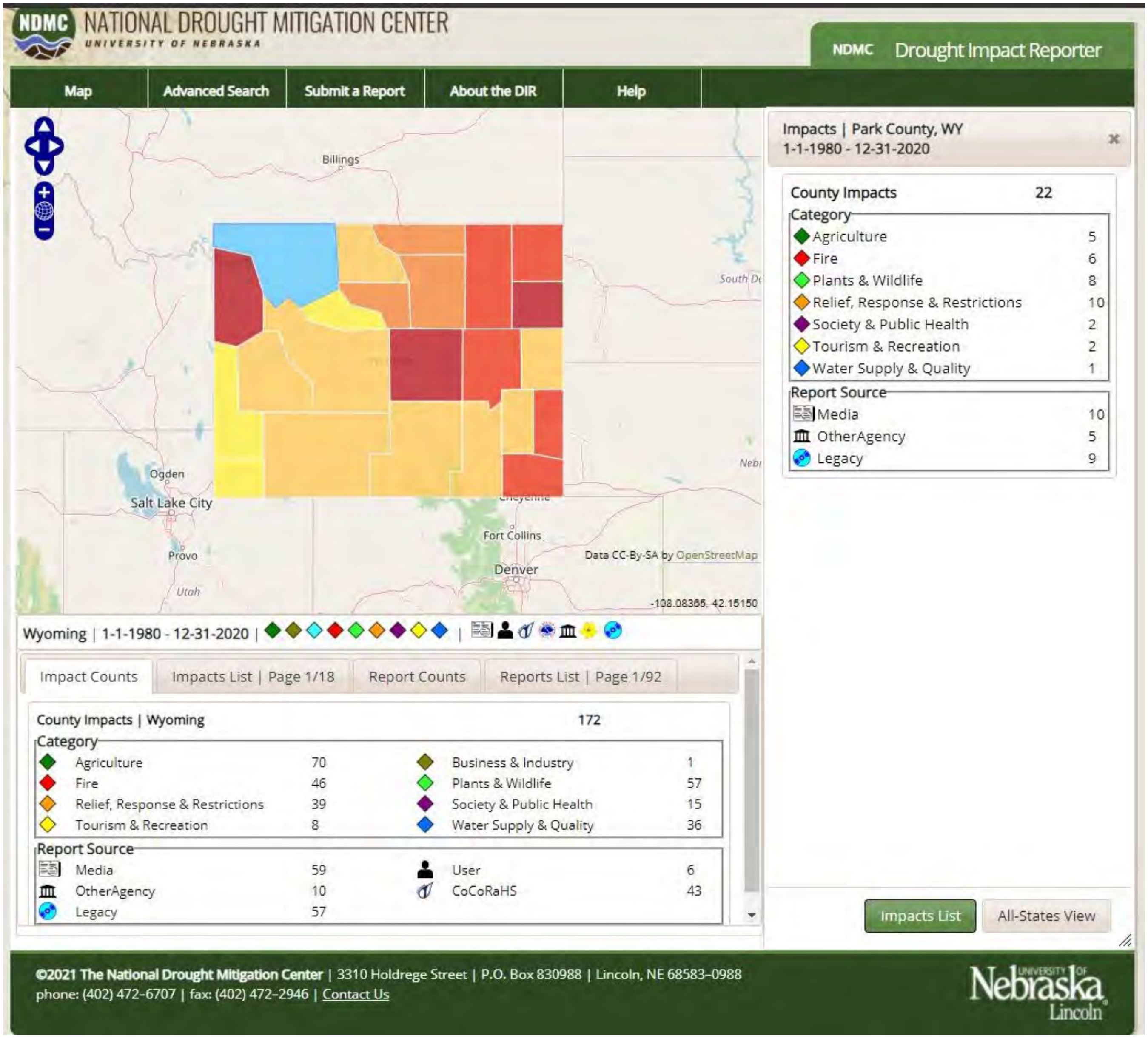


Figure 4-15 Number of Reported Drought Impacts 1980-2020 Park County



Some examples of losses during a drought include a July 2012, report regarding the selloff of cattle by Wyoming ranchers. "In the western part of the state, ranchers on Bureau of Land Management property are worried they will be forced to move their livestock earlier than normal because the riparian areas are in such poor shape due to the drought conditions," Magagna (vice president of the Wyoming Stock Grower's Association) said. Many of the people who lease grazing area from the BLM don't have anywhere else to go, Magagna said (Dayton Star Tribune 2012).

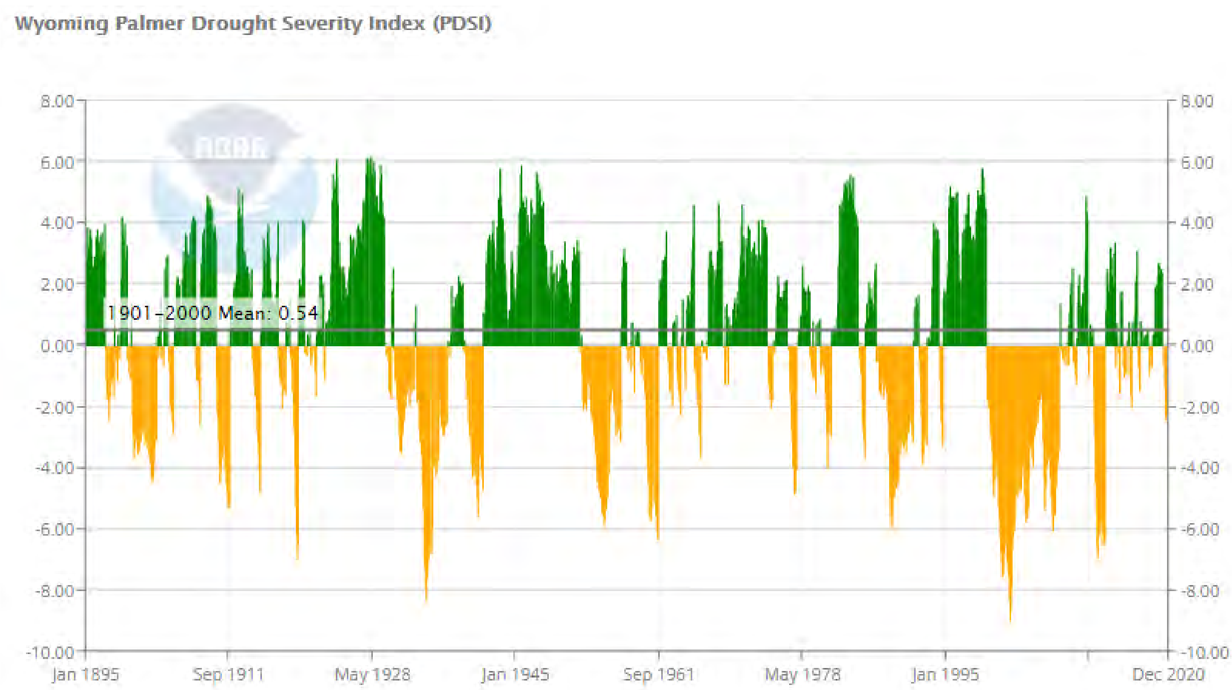
An MSNBC report in February 2007, stated, "Bighorn Lake in northern Wyoming has lost 30 miles in length over the last 8 years due to drought. Lower lake levels have hurt tourism in the area, although the lake used to draw nearly half a million visitors per year. Less water in the lake means fewer fishermen on the Montana side of Bighorn. Those anglers used to contribute $30 million to the local economy yearly. In Wyoming, the lower water level translates to the Kane boat launch near Lovell remaining closed and no water at the Horseshoe Bend campground and boat ramp" (MSNBC).

In July 2004, the Bureau of Land Management announced it would remove 140 wild horses from the Fifteenmile Wild Horse Management Area, as severe drought conditions in the area had reduced natural drinking water sources. "The Fifteenmile HMA is in the midst of a fifth consecutive year of severe drought. Forage and water availability for wild horses is severely limited, and currently is not adequate to sustain the existing wild horse population until the next growing season" (BLM).

Frequency/Likelihood of Future Occurrence

Figure 4-14 indicates that drought occurs approximately every five to 10 years in Region 6. The planning area spent approximately 10-15% of the 100-year span from 1895 to 1995 in severe or extreme drought. This is consistent with the data in the Past Occurrences subsection which suggests that severe multi-year droughts have occurred roughly every ten years since the mid-20th century. An occurrence interval of roughly once every ten years corresponds to a likely frequency of occurrence. This is consistent with Regional Steering Committee estimates.

Figure 4-16 Palmer Drought Severity Index for Wyoming, 1895-2020



Source: NOAA National Centers for Environmental Information, Statewide Time Series

Potential Magnitude (Extent)

The impacts drought can have on modern society are often underrated. Droughts cause obvious and severe impacts on agricultural areas by destroying existing crops and prolonging unsuitable growing conditions which hinders efforts to recover agricultural losses. This causes secondary financial impacts first on the farmers, who have no crops to sell, and then on the consumers, who must pay higher prices for scarce produce. Increased demand for a decreased water supply raises water costs, which also drives up the overall costs to both farm producers and consumers.

Urban areas are also impacted by rising water costs, which may impact personal property and personal water usage bills. Recreational uses which are water-dependent may increase significantly in price or decrease in availability, particularly those which are based in reservoirs or lakes, as the water levels may be too low to sustain safe recreation. Finally, the increased risk of wildfires impacts the planning region.

While the hazard of fire itself is profiled separately, drought conditions increase the likelihood that wildfires will occur, either naturally or due to human causes.

In order 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. In some cases, the event of record represents an anticipated worst-case scenario, and in others, it is a reflection of a common occurrence. Based upon Table 4-7 and Table 4-8 the drought of 1999-2004 is as significant, if not more significant than any other droughts in the last 100 years for the entire state. The droughts noted in previously in Table 4-6 derived from the Wyoming Climate Atlas, indicates that the most significant droughts in the last century, in terms of precipitation deficit, were in 1952-1956 and 1999-2004. In order to determine which drought period had the most significant impact on Wyoming, crop production and livestock inventory data for the two periods were compared. Both 1957 and 2005 were wetter years, with annual statewide precipitation totals above the 1895-2020 average. Those two years were used as endpoints for the droughts that started in 1952 and 1999 respectively. In both cases, the years following saw a return to drier conditions. Because of this, the most recent drought impacts were also calculated for 2005 and 2006 and are included in summary tables. The tables below show peak decline (%) in production during drought compared to the 5-year pre-drought production average for various commodities.

A comparison of Table 4-7 and Table 4-8 indicate that drought impacts to the Wyoming agricultural community were greater in the 1999-2004 drought than in the 1952-1956 drought. With the exception of dry beans, all commodities in the worst years of the 1999-2004 drought showed a greater percentage decline in production than in the 1952-1956 drought. As a result, the 1999-2004 drought will be used as the drought of historic record to calculate dollar impacts.

Table 4-12 Peak Commodity Production Changes from Pre-Drought (1947-1951) to Drought (1952-1956)

Commodity	5-Year Pre-Drought Production Average (1947-1951)	Units	Lowest Production During Drought (1952-1956)	Year of Lowest Production (1952-1956)	Percent Change
Winter Wheat	5,072	1,000 bu.	2,346	1954	-54%
Spring Wheat	1,579	1,000 bu.	600	1954	-62%
Barley	4,414	1,000 bu.	2,700	1956	-39%
Oats	4,577	1,000 bu.	2,470	1954	-46%
Dry Beans	1,009	1,000 cwt.	589	1955	-42%
Sugarbeets	413	1,000 tons	421	1955	+2%
Corn	227	1,000 bu.	161	1953	-29%
Alfalfa Hay	490	1,000 tons	675	1954	+38%
Other Hay	674	1,000 tons	442	1954	-34%
Cattle/ Calves Inventory	1,050	1,000 head	1,096	1954	+4%

Table 4-13 Peak Commodity Production Changes from Pre-Drought (1994-1998) to Drought (1999-2004)

Commodity	5-Year Pre-Drought Production Average (1994-1998)	Units	Lowest Production During Drought (1999-2006)	Year of Lowest Production (1999-2006)	Percent Change
Winter Wheat	6,029	1,000 bu.	2,375	2002	-61%
Spring Wheat	648	1,000 bu.	96	2002	-84%
Barley	8,383	1,000 bu.	4,680	2002	-44%
Oats	1,648	1,000 bu.	600	2005	-64%
Dry Beans	691	1,000 cwt.	514	2001	-26%
Sugarbeets	1,151	1,000 tons	659	2002	-43%
Corn	6,328	1,000 bu.	4,165	2002	-34%
Alfalfa Hay	1,581	1,000 tons	1,150	2002	-27%
Other Hay	817	1,000 tons	450	2002	-45%
Cattle/ Calves Inventory	1,536	1,000 head	1,300	2004	-16%

The U.S. Drought Monitor classifies droughts into different categories, from D0 (Abnormally Dry) to D4 (Exceptional Drought), as shown in Figure 4-14. Periods of dryness are classified in one of these categories as the drought's life cycle is tracked. The following table explains each of these categories. All drought categories can and have been experienced in the Region.

Figure 4-17 U.S. Drought Monitor Drought Severity Classifications

			Ranges				
Category	Description	Possible Impacts	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

Changing Future Conditions

According to analysis by FEMA Region VIII on the projected changes in natural hazards frequency and intensity, the areas in the state at risk to drought are not expected to change in the future, though drought is projected to increase in intensity and frequency. Seasonal precipitation patterns are projected to shift, leading to dryer summers and less precipitation as snow in early spring and late fall seasons. This, coupled with earlier spring runoff, is projected to result in longer duration in droughts statewide.

Vulnerability Assessment

The vulnerability of the people, buildings, and economy of Region 6 to drought is very difficult to quantify. Typically, people and structures are not directly vulnerable to drought, though secondary or indirect impacts may eventually increase vulnerability ratings. However, some areas are more vulnerable overall than others and, therefore, benefit from adequate mitigation planning and implementation. For Region 6, the agricultural sector is the most vulnerable to drought and will benefit the most from mitigation efforts. Economic resources tied to agricultural production are extremely vulnerable to drought. Outdoor recreation, which is important to the Region 6 economy, is also vulnerable to drought. The geographic extent of the hazard is considered extensive. The probability of future occurrences is considered likely to high, and the potential magnitude/severity is high. In addition, the Regional Steering Committee considers the hazard to have an overall impact rating of high for Region 6.

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, an increase in wildlife-human confrontations and respiratory complications as a result of declined air quality in times of drought.

Property

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Critical Facilities and Lifelines

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

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. Agricultural industries will be impacted if water usage is restricted for irrigation. According to the USDA 2017 Census of Agriculture, the combined market value of crops and livestock sold in the Region was $218,339,000, representing a 15% decrease since the 2012 Census of Agriculture (USDA). While there are several factors that affect market value, 2017 was a moderate drought year and its likely this is reflected in part in the decrease. Drought and extreme heat may impact all crops grown in the Region and the pastureland used to sustain livestock.

The 1999-2004 drought can be shown to be the drought of historic record. There have been significant impacts on the agricultural industry from the 1999-2004 drought. The worst-case year was 2002, with a negative dollar impact of $308,171,390 statewide. Region 6 is 14.7% of the State of Wyoming in land area. If it is assumed that the drought impact is equally distributed across the state, which in reality it is not, the potential drought impact in Region 6 for 2002 would be approximately $45,301,194. The total impact statewide for the 1999-2004 drought is $903,649,936. If it is assumed that the drought impact is equally distributed across the state, which in reality it is not, then the potential drought impact in Region 6 would be approximately $132 M.

Additionally, drought can exacerbate the risk of wildfires; increase the cost of municipal water usage; and deplete water resources used for recreation, affecting the economy.

Environment and Cultural Resources

Environmental losses from drought are associated with damage to plants, animals, 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. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. 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.

Development Trends

Future development in the Region is not anticipated to change vulnerability to drought significantly.

Risk Summary and Overall Significance by Jurisdiction

Drought is considered a high significance hazard for most of the Region due to the extensive economic and environmental impacts. Drought can be widespread and pervasive for several years.

Table 4-14 Drought Hazard Risk Summary

County	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/ Severity	Overall Significance
Big Horn	Extensive	Highly Likely	Critical	High
Hot Springs	Extensive	Likely	Critical	High
Park	Extensive	Likely	Critical	High
Washakie	Extensive	Likely	Critical	High

4.2.5 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 sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. 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, because the shocks shake, damage, or demolish buildings and other structures. 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 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. Small, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

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. Other damaging effects of earthquakes include surface rupture, fissuring, ground settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, seiches, liquefaction, fires, and dam failure. The combination of widespread primary and secondary effects from large earthquakes make this hazard potentially devastating.

Part of what makes earthquakes so destructive is that they generally occur without warning. The main shock of an earthquake can usually be measured in seconds, and rarely lasts for more than a minute. Aftershocks can occur within the days, weeks, and even months following a major earthquake.

By studying the geologic characteristics of faults, geoscientists can often determine when the fault last moved and estimate the magnitude of the earthquake that produced the last movement. Because the occurrence of earthquakes is relatively infrequent in Washakie County and the historical earthquake record is short, accurate estimations of magnitude, timing, or location of future dangerous earthquakes in the County are difficult to estimate.

Liquefaction

During an earthquake, near surface (within 30 feet), relatively young (less than 10,000 years old), water-saturated sands and silts may act as a viscous fluid. This event is known as liquefaction (quicksand is a result of liquefaction). Liquefaction occurs when water-saturated materials are exposed to seismic waves. These seismic waves may compact the material (i.e. silts and sands), increasing the interior pore water pressure within the material mass.

When the pore pressure rises to about the pressure of the weight of the overlying materials, liquefaction occurs. If the liquefaction occurs near the surface, the soil bearing strength for buildings, roads, and other structures may be lost. Buildings can tip on their side, or in some cases sink. Roads can shift and become unstable to drive on. If the liquefied zone is buried beneath more competent material, cracks may form in the overlying material, and the water and sand from the liquefied zone can eject through the cracks as slurry.

Geographical Area Affected

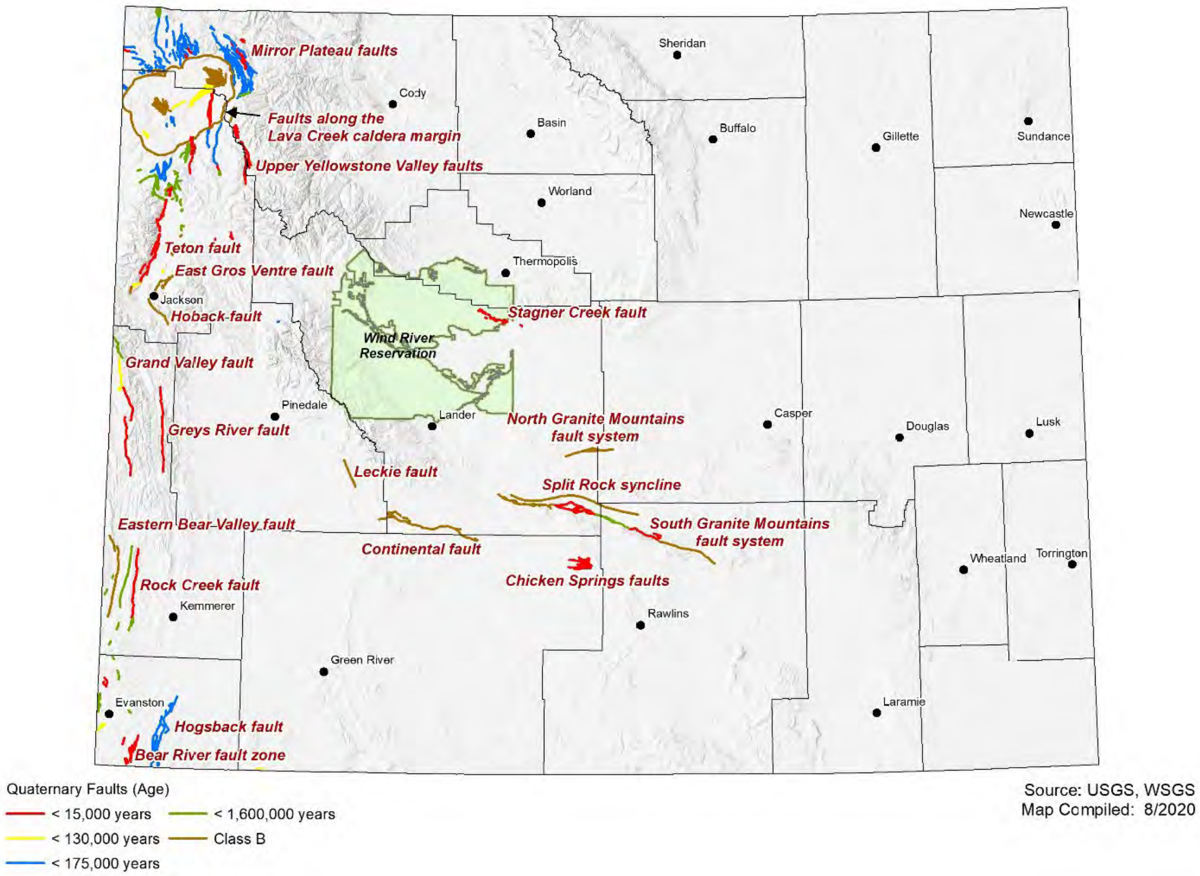
Yellowstone National Park is partially within the Region and one of the more seismically active areas in the United States. Most Wyoming earthquakes outside of Yellowstone National Park occur as a result of movement on faults. If the fault has moved within the Quaternary geological period, or last 1.6 million years, the fault is considered to be active. Active faults can be exposed at the surface or deeply buried with no significant surface expression. Historically, no earthquakes in Wyoming have been associated with exposed active faults. The exposed active faults, however, have the potential to generate the largest earthquakes. As a result, it is necessary to understand both exposed and buried active faults in order to generate a realistic seismological characterization of the state.

According to the Wyoming State Geological Survey, there are approximately 80 Quaternary faults mapped in Wyoming, with 26 considered active. Most of the exposed active faults are outside of Region 6. The Teton fault, Star Valley fault, Greys River fault, Rock Creek fault, and the Bear River fault system in western Wyoming are capable of generating magnitude 7.0 to 7.5 earthquakes and are considered to be overdue for reactivation. In central Wyoming, the Stagner Creek fault system near Boysen Reservoir and the South Granite Mountain fault system near Jeffrey City, are both considered potentially active and capable of generating magnitude 6.5 to 6.75 earthquakes. Earthquake risks related to Boysen Dam are of concern to Region 6 counties as explained in the dam failure section of this plan.

A dynamic magma chamber beneath Yellowstone National Park, combined with regional tectonic forces, results in significant seismic activity. Many of the earthquakes are associated with movement of hydrothermal fluids in the subsurface. Some deeper earthquakes may be related to fluids within or around the magma chamber. Earthquakes which may be related to active faults also occur in the park. Yellowstone is a super-volcano, and it has explosively erupted 0.64 million, 1.3 million, and 2.1 million years ago. The explosive eruptions led to the formation of three giant calderas, the collapse of which led to the formation of faults. In addition, after major eruptions, resurgent domes formed within the calderas. The doming process led to the formation of other faults. As a result, many of the faults in Yellowstone are not considered major threats.

Historically, Wyoming's earthquakes are tied to faults that are buried. Buried faults that have never broken the surface are generally considered to be capable of generating up to magnitude 6.5 earthquakes. Since the distribution of the buried faults is not well known, it is assumed that earthquakes up to magnitude 6.5 can occur anywhere in the state. (State Hazard Mitigation Plan 2021).

Figure 4-18 Exposed Known or Suspected Active Faults in Wyoming



Source: Wyoming Hazard Mitigation Plan based on data from the Wyoming Geological Survey

A fault system called the Cedar Ridge/Dry Fork fault system is present near the southern border of Washakie County in Natrona and Fremont Counties near Lysite. The 35-mile long Cedar Ridge fault comprises the western portion of the fault system, and the 15-mile long Dry Fork fault makes up the eastern portion. There is also no compelling reason to believe that the Cedar Ridge fault system is active. Based upon its fault rupture length of 35 miles, however, if the fault did activate it could potentially generate a maximum magnitude 7.1 earthquake (Wong et al., 2001). A magnitude 7.1 event could generate peak horizontal accelerations of approximately 7.4%g at Big Trails, approximately 3.8 %g at Ten Sleep, and approximately 3.7%g at Worland (Campbell, 1987). Those accelerations would be roughly equivalent to an intensity V earthquake at Big Trails and intensity IV earthquakes at Ten Sleep and Worland. Minor damage could occur at Big Trails.

Figure 4-17 shows areas in Wyoming that could experience liquefaction during an intense earthquake. Areas shown have sands and coarse silts that are less than 10,000 years in age and are within 30 feet of the surface. Portions of the Bear River Valley, Star Valley, Snake River Valley, Yellowstone National Park, Yellowstone River Valley, and the New Fork River Valley, as well as portions along the Wind and Bighorn rivers, have the necessary components to experience liquefaction.

Figure 4-19 Wyoming Liquefaction Coverage

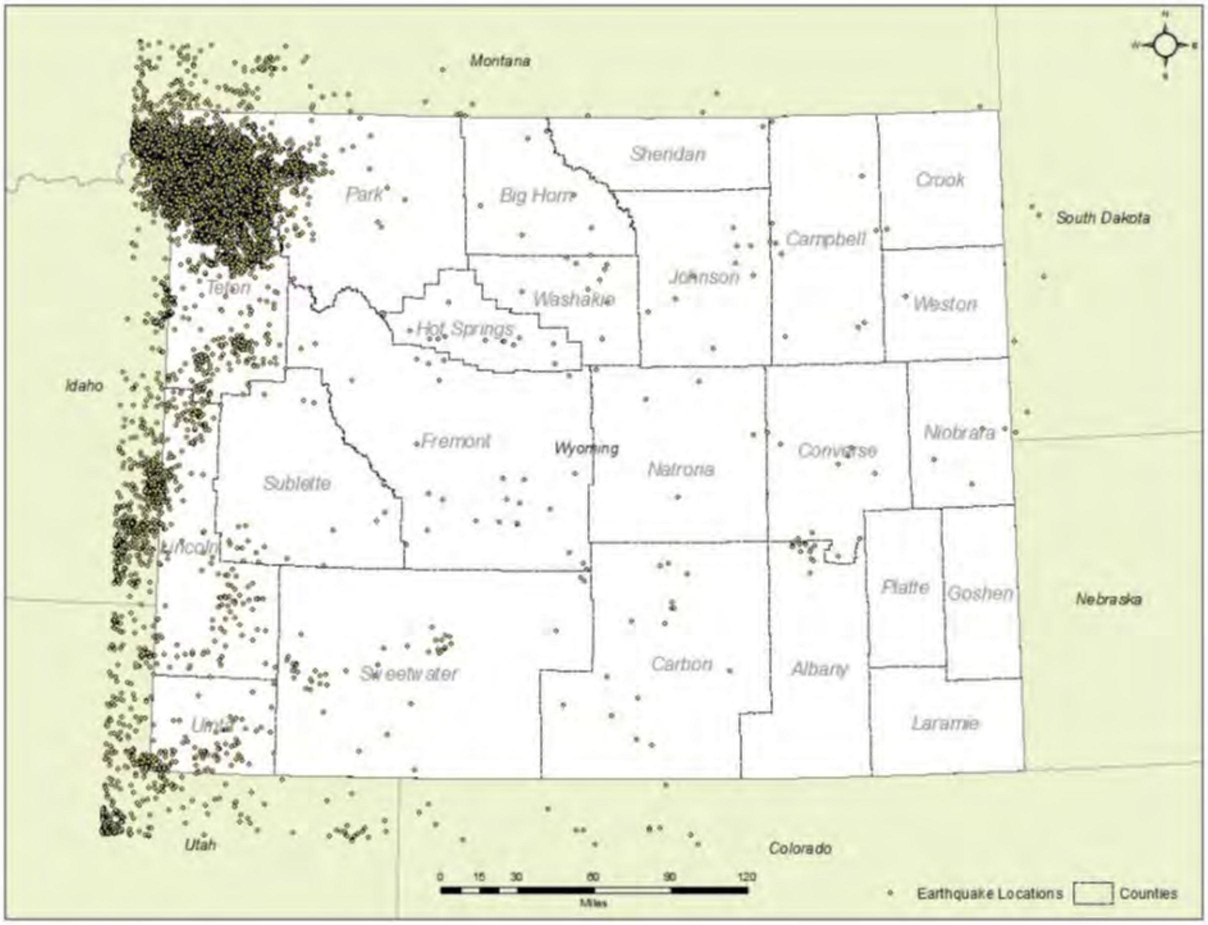
Source: Wyoming Geological Survey

Past Occurrences

Prior to the 1950s, most earthquakes were detected and located by personal reports. After the Hebgen Lake earthquake in 1959 near Yellowstone Park, monitoring in Wyoming started to improve and earthquakes were more commonly located by seismometers.

Since 1871, the state has logged some 47,000 earthquakes, with the majority of the events taking place in the western third of the state (see Figure 4-18) where the majority of the active, or Quaternary Period, faults are identified.

Figure 4-20 Wyoming Historic Earthquake Occurrences Statewide Since 1963- 2010



Source: Wyoming Geological Survey - Wyoming Earthquake Hazard and Risk Analysis: HAZUS-MH Loss Estimations for 16 Earthquake Scenarios Report

Historically, earthquakes have occurred in every county in Wyoming. The first was reported in Yellowstone National Park in 1871. Data on instrumentally recorded earthquakes is available from the USGS Earthquake Hazards Program dating back to 1973. Nineteen magnitude 4.5 and greater earthquakes have been recorded in Region 6 since 1973-May 2021, all of which were in Park County and Yellowstone National Park. These earthquakes are noted in Table 4-26 below.

Table 4-15 Highest Magnitude* Earthquakes in Region 6: 1973-May 2021

County	Magnitude	Date
Park	5.9	1975-06-30
Park	5.5	1976-12-08
Park	5.3	1976-10-19
Park	5.3	1976-10-19
Park	5.1	1975-06-30
Park	4.9	1976-12-19
Park	4.9	1976-12-09
Park	4.9	1975-06-30
Park	4.9	1974-06-09

County	Magnitude	Date
Park	4.8	2014-03-30
Park	4.7	1975-06-30
Park	4.6	1974-10-22
Park	4.6	1975-06-30
Park	4.6	1975-07-02
Park	4.5	1974-08-30
Park	4.5	1975-07-03
Park	4.5	1975-07-05
Park	4.5	1976-12-09
Park	4.5	1980-02-22

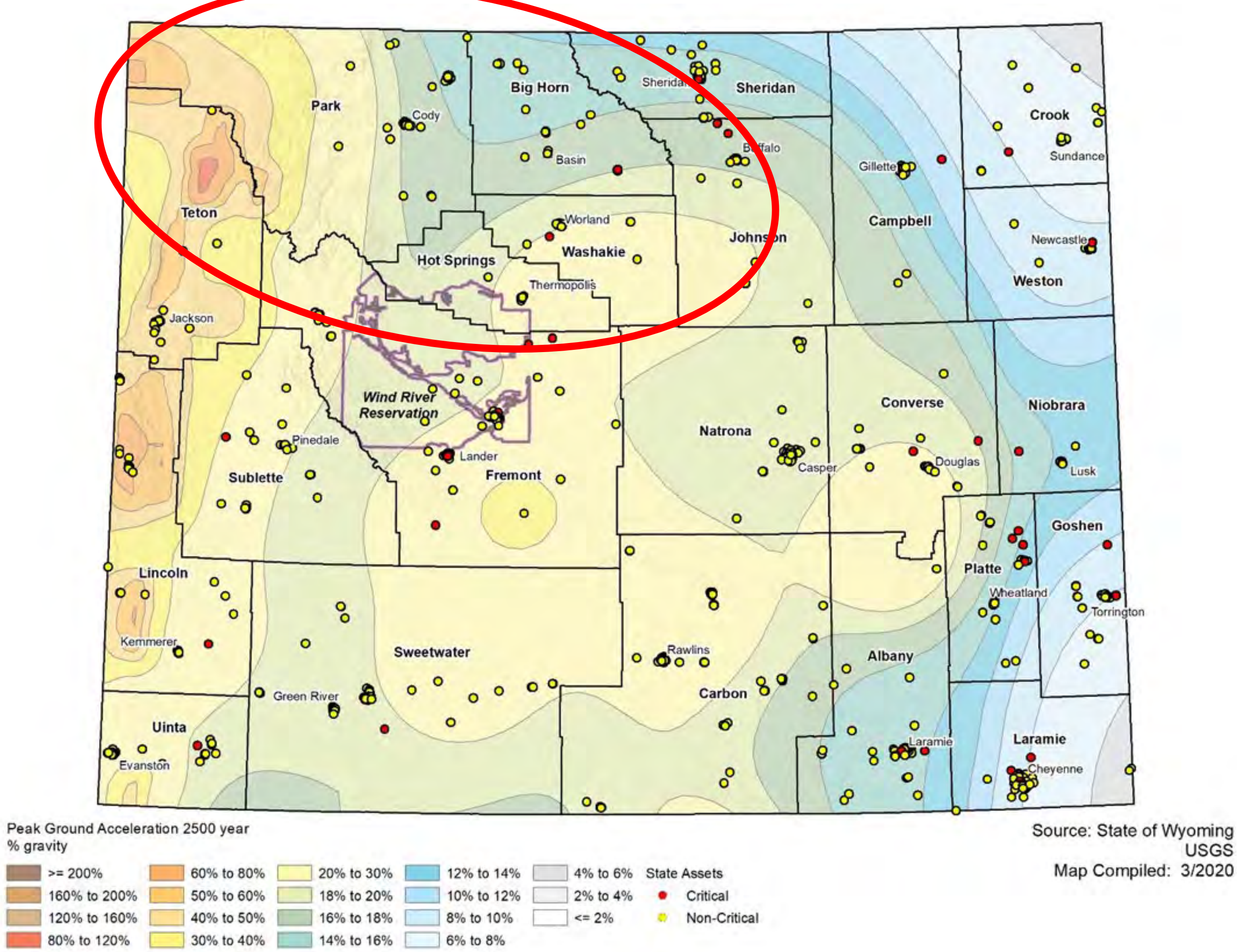
*Based on instrumentally recorded earthquakes. Source: USGS Earthquake Hazards Program

Frequency/Likelihood of Future Occurrence

Based on past occurrences the Region is likely to experience one 3.0 or greater earthquake approximately every ten to fifteen years; however also based on past occurrences, the earthquakes are likely to cause little to no damage. This equates to between 1 and 10 percent chance of occurring in the Region in the next year, or an occasional occurrence rating. To determine the likelihood of damaging earthquakes the U.S. Geological Survey (USGS) publishes probabilistic acceleration maps for 500-, 1000-, and 2,500-year time frames. The maps show what accelerations may be met or exceeded in those time frames by expressing the probability that the accelerations will be met or exceeded in a shorter time frame. For example, a 10% probability that acceleration may be met or exceeded in 50 years is roughly equivalent to a 100% probability of exceedance in 500 years. The 2,500-year (2% probability of exceedance in 50 years) map is shown in the figure below. The International Building Code uses a 2,500-year map as the basis for building design. The maps reflect current perceptions on seismicity in Wyoming based on available science. In many areas of Wyoming, ground accelerations shown on the USGS maps can be increased further due to local soil conditions. For example, if fairly soft, saturated sediments are present at the surface, and seismic waves are passed through them, surface ground accelerations will usually be greater than would be experienced if only bedrock was present. In this case, the ground accelerations shown on the USGS maps would underestimate the local hazard, as they are based upon accelerations that would be expected if firm soil or rock were present at the surface.

As the historic record is limited, it is nearly impossible to determine when a 2,500-year event last occurred in the county. Because of the uncertainty involved and based upon the fact that the new International Building Code utilizes 2,500-year events for building design, it is suggested that the 2,500-year probabilistic maps be used for regional and county analyses. This conservative approach is in the interest of public safety.

Figure 4-21 2500-year probabilistic acceleration map (2% probability of exceedance in 50 years) – Region 6 in oval



Changing Future Conditions

Changes in future conditions is not expected to directly affect earthquake frequency or intensity.

Potential Magnitude (Extent)

The amount of energy released during an earthquake is usually expressed as a Richter magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface as felt by humans or resulting damage to structures and defined in the Modified Mercalli scale (see Table 4-23 and Table 4-24). Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Table 4-16 Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.

MMI	Felt Intensity
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: USGS. http://earthquake.usgs.gov/learn/topics/mercalli.php

Table 4-17 Modified Mercalli Intensity (MMI) Scale and Peak Ground Acceleration

MMI	Acceleration (%g) (PGA)
I	<0.17
II	0.17 – 1.4
III	0.17 – 1.4
IV	1.4 – 3.9
V	3.9 – 9.2
VI	9.2 – 18
VII	18 – 34
VIII	34 – 65
IX	65 – 124
X	>124
XI	>124
XII	>124

Source: Modified Mercalli Intensity and peak ground acceleration (PGA) (Wald, et al 1999).

Limited damages have been documented in the Region from historic earthquakes. Because of the limited historic record, however, it is possible to underestimate the seismic hazard in the Region if historic earthquakes are used as the sole basis for analysis. Earthquake and ground motion probability maps give a more reasonable estimate of damage potential in areas with or without exposed active faults at the surface. Current earthquake probability maps that are used in the newest building codes suggest a scenario that would result in moderate damage to buildings and their contents in the Region.

Vulnerability Assessment

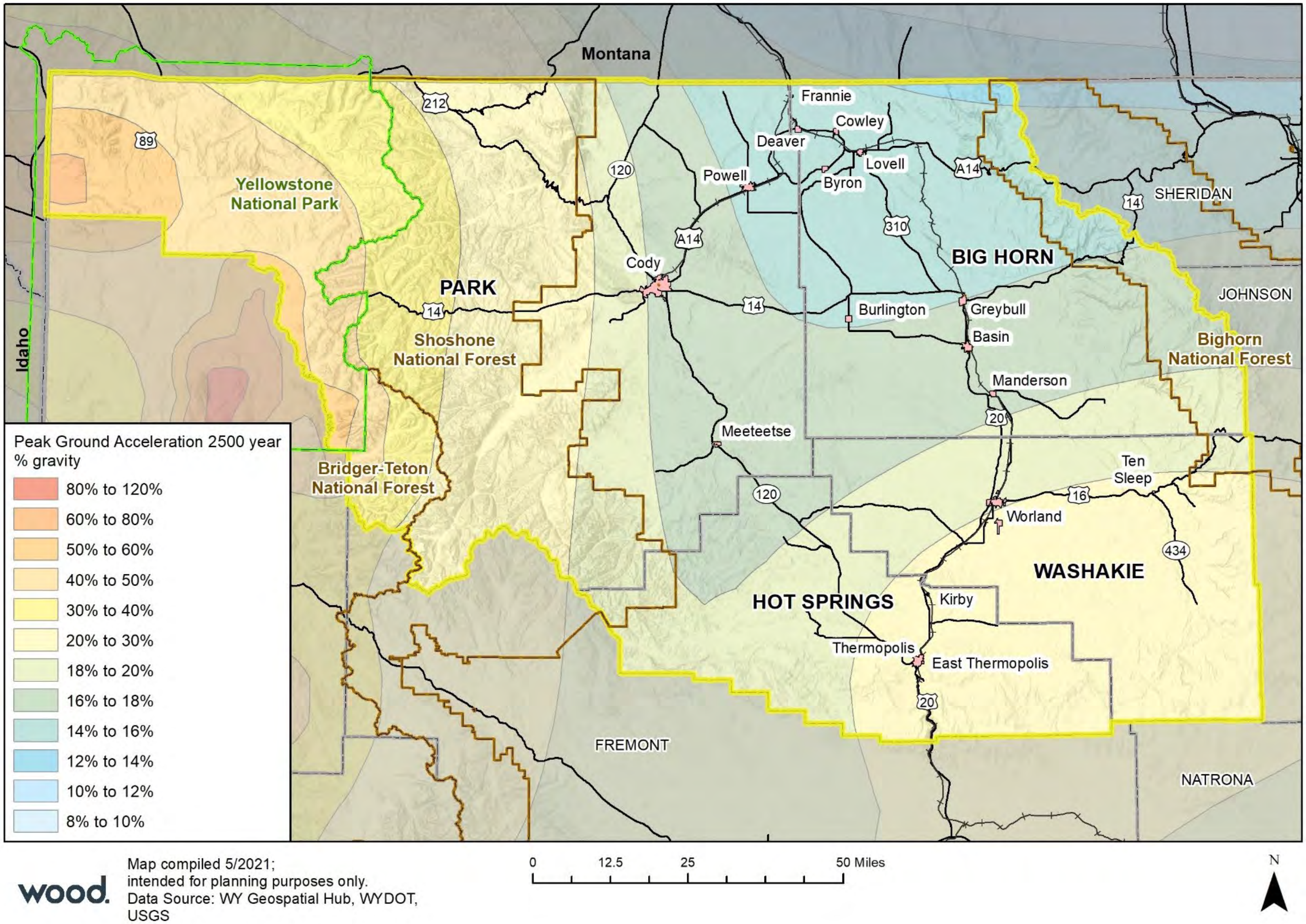
During the 2020-2021 update process for the Wyoming State Hazard Mitigation Plan, earthquake vulnerability data was generated for each county in the state using a Level 1 HAZUS-MH analysis. HAZUS (Hazards U.S.) is a nationally standardized, GIS-based, risk assessment and loss estimation computer program that was originally designed in 1997 to provide the user with an estimate of the type, extent, and cost of damages and losses that may occur during and following an earthquake. It was developed for the

FEMA by the National Institute of Building Sciences (NIBS). There have been a number of versions of HAZUS generated by FEMA, with HAZUS-MH (HAZUS - Multi-Hazard) being the most recent release.

Once the location and size of a hypothetical earthquake are identified, 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. Additional information provided includes anticipated households displaced or seeking temporary shelter, electrical outages anticipated, number of households without potable water, debris generated by the scenario and economic losses resulting from three categories: buildings, transportation, and utilities.

Figure 4-20 below shows the peak ground acceleration for all of Region 6 under the 2500-year probabilistic earthquake scenario, the impacts of which are discussed in this vulnerability section.

Figure 4-22 Region 6 2500-Year Earthquake Peak Ground Acceleration



People

The entire population of Region 6 is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil types their homes are constructed on, their proximity to fault location, etc. Whether impacted directly or indirectly, the entire population will have to deal with the consequences of earthquakes 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.

Three population groups are particularly vulnerable to earthquake hazards:

- **Linguistically Isolated Populations**—Problems arise when there is an urgent need to inform non-English speaking residents of an earthquake event. They are vulnerable because of difficulties in understanding hazard-related information from predominantly English-speaking media and government agencies.
- **Population below Poverty Level**—Families and individuals with incomes below the poverty level may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Poorer residents are also less likely to have insurance to compensate for losses in earthquakes.
- **Population over 65 Years Old**—This population group is vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations

Casualty impacts on persons in the planning area were estimated for the 2,500-Year Probabilistic Earthquake. Casualty levels as defined by Hazus-MH are described as follows;

- Level 1: Injuries will require medical attention, but hospitalization is not needed
- Level 2: Injuries will require hospitalization but are not considered life-threatening
- Level 3: Injuries will require hospitalization and can become life-threatening if not promptly treated
- Level 4: Victims are killed by the earthquake

These impacts are summarized by County in Table 4-26 below.

Table 4-18 Estimated 2500-Year Probabilistic Earthquake Impact on Persons and Households

Jurisdiction	Casualty Level 1	Casualty Level 2	Casualty Level 3	Casualty Level 4
Hot Springs	9	1	0	0
Big Horn	11	1	0	0
Park	62	11	1	2
Washakie	18	3	0	1

Source: Hazus-MH 4.2

Property

All structures in the planning area are susceptible to earthquake impacts to varying degrees. Hazus 4.2.3 uses building inventory based on 2018 RS Means Valuation Updates for general building stock and values.

There are two methods of ranking counties to determine where earthquake impacts may be the greatest. Either the loss ratios or total damage figures can be used (Table 4-27). The loss ratio is determined by dividing the sum of the structural and non-structural damage by the total building value for the county. The loss ratio is a better measure of impact for a county as it gives an indication of the percent of damage to buildings. The total damage figure by itself does not reflect the percentage of building damage. If a county has a number of valuable buildings, small damage to a number of valuable buildings may result in a higher total damage figure than what may be found in a county with fewer, less expensive buildings with a higher percentage of damage. The probabilistic loss estimates may significantly over-estimate actual losses sustained from an individual earthquake. The data shows aggregated loss potential, rather than potential losses for a specific event. Park County can experience the highest potential loss due to building exposure and closer proximity to seismic sources.

Table 4-19 2,500-Year Probabilistic Scenario Loss Estimates

Jurisdiction	Total Loss ($M)	Loss Ratio
Park	$126	2.3%
Washakie	$41	2.6%
Big Horn	$26	1.3%
Hot Springs	$24	2.4%

Source: HAZUS-MH Global Summary Report, Wood analysis

Critical Facilities and Lifelines

All critical facilities and infrastructure in the planning area are exposed to the earthquake hazard. Hazardous Materials (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.

Damage impacts to transportation corridors and communications lines could affect first responders' ability to effectively respond in the aftermath of an earthquake. Damage to government facilities/personnel in incident area may require temporary relocation of some operations. Regulatory waivers may be needed locally. The public may question local government's ability to respond and recover if planning, response, and recovery are not timely and effective. A significant earthquake may require disaster declarations and aid programs. These needs may impact funding or administrative resources for other regular operations or may necessitate changes to existing operating procedures.

HAZUS-MH classifies the vulnerability of critical 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. Damage to the transportation system and utility lifelines is possible; specific loss numbers were not available at county levels from the Hazus analysis done for the Wyoming State Hazard Mitigation Plan.

Economy

Impacts to the economy from an earthquake can be direct, in the form of direct damages and losses to buildings and infrastructure, and indirect, often in the form of lost wages and business income, relocation costs, and other costs of recovery. Capital stock and income losses by County in Region 6 are shown below in Table 4-28.

Table 4-20 Region 6 Economic Impacts, 2500-Year Probabilistic Earthquake Scenario

	Capital Stock Losses (Thousands of Dollars)					Income Losses (Thousands of Dollars)				
County	Structural	Non-Structural	Contents	Inventory	Loss Ratio (%)	Relocation	Capital-Related	Wages	Rental	Total Loss
Big Horn	$3,018	$12,141	$5,902	$159	1.31	$2,007	$885	$1,102	$899	**$26,115**

	Capital Stock Losses (Thousands of Dollars)					Income Losses (Thousands of Dollars)				
County	Structural	Non-Structural	Contents	Inventory	Loss Ratio (%)	Relocation	Capital-Related	Wages	Rental	Total Loss
Hot Springs	$2,504	$10,792	$5,419	$108	2.35	$1,895	$956	$1,208	$871	**$23,754**
Park	$13,895	$59,845	$26,731	$740	2.31	$9,652	$5,145	$6,027	$4,363	**$126,397**
Washakie	$4,852	$18,307	$9,490	$340	2.65	$3,574	$1,368	$1,789	$1,573	**$41,293**

Environment and Cultural Resources

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. Streams can be rerouted or blocked entirely as occurred in the Hebgen Lake event in Montana, after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology. Historic building stock is commonly made of unreinforced masonry which is vulnerable to damage from earthquakes.

Development Trends

Future development in the Region is not anticipated to extensively change vulnerability to earthquake significantly.

Risk Summary and Overall Significance by Jurisdiction

In summary, within Region 6 Park County and Hot Springs County have higher risk due to the closer proximity of potentially active faults within and near these counties and the past record of seismic activity in the area. It is estimated in a 2,500-year probabilistic scenario that Park County could experience $126 million in combined capital stock and income losses. While the probability is low, WSGS studies indicate the possibility of a 6.5 magnitude could occur anywhere in the state.

Table 4-21 Earthquake Hazard Risk Summary

County	Likelihood	Spatial Extent	Potential Magnitude	Significance
Big Horn	Occasional	Significant	Critical	Medium
Hot Springs	Occasional	Significant	Critical	Medium
Park	Occasional	Limited	Limited	Medium
Washakie	Occasional	Limited	Limited	Medium

4.2.6 Expansive Soils

Hazard/Problem Description

Soils and swelling bedrock contain clay which causes the material to increase in volume when exposed to moisture and shrink as it dries. They are also commonly known as expansive, shrinking and swelling, bentonitic, heaving, or unstable soils and bedrock. In general, the term refers to both soil and bedrock contents although the occurrence of the two materials may occur concurrently or separately. The difference between the materials is that swelling soil contains clay, while swelling bedrock contains claystone. (Source: Colorado Geological Survey Department of Natural Resources, *A Guide to Swelling Soils for Colorado Homebuyers and Homeowners*. (Denver, Colorado.) 1997. p 15-16.)

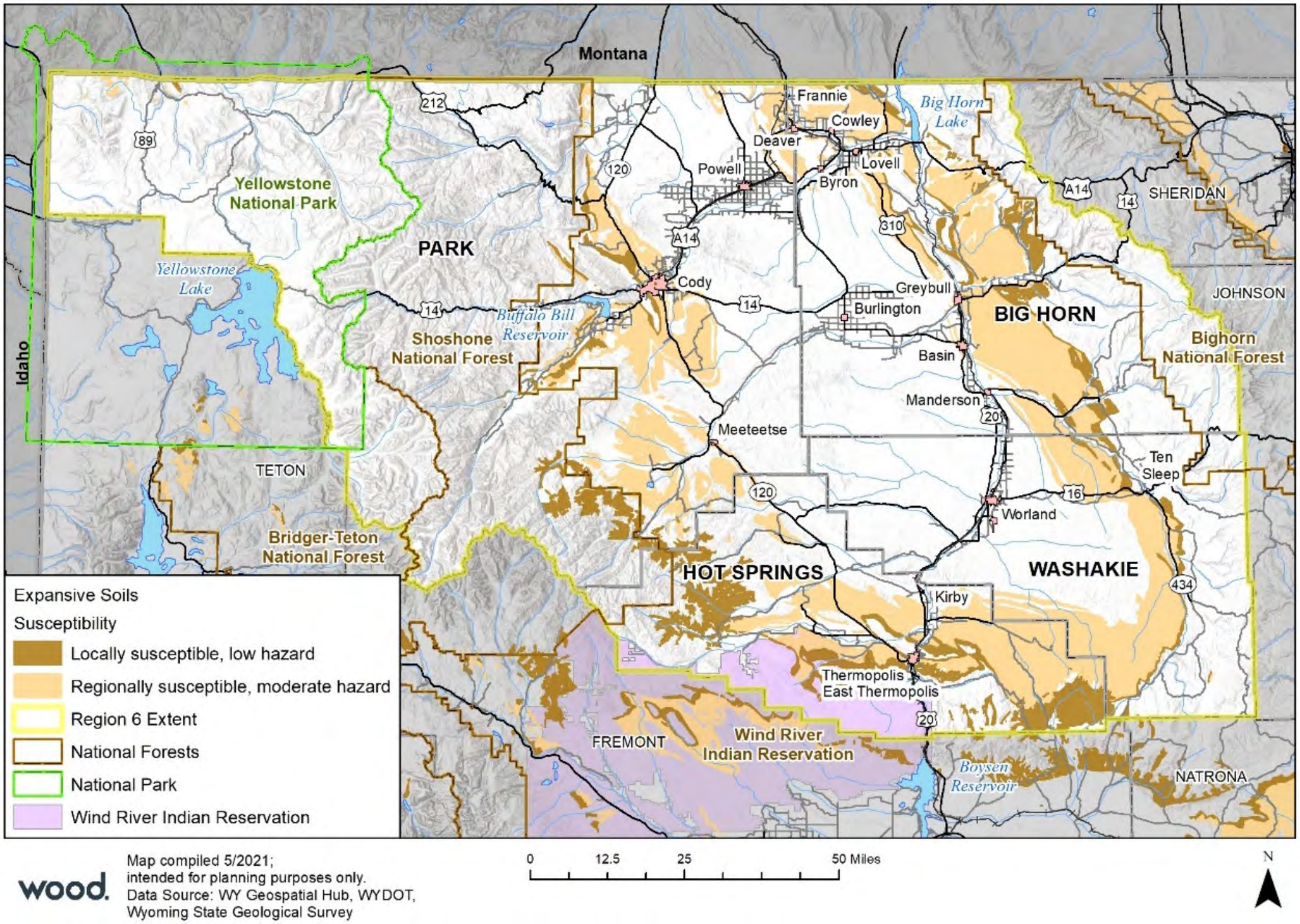
The clay materials in swelling soils are capable of absorbing large quantities of water and expanding 10 percent or more as the clay becomes wet. The force of expansion is capable of exerting pressures of 15,000 pounds per square foot or greater on foundations, slabs, and other confining structures. (Ibid., p 17.) The amount of swelling (or potential volume of expansion) is linked to five main factors: the type of mineral content, the concentration of swelling clay, the density of the materials, moisture changes in the environment, and the restraining pressure exerted by materials on top of the swelling soil. Each of these factors impact how much swelling a particular area will experience, but may be modified, for better or worse, by development actions in the area.

- **Low**—This soils class includes sands and silts with relatively low amounts of clay minerals. Sandy clays may also have low expansion potential, if the clay is kaolinite. Kaolinite is a common clay mineral.
- **Moderate**—This class includes silty clay and clay textured soils, if the clay is kaolinite, and also includes heavy silts, light sandy clays, and silty clays with mixed clay minerals.
- **High**—This class includes clays and clay with mixed montmorillonite, a clay mineral which expands and contracts more than kaolinite.

Geographical Area Affected

Some Wyoming clays have the potential to swell or shrink when transitioning between wet or dry. These clays are primarily montmorillonites. There is one type of montmorillonite, sodium montmorillonite (bentonite) that is especially prone to shrinking and swelling. Expansive soils are known to be present in the eastern and western sides of the Big Horn Basin. Figure 4-24 highlights expansive soils throughout Region 6 based on mapping from the WYGS. Those formations selected have characteristics that could lead to expansive soils where they outcrop. Based on these figures, Washakie and Big Horn Counties have the largest amount of potentially swelling soil, but areas exist in Park and Hot Springs as well. In Washakie County, Ten Sleep and the surrounding area are most likely to face problems related to expansive soils. Deposits of calcium montmorillonite can also contribute to swelling problems, but these areas have not been completely mapped. Based on the figures below, expansive soils are estimated to affect a limited portion of the planning area.

Figure 4-23 Region 6 Expansive Soils



Past Occurrences

Very little data exists on expansive soil problems and past damages in Wyoming. Studies on the issue have not been performed and no database exists to catalog occurrences. Damages due to expansive soils such as foundation cracks, parking lot/sidewalk cracks, etc. do occur but are generally handled by individual property owners. Other damages to supply lines, roads, railways, bridges, and power lines typically occur over time and are not attributed to or reported as an event.

Anecdotal comments from the county planning teams during the 2021 update process note past impacts to state highways in Park County and county roads in Washakie and Big Horn counties, summarized below:

- The Park CPT noted that common impacts are to the roads in the area and WYDOT expends a lot of money fixing buckling pavement notably on highway 120 north and south of Cody and the Chief Joseph Highway. Highway 14 east to Big Horn County was also noted as an area that is frequently repaired by WYDOT. Meeteetse noted some issues with their roads.
- The Big Horn CPT noted that a new school in Basin required a lot of expansive soil mitigation during construction. Big Horn CPT also noted that expansive soils affect the rail industry.
- Washakie CPT noted local road impacts combined with frost-heave issues.

Frequency/Likelihood of Occurrence

Since records of specific occurrences are not readily available, it is difficult to estimate the probability of future occurrences. Due to the extensiveness of expansive soils throughout the Big Horn Basin, impacts of expansive soils will most likely continue to be an issue for Region 6. The frequency of impacts will likely be an occasional problem for the counties in Region 6.

Changing Future Conditions

Many soils and rocks have the potential to swell based on a combination of mineralogy and water content. The actual swelling will be caused by a change in the environment (e.g. water content, stress, chemistry, or temperature) in which the material exists. Since the 1950s, precipitation and duration of snowpack have both decreased while rising temperatures have increase rate of water evaporating into the air, creating drier soil conditions in Wyoming (EPA 2016). More extremes in future conditions, such as drastic wet/dry weather patterns, could potentially exacerbate swelling soil issues in the future.

Potential Magnitude (Extent)

Expansive soils vary by the potential for linear extensibility. The volume change measured with linear extensibility is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The higher the shrink-swell potential of the soil, the greater the damage that may occur to buildings or infrastructure built in those areas. Expansive soils with linear extensibility potential of less than 3 percent have a low shrink-swell potential, 3-6 percent is moderate, and 6-9 percent is high, and above 9 percent is very high. It is estimated that expansive soils in the Region can span the spectrum of linear extensibility, mostly in the low to moderate range, and will vary based on site specifics.

The potential magnitude of expansive soils events and damages is estimated to be **negligible** for the counties in the Region. Sporadic impacts related to expansive soils have been reported thus far, primarily affecting road infrastructure. Because damages from expansive soils tend to happen over an extended period of time, it is difficult to estimate the potential severity of a problem. Many deposits of expansive soils do not inflict damage over large areas. Instead, these deposits can often create localized damage to individual structures and supply lines, such as sidewalks, foundations, roads, railways, bridges, and power lines.

Vulnerability Assessment

Vulnerability to expansive soils comes from exposure to the hazard. Geologic formations with suspected expansive soils have been digitized, allowing a GIS overlay analysis with county assessor data to be conducted in order to better understand and quantify the vulnerability in Region 6. This data represents and enhancement to this plan in 2021, as previously there was not GIS data for expansive soils. These results represent exposure and the potential for damage, not a true loss estimate. Damage from these soils will typically be isolated events, which will cause damage to a small number of buildings or road segments over time and does not cause complete damage or structure loss.

People

According to GIS analysis of the number of residential structures exposed to expansive soils and the average household size for each county, there are approximately 14,258 people residing in areas of expansive soils throughout Region 6. However, there have been no reported injuries or deaths resulting from expansive soils in Region 6, and direct impacts on people are likely to be very minimal.

Property

As identified in the hazard profile and noted above, extensive areas of the planning region specifically in the Big Horn Basin are characterized to some extent by swelling soils. Older construction may not be resistant to the swelling soil conditions and, therefore, may experience expensive and potentially extensive damages. This includes heaving sidewalks, structural damage to walls and basements, the need to replace windows and doors, or dangers and damages caused by ruptured pipelines. Newer construction may have included mitigation techniques to avoid most damage from the hazard, but the dangers continue if mitigation actions are not supported by homeowners. For example, the maintenance of grading away from foundations and the use of appropriate landscaping near structures must be continued to prevent an overabundance of water in vulnerable soils near structures. While continued public education efforts may help increase compliance for landscaping and interior finishing mitigation actions, physical reconstruction of foundations is probably not feasible in all but the most heavily impacted of existing development. Therefore, damages may be expected into the future for existing structures.

The results of this analysis are shown in Table 4-22 below. In total throughout Region 6, there is more than $439 million in structure improved value exposed to moderate expansive soils across the Region, with the greatest amount in unincorporated Park County.

Table 4-22 Region 6 Parcels at Risk to Low and Moderate Expansive Soils by Jurisdiction

Moderate					
County	**Jurisdiction**	**Improved Parcels**	**Improved Value**	**Est. Content Value**	**Total Exposure**
Big Horn County	Basin	2	$357,946	$178,973	$536,919
	Deaver	8	$725,356	$511,031	$1,236,387
	Frannie	3	$121,070	$70,624	$191,694
	Greybull	167	$15,734,832	$8,755,248	$24,490,080
	Big Horn Unincorporated	261	$35,624,957	$20,211,771	$55,836,728
	Total	**441**	**$52,564,161**	**$29,727,646**	**$82,291,807**
	East Thermopolis	85	$5,238,640	$2,635,162	$7,873,802

Hot Springs County	Thermopolis	245	$28,520,915	$14,605,489	$43,126,404
	Hot Springs Unincorporated	69	$11,442,309	$7,474,572	$18,916,881
	Total	**399**	**$45,201,864**	**$24,715,222**	**$69,917,086**
Park County	Cody	330	$109,541,687	$80,024,193	$189,565,880
	Meeteetse	136	$13,296,244	$6,997,095	$20,293,339
	Park Unincorporated	753	$212,284,863	$118,581,194	$330,866,057
	Total	**1,219**	**$335,122,794**	**$205,602,481**	**$540,725,275**
Washakie County	Washakie Unincorporated	27	$6,97,289	$3,910,696	$7,159,779
	Total	**27**	**$6,97,289**	**$3,910,696**	**$7,159,779**
	Grand Total	**2,086**	**$439,186,108**	**$263,956,044**	**$700,093,946**
Low					
County	**Jurisdiction**	**Improved Parcels**	**Improved Value**	**Est. Content Value**	**Total Exposure**
Big Horn County	Big Horn Unincorporated	52	$9,687,067	$5,424,226	$15,111,293
	Total	**52**	**$9,687,067**	**$5,424,226**	**$15,111,293**
Hot Springs County	Hot Springs Unincorporated	14	$552,971	$433,766	$986,737
	Total	**14**	**$552,971**	**$433,766**	**$986,737**
Park County	Cody	18	$15,780,290	$11,893,397	$27,673,687
	Park Unincorporated	22	$7,775,365	$4,075,910	$11,851,275
	Total	**40**	**$23,555,655**	**$15,969,307**	**$39,524,962**
Washakie County	Washakie Unincorporated	13	$2,378,172	$1,592,442	$3,970,614
	Total	**13**	**$2,378,172**	**$1,592,442**	**$3,970,614**
	Grand Total	**119**	**$36,173,865**	**$23,419,739**	**$59,593,604**

Source: Wyoming Geological Survey, County Assessors, Wood GIS Analysis

Critical Facilities and Lifelines

Existing critical facilities impacted expansive soil hazards are of particular concern, as the damages caused to these structures may impact the ability of the planning area to provide critical services to the population. Table 4-23 includes the results of a GIS overlay of critical facilities on the expansive soils data. The unincorporated areas of Region 6 have the most critical facilities at risk and a majority of those are communication and energy FEMA lifelines. This analysis does not take into account site-specific mitigation measures that may be in place. They analysis did not account for highway and road impacts. As noted in the Past Occurrences section Highway 120 north and south of Cody and the Chief Joseph Highway and Highway 14 east to Big Horn County are areas that are frequently repaired by WYDOT. Meeteetse noted some issues with their roads, as well as Washakie County.

Table 4-23 Critical Facilities at Risk to Moderate Expansive Soils by Jurisdiction and FEMA Lifeline

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn	Deaver	-	-	2	-	-	-	-	**2**
	Greybull	4	-	-	-	1	1	-	**6**
	Unincorporated	44	7	-	-	-	-	5	**56**
	Total	**48**	**7**	**2**	**0**	**1**	**1**	**5**	**64**
Hot Springs	East Thermopolis	-	-	-	-	-	1	-	**1**
	Thermopolis	3	-	-	-	3	3	-	**9**
	Unincorporated	19	11	-	-	-	2	7	**39**
	Total	**22**	**11**	**0**	**0**	**3**	**6**	**7**	**49**
Park	Cody	8	1	-	-	-	1	-	**10**
	Meeteetse	1	2	2	-	-	1	-	**6**
	Unincorporated	57	14	-	3	-	1	12	**87**
	Total	**66**	**17**	**2**	**3**	**0**	**3**	**12**	**103**
	Grand Total								**216**

Source: Wyoming Geological Survey, HIFLD, Wood GIS Analysis

Economy

The economic cost of this hazard is typically minor in the short term, although over time they can add up to significant impacts. Road closures or detours during expansive soil repairs can result in temporary economic impacts.

Environment and Cultural Resources

Expansive soils are a natural environmental process. Nonetheless they have the potential to alter the landscape and can cause damages to historic and cultural resources.

Development Trends

The most effective mitigation actions for expansive soil are complete avoidance or non-conflicting use, or correct engineering design. Modern building practices incorporate mitigation techniques, such as foundation design, adequate drainage, landscaping, and appropriate interior finishing, provided proper geotechnical testing is employed to identify expansive soils. If areas prone to expansive soils are identified, future areas for development will need to take this hazard into account. Due to mitigation with new development and generally low rates of development losses are not expected to increase with this hazard.

Risk Summary and Overall Significance by Jurisdiction

Expansive soils primarily impact road infrastructure and have had sporadic building impacts in the Region. Overall, they are a low significance hazard for the counties and municipalities in the region.

Table 4-24 Expansive Soil Hazard Risk Summary

County	Likelihood	Spatial Extent	Potential Magnitude	Significance
Big Horn	Occasional	Limited	Negligible	Low
Hot Springs	Occasional	Limited	Negligible	Low
Park	Occasional	Limited	Negligible	Low
Washakie	Occasional	Limited	Negligible	Low

4.2.7 Extreme Cold

Hazard/Problem Description

Extreme cold often accompanies a winter storm or is left in its wake. It is most likely to occur in the winter months of December, January, and February. Prolonged exposure to the cold can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Extreme cold can disrupt or impair communications facilities. Extreme cold temperatures can destroy crops and cause utility outages, leaving people without water or power until the utility companies are able to restore service.

What constitutes extremely cold temperatures varies across different areas of the United States, based on normal climate temperatures for the time of year. In Wyoming, cold temperatures are normal during the winter. When temperatures drop at least 20 degrees below normal winter lows, the cold is considered extreme and begins to impact the daily operations of the county. Extreme cold/wind chill impacts plants, animals and water supplies.

The effects of extremely cold temperatures are amplified by strong to high winds that can accompany winter storms. Wind-chill measures how wind and cold feel on exposed skin and is not a direct measurement of temperature. As wind increases, heat is carried away from the body faster, driving down the body temperature, which in turn causes the constriction of blood vessels, and increases the likelihood of severe injury or death to exposed persons. Animals are also affected by wind-chill however cars, buildings, and other objects are not.

Geographical Area Affected

The inherent nature of extreme cold makes it a regional threat, impacting most or all of the planning area simultaneously as well as extending the effects into the surrounding jurisdictions. Therefore, it is considered to have an extensive geographic impact rating. Lower elevations and valley bottoms can be more susceptible to trapping cold air, thus portions of Washakie and Big Horn counties are more prone to this hazard.

Past Occurrences

The National Center for Environmental Information (NCEI) Storm Events Database records a total of 21 events of extreme cold and wind chill conditions since 1996 for all of Region 6. The NCEI records $25,000 of property damage in February 1996, due to froze pipes bursting.

In 2009, 2,300 homes in Washakie County lost power when temperatures reached -19° F. By the following morning, temperatures had dipped to -31° F. Fortunately, the power lines were repaired before that point, but this incident illustrates how dangerous extreme cold can be. During this time, the USDA designated six counties as natural disaster areas for severe freezes including Fremont, Hot Springs, Johnson, Sheridan, Teton and Washakie. Based on information from the previous version of this HMP another severe cold event occurred in the late 1970s. This event saw 62 days of below zero weather. Frozen pipes were an issue for the planning area, and there were claims that some people were even driven to suicide by the event. During the 2021 plan update the Washakie County CPT noted sewer lines had frozen in Worland.

The following table shows regional temperature profiles based on data from the Western Regional Climate Center for sensor locations in each county. Note the record low of -50 degrees in Worland in 1990.

Table 4-25 Region 6 Temperature Summaries

County	Station	Average Annual Minimum Temperature	1 Day Extreme Low	# Days Max Temp <32°F/ Year	# Days Min Temp <0°F/ Year
Big Horn	Greybull	30.9°F	-40°F December 22, 1990	44.5	25.9
Hot Springs	Thermopolis	30.8°F	-44°F January 16, 1930	31.6	24
Park	Cody Muni Airport	33°F	-46°F February 8, 1936	34.7	18.2
Washakie	Worland	31.2°F	-50°F December 21, 1990	45.6	26.9

Source: Western Regional Climate Center, www.wrcc.dri.edu/

Frequency/Likelihood of Occurrence

Based on data provided by the Regional Steering Committee and historical records, extreme cold and wind-chill is an annual occurrence in all counties in Region 6. Thus, this hazard has a high likelihood of occurrence. Damaging events occur less frequently.

It is important to note that the lack of specific historical accounts on extreme cold temperatures does not necessarily indicate a low frequency of occurrence. Certain hazards occur more frequently in specific areas. Therefore, the residents of these areas are less likely to report events that seem commonplace in the planning area, even though the events may be considered extreme in other locations.

Changing Future Conditions

Climate change is projected to increase the uncertainty of weather patterns and produce more extreme climate induced events. Scientists have suggested that warming in the Artic has been linked changes in the jet stream which may lead to increased polar vortex events. The polar vortex is well documented and is described as large areas of low pressure and cold air surrounding the North and South poles. Increased temperatures in the polar regions has weakened and destabilized the jet stream leading to polar air to dip into lower latitudes, bringing it farther south than typical (UC Davis).

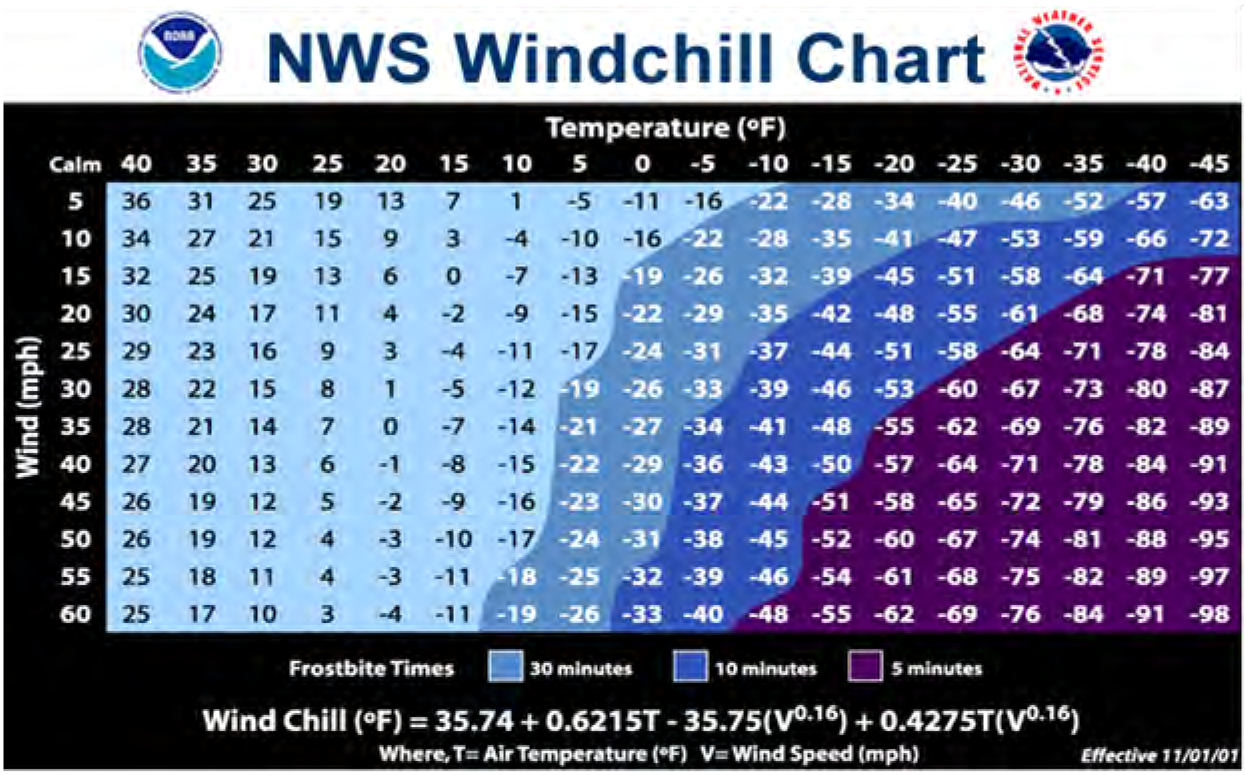
Potential Magnitude (Extent)

In order 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. In some cases, the event of record represents an anticipated worst-case scenario, and in others, it is a reflection of common occurrence. Based on the NCEI records, the event of record for extreme cold in the Region occurred on February 1, 1996. This event resulted in $43,101 in damages (adjusted for 2021 dollars).

Overall, extreme temperature impacts would likely be limited in the Region, with 10 to 25 percent of the planning area affected. Extreme cold can occasionally cause problems with communications facilities and utility transmission lines. Danger to people is highest when they are unable to heat their homes and when water pipes freeze. Extreme cold can also impact livestock and even crops if the event occurs during certain times of the year.

In 2001, the NWS implemented an updated Wind-Chill Temperature index. 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 4-24 National Weather Service Wind-Chill Chart



Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Vulnerability Assessment

People

While everyone is vulnerable to extreme cold/wind chill events, some populations are more vulnerable than others. Extreme cold/wind chill pose the greatest danger to outdoor laborers, such as highway crews, police and fire personnel, and construction. The elderly, children, people in poor physical health, and the homeless are also vulnerable to exposure. Overall, the population has a medium exposure to severe cold.

Property

Extreme cold/wind chill presents a minimal risk to the structures of Region 6. Property damage occurs occasionally when water pipes freeze and break. Homes without adequate insulation or heating may put owners at a higher risk for damages or cold-related injury. In cases of periods of prolonged cold, water pipes may freeze and burst in poorly insulated or unheated buildings. Vehicles may not start or stall once started due to the cold temperatures and the risks of carbon monoxide poisoning or structure fires increases as individuals attempt to warm cars in garages and use space heaters. Stalled vehicles, or those that fail to start, may result in minor economic loss if individuals are unable to commute between work, school, and home. Driving conditions may deteriorate if extreme cold/wind chill prolongs icy road conditions, which will impact commutes and emergency response times as well. Landscaping and agricultural products may be damaged or destroyed by unseasonable occurrences of extreme cold/wind chill, causing plants to freeze and die. This may increase the indirect vulnerabilities to severe cold by causing greater economic costs and losses for the year. The overall vulnerability of general property is low.

Critical Facilities and Lifelines

Like general property, extreme cold/wind chill events have a limited impact on the physical property of essential infrastructures and facilities. Communications lines such as fiber optic cables can freeze. There may be incidents of delayed emergency response due to stalled vehicles, delays in dispatching due to frozen communications lines, or an increased volume in calls. Hospitals may see an increase in cold-related injuries directly or injuries associated as secondary effects of the cold (traffic accidents, broken bones or severe cuts due to slips, etc.) and a prolonged extreme cold/wind chill event may impact hospital personnel capabilities. Personnel working in the cold, such as firefighters, EMTs, police officers and construction workers, have a higher vulnerability due to exposure times, and response capabilities may be hindered. Human services programs that care for at-risk individuals and families may be stressed, but usually can still adequately provide services through the duration of the extreme cold/wind chill event. Unusually high volumes of individuals seeking shelter or food may overwhelm some facilities if the event is prolonged. There may be an increased number of displaced individuals or families due to flooding caused by ruptured pipes, which may strain local aid organizations such as the Red Cross. If the event is extremely extended and impacts multiple other counties and states, which in turn impacts the availability of mutual assistance, the risk factors may increase. The overall vulnerability of essential infrastructure and community assets is medium.

Economy

A review of USDA Risk Management Agency (RMA) Records between 2007 and 2020 show a combined total of 36,756 acres lost to frost and freeze and $13,027,491 indemnity payments. Average annualized losses for crops due to frost and freeze is estimated to be $1,002,115 for the entire region.

Environment and Cultural Resources

Older venues or historical properties are more vulnerable than recent development due to older heating and less insulation than modern buildings, with the added vulnerability of potential for damaging historic and often irreplaceable property in the process. Region 6 has hundreds of square miles of parks and open space which provide habitat for various species that are valuable to residents and visitors to the Region,. Natural resources may be damaged by extreme cold and freezing temperatures, including broken trees and death of wildlife. Unseasonable storms may damage or kill plants and wildlife, which may impact natural food chains until the next growing seasons. Most of these impacts would be short-term.

Development Trends

Since structures are not usually directly impacted by severe temperature fluctuations, continued development is less impacted by this hazard than others in the plan. However, new development can add stress to the electric grid, potentially increasing the possibility of brownouts or blackouts, though this is not anticipated with current development trends.

Pre-emptive cautions such as construction of green buildings that require less energy to heat, use of good insulation on pipes and electric wirings, and smart construction of walkways, parking structures, and pedestrian zones that minimize exposures to severe temperatures may help increase the overall durability of the buildings and the community to the variations. Continued development also implies continued population growth, which raises the number of individuals potentially exposed to variations. Public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of extreme cold.

Risk Summary and Overall Significance by Jurisdiction

Extreme cold can cause occasional impacts, contributes to ice jam flooding, and in the valleys of the Big Horn Basin can be a significant hazard in some counties in Region 6. It often contributes to agricultural losses and utility outages (power and water).

Table 4-26 Extreme Cold Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Extensive	Highly Likely	Critical	High
Hot Springs	Extensive	Likely	Limited	Medium
Park	Extensive	Likely	Critical	Medium
Washakie	Extensive	Likely	Critical	High

4.2.8 Flood

Hazard/Problem Description

Floods can and have caused significant damage in Region 6 and are one of the more significant natural hazards in the Region. They have caused millions of dollars in damage in just a few hours or days. A flood, as defined by the National Flood Insurance Program, is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of waters; unusual and rapid accumulation or runoff of surface waters from any source; or, a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days. Causes of flooding relevant to the Region include:

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

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 1% annual chance flood, the flood that has a 1 percent chance in any given year of being equaled or exceeded, which is also sometimes referred to as the 100-year flood. The 1% annual chance flood is the national standard to which communities regulate their floodplains through the National Flood Insurance Program.

Region 6 is susceptible to multiple types of floods including riverine flooding, flash floods, slow rise floods, ice jams and possibly flooding resulting from dam or levee failure.

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 as a result of prolonged rainfall, or rainfall that is combined with soils already saturated from previous rain events. Slow rise floods associated with snowmelt and sustained precipitation usually are preceded with adequate warning, though the event can last several days.

Floods can also occur with little or no warning and can reach full peak in only a few minutes. Such floods are called flash floods. A flash flood usually results from intense storms dropping large amounts of rain within a brief period. Flash floods, by their nature, occur very suddenly but usually dissipate within hours. Even flash floods are usually preceded with warning from the National Weather Service in terms of flash flood advisories, watches, and warnings.

Floods can occur for reasons other than precipitation or rapidly melting snow. They can also occur because of ice jams, which have occurred in Washakie and Big Horn Counties. An ice jam is a stationary accumulation of ice that restricts flow. Ice jams can cause considerable increases in upstream water levels, while at the same time downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. These types of floods can be slow or fast rising, but generally develop over a period of many hours or days.

Levee failure can also cause a flash flood and is a risk in the region. A levee is an earthen embankment constructed along the banks of rivers, canals and coastlines to protect adjacent lands from flooding by reinforcing the banks. By confining the flow, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the riverbank, raising the level of the land around the river. To construct a man-made levee, workers pile dirt or concrete along the riverbanks, creating an embankment. This embankment is flat at the top, and slopes at an angle down to the water. For added strength, sandbags are sometimes placed over dirt embankments. Natural disasters such as Hurricane Katrina demonstrate that, although levees can provide strong flood protection, they are not failsafe. Levees can reduce the risk to individuals and structures behind them; but they do not eliminate risk entirely. Levees are designed to protect against a specific flood level; severe weather could create a higher flood level that the levee cannot withstand. Levees can fail by either overtopping or breaching. Overtopping occurs when floodwaters exceed the height of a levee and flow over its crown. As the water passes over the top, it may erode the levee, worsening the flooding and potentially causing an opening, or breach, in the levee. A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning. Unfortunately, in the rare occurrence when a levee system fails or is overtopped, severe flooding can occur due to increased elevation differences associated with levees and the increased water velocity that is created. It is also important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

The potential for flooding can also change and increase through various land use changes and changes to land surface. A change in the built 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. Flooding in the communities in Region 6 could be exacerbated by inadequate drainage and channel systems that would not stand up to the 1% annual chance flood. Inadequate culverts and drainage systems can cause flooded roads and flood adjacent properties. Refer to the County Annexes for a description of localized problems.

Increased flooding can also be created by other events such as wildfires. Wildfires 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.

Geographical Area Affected

All counties within the planning region have the potential for flooding. The extent of the flooding varies based on the location of the county, and on what part of the county is being examined. Detailed geographic flood assessments are provided in each County's attached annex.

The counties of Region 6 are predominantly located in the Wind/Big Horn River Basin of Wyoming. The northwest portion of Park County, Yellowstone National Park, lies in a separate drainage basin which drains to the north into Montana.

The Big Horn River Basin's mainstem is made up of the Wind and Bighorn Rivers. The Wind originates in the mountainous terrain between the Absaroka and Wind River Ranges and flows southeast through the Wind River Indian Reservation. At Riverton the river turns north and forms Boysen reservoir (in Fremont County) with a capacity of over 800,000 acre-ft. Once the river exits the Wind River Canyon near Thermopolis, it becomes the Bighorn which continues northward, passing through Hot Springs, Washakie and Big Horn Counties and the communities of Thermopolis, East Thermopolis, Worland, Manderson, Basin and Greybull.

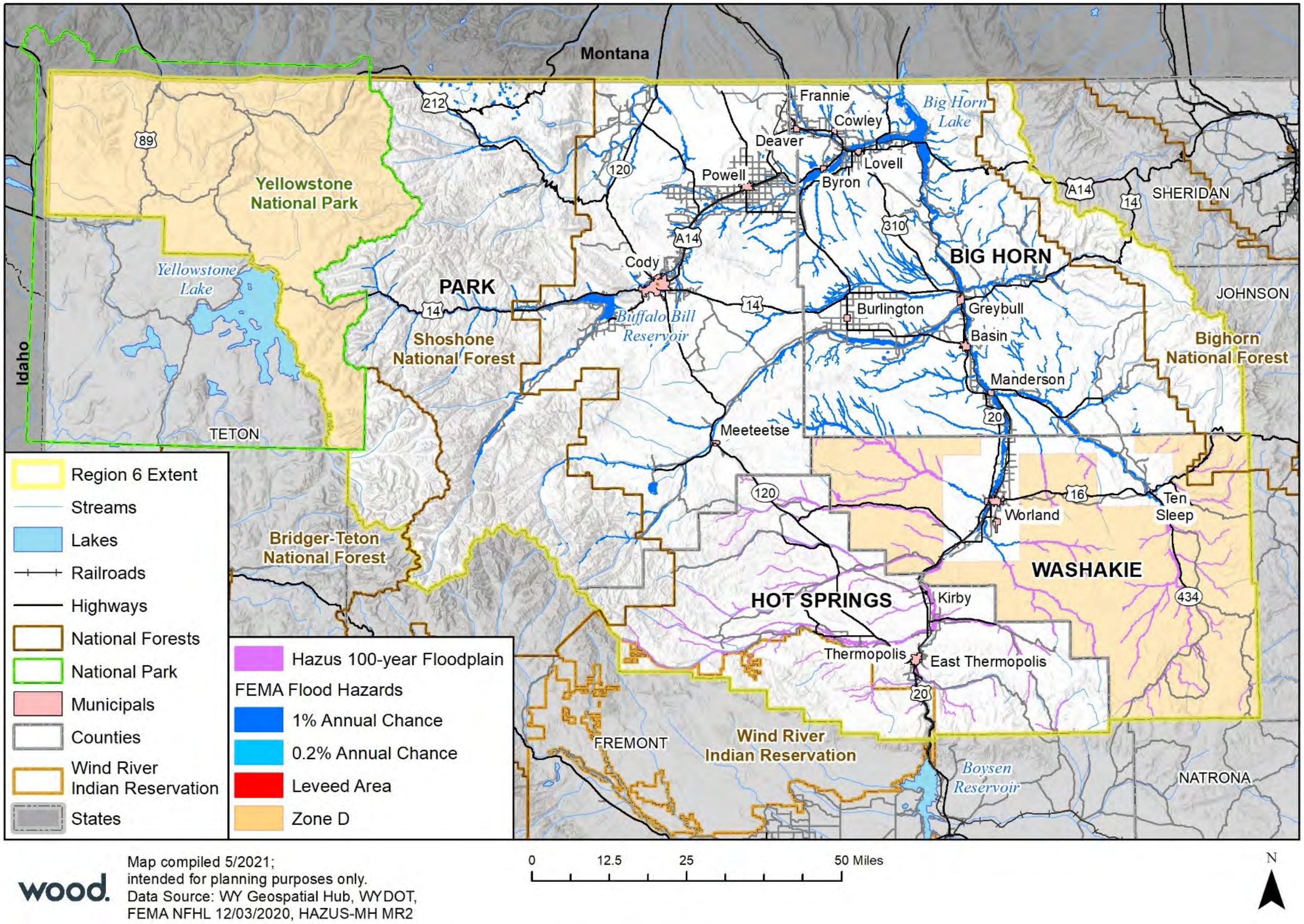
At Worland, Sage Creek enters the Big Horn River. At the Town of Manderson it receives the Nowood River. At Greybull it receives the Greybull River and about 30 mi north of this confluence it enters Bighorn Lake.

The Shoshone River traverses Park County through the communities of Cody and Powell and enters Big Horn County where it passes through the communities of Byron, and Lovell on its way to its confluence with the Big Horn River at Bighorn Lake.

The geographic extent rating for Region 6 is **significant**, meaning that a flood event could impact 10-50% of the planning area. The following sections detail the extent and history of flood hazards in the Region.

Figure 4-25 shows the Region 6 Flood Hazards. More detailed mapping is shown in the County annexes.

Figure 4-25 Region 6 Flood Hazards



Past Occurrences

A brief history of significant floods is presented below, while a more extensive summary is included in the county annexes. A damaging flood occurs in the area every year on average, based upon the historical data presented below.

The documented flood history for the Region extends back to 1917, when a 1% annual chance flood occurred in Hot Springs County along the Big Horn River and impacted Thermopolis. Cool weather preserving the heavy snowfall in the mountains until hot weather melted the snow quickly caused flooding according to FEMA Flood Insurance Study (March 23, 1999). The flood caused washed out bridges, destroyed irrigation flumes, and flooded low lying ground.

One of the most significant flooding events in the region occurred in July 1923, in Hot Springs County. A 300-year flood producing 4.10 inches of rain was caused by a cloudburst. The cause was cool weather preserving the heavy snowfall in the mountains, when hot weather melted the snow suddenly. Damage was to bridges, irrigation flumes, highways, and railroads. In Thermopolis, a city pump station was flooded, no water was available to the public, and loss of power to the city was due to severed gas line. Damage estimate was well over $100,000 (roughly $1.4 M in 2016 dollars). (FEMA Flood Insurance Study March 23, 1999)

In July of 1962 a damaging flood occurred in northern Big Horn Basin when severe thunderstorms and heavy rains of 4 to 6 inches with 6 to 9 inches of hail and high gusty winds caused widespread damage and flash flooding in the Cowley, Byron, Penrose, and Lovell areas. Total damage was estimated at $2,475,000.

On May 15, 1978, heavy wet snow and record rains did very extensive damage to property, crops, and livestock in 12 counties (Park, Big Horn, Campbell, Converse, Crook, Johnson, Natrona, Sheridan, Washakie, Weston, Hot Springs, and Niobrara). Hundreds of homes were damaged, and many totally destroyed. Numerous bridges and sections of roads were washed out, power lines downed, with much damage to cars and personal property. Total estimated damages came to $15,500,000 (roughly $60.7 M in 2016 dollars).

In May 1988 a notable flood occurred from a winter-like storm system. It produced heavy snowfall above 6000 feet and drenching rainfall below, between 1.5 and 5.0 inches of rain fell in less than 24 hours. This flood damaged newly planted crops of beets and barley. Estimated damage to houses, washed out bridges, damaged culverts and canals, damaged roads, and other damage to irrigation works and utility lines ranged from $500,000 to more than $1 million (roughly $1-2 M in 2016 dollars). Most of the flood damage occurred in Park County, which was later declared a disaster area. At least 17 bridges or crossings were destroyed, and six roads washed away by the flood waters in Park County.

In March 1996, ice jams caused flooding in lowland areas around Greybull on the Big Horn River. Other rivers and streams in the southern part of the Big Horn Basin also had flooding due to ice jams. A one-hundred-foot-long footbridge was washed out between Ten Sleep and Manderson on March 13 on the Lower Nowood River. Flooding also occurred between Manderson and Basin, shortly after midnight on March 13. A factory on the north side of Greybull was flooded. The sewer lagoon for the city was also underwater during this time.

In March 2007 there was significant damage in the region due to ice jams. Ice built up on area rivers following very cold temperatures through February and early March. The last cold snap in early March was followed by a round of unseasonably warm temperatures that caused the ice to begin melting and to break-up on the Big Horn and Nowood rivers in Big Horn and Washakie counties. The result was ice jam flooding that impacted areas from Worland to north of Greybull on the Big Horn River, and from near Ten

Sleep to Manderson on the Nowood River. The flooding caused damage in Worland. Reported damage was $250,000 (roughly $300,000 in 2016 dollars). Flooding of two ranches occurred along the Nowood River north of Ten Sleep. The ice jams formed on several bends in the serpentine river flooding ranch lands. At least one resident evacuated their residence as the water level climbed. Reported damage was $50,000 (roughly $64,000 in 2021 dollars).

In late June 2011, following a winter with excessive snowpack, the warmest temperatures of the summer season produced snowmelt runoff in the drainages of the western Bighorn Mountains. Creeks and streams in Big Horn and Washakie counties quickly rose as a result of the increased runoff. The flood waters washed out roads and flooded residential yards. Reported damage was $100,000 (roughly $119,000 in 2021 dollars).

This extended warm period in late June 2011, also caused the high waters at the confluence of the Lamar River and Soda Butte Creek in Park County to undercut and damage a 200-foot-section of Yellowstone National Park's Northeast Entrance road. Road closures were needed to complete repairs. Reported damage was $160,000 (roughly $190,000 in 2021 dollars).

By late July 2011, excessive snowmelt runoff filled Big Horn Lake from late June through mid-July. Gusty winds combined with the already high water in the lake caused significant problems on area roads in late July. Reported damage was $351,500 (roughly $417,000 in 2021 damages).

In March 2014 ice built up on area rivers following very cold temperatures through February and early March. The last cold snap in early March was followed by a round of unseasonably warm temperatures that caused the ice to begin melting and to break-up on the Big Horn and Nowood rivers in Big Horn and Washakie counties. The result was ice jam flooding that impacted areas from Worland to north of Greybull on the Big Horn River, and from near Ten Sleep to Manderson on the Nowood River.

The flooding began on Friday morning, March 7, in Worland near the Highway 789 bridge on the west side of town. Several homes received at least minor flooding, the local radio station had to be sandbagged to protect it, and at least 80 people were evacuated. A gas pipeline also broke in Riverside Park under the weight of the massive chunks of ice that were as big as trucks. The ice jams affecting Worland gradually gave way and moved downstream on March 8, but downstream areas north to the Big Horn County line still experienced flooding for the next few days. Flooding on the Nowood River in Washakie County inundated ranch lands, corrals, and a barn, and caused at least one resident to evacuate their home.

In Big Horn County, the town of Manderson, near the confluence of the Big Horn and Nowood, was threatened for a couple of days as the ice jams moved down both rivers. One business was flooded, and water surrounded more than a few homes on March 9 and 10. At one time, water was flowing down the main street of town. Aggressive sandbagging efforts diverted water around Manderson School and the water treatment plant. Farther downstream on the Big Horn River, flooding threatened the town of Greybull. A levee system served well to protect the community and only three homes outside the levee received minor flooding. Water levels rose to within two feet of the top of the Greybull levee on March 9th. Overall, the levee performed as designed enduring the ice jamming without breach and experiencing no visible damage from the chunks and slabs of ice that had caused water levels to rise. Even where the river reached its closest point to the top of the levee, the jam itself prevented the slabs of ice, which had settled along the levee’s riverside bank, from moving and gouging into the levee embankment. The Spence Oil Field north of Greybull and other low-lying areas north of town were flooded during the ice jam episode. Total reported damage was $750,000 (roughly $846,000 in 2021 dollars).

May and June of 2015 were particularly wet months for the Region, with damaging storms in Park, Hot Springs and Big Horn Counties. The most significant event occurred on May 24, 2015. A slow-moving upper level low south of Wyoming sent waves of moisture northward over central and eastern Wyoming during the Memorial Day holiday weekend. Measured and estimated rainfall totals ranged from two to around five inches. This resulted in flooding and flash flooding in several areas. The greatest impact was felt in Hot Springs County where very heavy rains in the Wind River Canyon resulted in several mud and rockslides that closed State Highway 789 between Thermopolis and Shoshoni. The slides also damaged several sections of railroad track in the same area subsequently shutting down rail traffic. Additional slides on the west side of the Wind River Canyon destroyed several sections of railroad track that resulted in a halt of train traffic for several days. Damage reported was $1,500,000 (roughly $1.7 million in 2021 dollars).

In February 2017, flooding occurred in Region 6 due to ice jams on the Big Horn River near Worland in Washakie County. According to the National Centers for Environmental Information (NCEI) database, over 100 homes in the Worland area were evacuated as the river rose to 13.9 feet. As the ice jam moved northward into Big Horn County, the flood waters began to recede, but large blocks of ice were left behind in the flooded neighborhoods. Flooding moved northward into Big Horn County, with minor flooding reported from the town of Basin north through the Town of Greybull. Little to no property damage was reported in Big Horn County, with the hardest hit area being Worland. According to the NCEI incident log for this event, approximately $100,000 of property damage occurred.

The abbreviated flood history below (Table 4-33) was in large part derived from the monthly Storm Data reports generated and released by the National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NCEI) database. Other sources include the past event accounts from members of the Regional Steering Committee. The table represents floods that have caused damage, injuries, or loss of life. While significant damage has occurred in the Region, no injuries nor deaths have been reported. More detailed flood histories are included in each County's Annex.

Table 4-27 Flood Occurrences per County

County	Events	Period of Record
Big Horn	28	1996-2020
Hot Springs	10	1996-2020
Park	21	1996-2020
Washakie	17	1996-2020

Source: NCEI, CPT records

Frequency/Likelihood of Future Occurrence

Judging by the historical flood record for the Region, a flood of at least minimal magnitude has anywhere from a 42% to 116% chance of occurrence in a given year, depending on the county. Most of these floods were less than the 100-year flood; the chance of a 100-year flood occurring within any 30-year period is 26%. The chance of a 100-year flood occurring in any 100-year period is approximately 63%. Using the formula in Section 4.2 and the record of past events in Table 4-27, the average probability of future occurrences for a flood occurring somewhere in the of Region 6 is 79%. This corresponds to a **Likely** occurrence rating, meaning that a flood has a 10-100 percent chance of occurrence in the next year somewhere in the Region.

Changing Future Conditions

According to the 2021 Wyoming State Hazard Mitigation Plan and analysis conducted by FEMA Region VIII, flood hazard zones across the state are projected to increase in size. Intense storms and periods of heavy rain are also projected to increase in frequency across the state, which in turn could increase the frequency of flood events in Region 6.

Potential Magnitude (Extent)

Magnitude and severity can be described or evaluated in terms of a combination of the different levels of impact that a community sustains from a hazard event. Specific examples of negative impacts from flooding on Region 6 span a comprehensive range and are summarized as follows:

- Floods cause damage to private property that often creates financial hardship for individuals and families;
- Floods cause damage to public infrastructure resulting in increased public expenditures and demand for tax dollars;
- Floods cause loss of personal income for agricultural producers that experience flood damages;
- Floods cause loss of income to businesses relying on recreational uses of regional waterways;
- Floods cause emotional distress on individuals and families; and
- Floods can cause injury and death.

Floods present a risk to life and property, including buildings, their contents, and their use. Floods can affect crops and livestock. Floods can also affect lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies. The impact of a flood event can vary based on geographic location to waterways, soil content and ground cover, and construction. The extent of the damage of flooding ranges from very narrow to widespread based on the type of flooding and other circumstances such as previous rainfall, rate of precipitation accumulation, and the time of year.

The magnitude and severity of the flood hazard is usually determined by not only the extent of impact it has on the overall geographic area, but also by identifying the most catastrophic event in the previous flood history. Sometimes it is referred to as the "event of record." The flood of record is almost always correlated to a peak discharge at a gauge, but that event may not have caused the worst historic flood impact in terms of property damage, loss of life, etc. The flood of record on the Big Horn River occurred in 1923 in Hot Springs County. Highways and railroads were both out of commission. Domestic water was unavailable due to the flooding of the Town of Thermopolis' pump station. A break in the gas line to the power plant caused a town-wide loss of power. The 29,800 cfs discharge was representative of the 300-year flood.

Flooding from the Big Horn River has been reduced since the construction of Boysen Reservoir Dam. Ice jamming has caused minor damage in recent years to properties along the river.

According to the available records from the NCEI database, flooding in Region 6 over the 24 years since 1996 has caused a cumulative $5.5 million in property damage and $180,000 in crop damage. No injuries or fatalities have been recorded in Region 6 in the NCEI database. Based on the average annual losses is approximately $300,000/year, but the potential for more property damage exists as discussed in the vulnerability assessment section.

Vulnerability Assessment

People

Vulnerable populations in Region 6 include residents living in known floodplains or near areas vulnerable to flash floods. Certain populations are particularly vulnerable. This may include 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. These populations may be more vulnerable to flooding due to limitations of movement, fiscal income, challenges in receiving and understanding warnings, or unfamiliarity with surroundings.

As part of this plan's preparation, an estimate of the population exposed to flooding was created using a GIS overlay of the National Flood Hazard Layer (NFHL) on potentially flooded parcels. The NFHL used for this GIS analysis was last updated December 3, 2020. The flood-impacted population for each county in the region was then calculated by taking the number of residential units in the 1% annual chance (100-year) and 0.2% annual chance (500-year) floodplains and multiplying that number by the average household size based on the Census Bureau's American Community Survey 5-year estimates for the county. The average household factor was 2.6 in Big Horn County, 2.13 in Hot Springs County, 2.33 in Park County and 2.34 in Washakie County. The results are displayed below in Table 4-34.

Table 4-28 Population Estimate in Region 6 by Flood Hazard and Jurisdiction

	Big Horn County	Hot Springs County	Park County	Washakie County
1% Annual Chance Flood	458	190	454	164
Protected by Levee	1,763	-	-	-
0.2% Annual Chance Flood	-	202	-	295
Total Population	2,221	392	454	459

Property

GIS analysis was used to estimate Region 6's potential property and economic losses. The four county parcel layers were 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. For the purposes of this analysis, the flood zone that intersected the centroid was assigned as the flood zone for the entire parcel. In some cases, there are parcels in multiple flood zones. 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 jurisdiction, property type and flood zone. The summarized results for the Region are shown below. The summarized results for each community are shown in the tables and maps provided within each County Annex.

Table 4-35 and Table 4-36 below summarize the counts and improved value of parcels in the region, broken out by each county, that fall within the 1% or 0.2% annual chance floodplains. Additionally, Table 4-28 summarizes The table also shows loss estimate values which are calculated based upon the improved value and estimated contents value. The estimated contents value is 50% of the improved value; the total value is the sum of the improved and estimated contents values; the loss estimate is 25% of the total value based on FEMA's depth-damage loss curves. For example, a two-foot flood generally results in about 25% damage to the structure (which translates to 25% of the structure's replacement value).

Table 4-29 Region 6 Parcels at Risk to 1% Annual Chance Flood Hazard by County and Jurisdiction

County	Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
Big Horn	Basin	1	$6,353	$3,177	$9,530	$2,382
	Cowley	1	$70,555	$70,555	$141,110	$35,278
	Greybull	1	$8,153	$4,077	$12,230	$3,057
	Lovell	4	$535,819	$300,781	$836,600	$209,150
	Manderson	49	$3,712,322	$2,310,118	$6,022,440	$1,505,610

County	Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
	Big Horn Unincorporated	180	$21,934,696	$16,822,830	$38,757,526	$9,689,382
	Total	**236**	**$26,267,898**	**$19,511,537**	**$45,779,435**	**$11,444,859**
Hot Springs	East Thermopolis	14	$1,132,480	$595,783	$1,728,263	$432,066
	Thermopolis	16	$1,762,130	$1,372,222	$3,134,352	$783,588
	Hot Springs Unincorporated	74	$12,927,070	$6,955,264	$19,882,334	$4,970,584
	Total	**104**	**$15,821,680**	**$8,923,269**	**$24,744,949**	**$6,186,237**
Park	Cody	5	$1,369,950	$919,409	$2,289,359	$572,340
	Meeteetse	31	$2,723,810	$1,361,905	$4,085,715	$1,021,429
	Powell	1	$131,186	$131,186	$262,372	$65,593
	Park Unincorporated	175	$59,224,865	$32,817,279	$92,042,144	$23,010,536
	Total	**212**	**$63,449,811**	**$35,229,779**	**$98,679,590**	**$24,669,897**
Washakie	Worland	18	$7,879,408	$10,550,000	$18,429,408	$4,607,352
	Washakie Unincorporated	76	$13,564,551	$7,724,705	$21,289,256	$5,322,314
	Total	**94**	**$21,443,959**	**$18,274,705**	**$39,718,664**	**$9,929,666**
	Grand Total	**646**	**$126,983,348**	**$81,939,289**	**$208,922,637**	**$52,230,659**

Table 4-30 Region 6 Parcels at Risk to 0.2% Annual Chance Flood Hazard by County and Jurisdiction

County	Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
Hot Springs County	Thermopolis	107	$7,134,442	$4,440,011	$11,574,453	$2,893,613
Washakie County	Worland	184	$17,658,777	$14,780,838	$32,439,615	$8,109,904
	Total	**291**	**$24,793,219**	**$19,220,848**	**$44,014,067**	**$11,003,517**

Table 4-31 Region 6 Parcels at Risk to Area Protected by Levee Flood Hazard (FEMA) by County and Jurisdiction Summary

County	Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
Big Horn County	Greybull	781	$70,894,911	$41,625,341	$112,520,252	$28,130,063
	Total	**781**	**$70,894,911**	**$41,625,341**	**$112,520,252**	**$28,130,063**

Based on this analysis, the Region 6 planning area has significant assets at risk to the 1% annual chance and greater floods. There are 646 improved parcels within the 1% annual chance floodplain with a total value of $126,983,348. There are 291 improved parcels within the 0.2% annual chance floodplain, which is typically not regulated, with a total value of $24,793,219. Additionally, there are 781 improved parcels in Big Horn County which are protected by a levee, with a total improved value of $70,894,911. Overall, Region 6 counties potentially face almost $91 million in losses from flooding. Approximately $52.2 million of that is based on damage estimates from the 1% annual chance flood, with the remaining $39.1 million in damages resulting from potential flooding behind levees and the 0.2% annual chance flood. The area protected by levee is within the Town of Greybull. The Town has been proactive in its levee improvements and received funding from the FEMA Hazard Mitigation Grant Program to address issues to have the levee accredited by the NFIP to provide 1% annual chance flood protection. This accreditation was granted in 2021.

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 4-37. Critical facilities at-risk to the 0.2% annual chance flood are shown in Table 4-38.

Replacement values were not available with the data thus an estimate of potential monetary loss could not be performed. Impacts to any of these facilities could have wide ranging ramifications, in addition to property damage and other cascading impacts.

Table 4-32 Critical Facilities at Risk to 1% Annual Chance Flood Hazard by Jurisdiction and FEMA Lifeline

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn County								
Basin	-	-	2	-	-	-	1	**3**
Deaver	-	-	-	-	-	-	1	**1**
Frannie	-	-	2	-	-	-	-	**2**
Manderson	1	-	-	-	-	4	2	**7**
Unincorporated	11	1	6	-	-	-	39	**57**
Total	**12**	**1**	**10**	**0**	**0**	**4**	**43**	**70**
Hot Springs County								
East Thermopolis	-	-	-	-	-	-	1	**1**
Thermopolis	2	-	-	-	-	-	2	**4**
Unincorporated	2	-	-	-	-	-	14	**16**
Total	**4**	**0**	**0**	**0**	**0**	**0**	**17**	**21**
Park County								
Cody	4	-	-	-	-	-	1	**5**
Meeteetse	-	-	-	-	-	-	1	**1**
Unincorporated	2	-	-	-	-	1	71	**74**
Total	**6**	**0**	**0**	**0**	**0**	**1**	**73**	**80**
Washakie County								
Worland	1	-	-	-	-	-	1	**2**
Unincorporated	3	1	-	-	-	-	16	**20**
Total	**4**	**1**	**0**	**0**	**0**	**0**	**17**	**22**

Source: State Assets, HIFLD, FEMA NFHL, Wood GIS Analysis

Table 4-33 Critical Facilities at Risk to 0.2% Annual Chance Flood Hazard by Jurisdiction and FEMA Lifeline

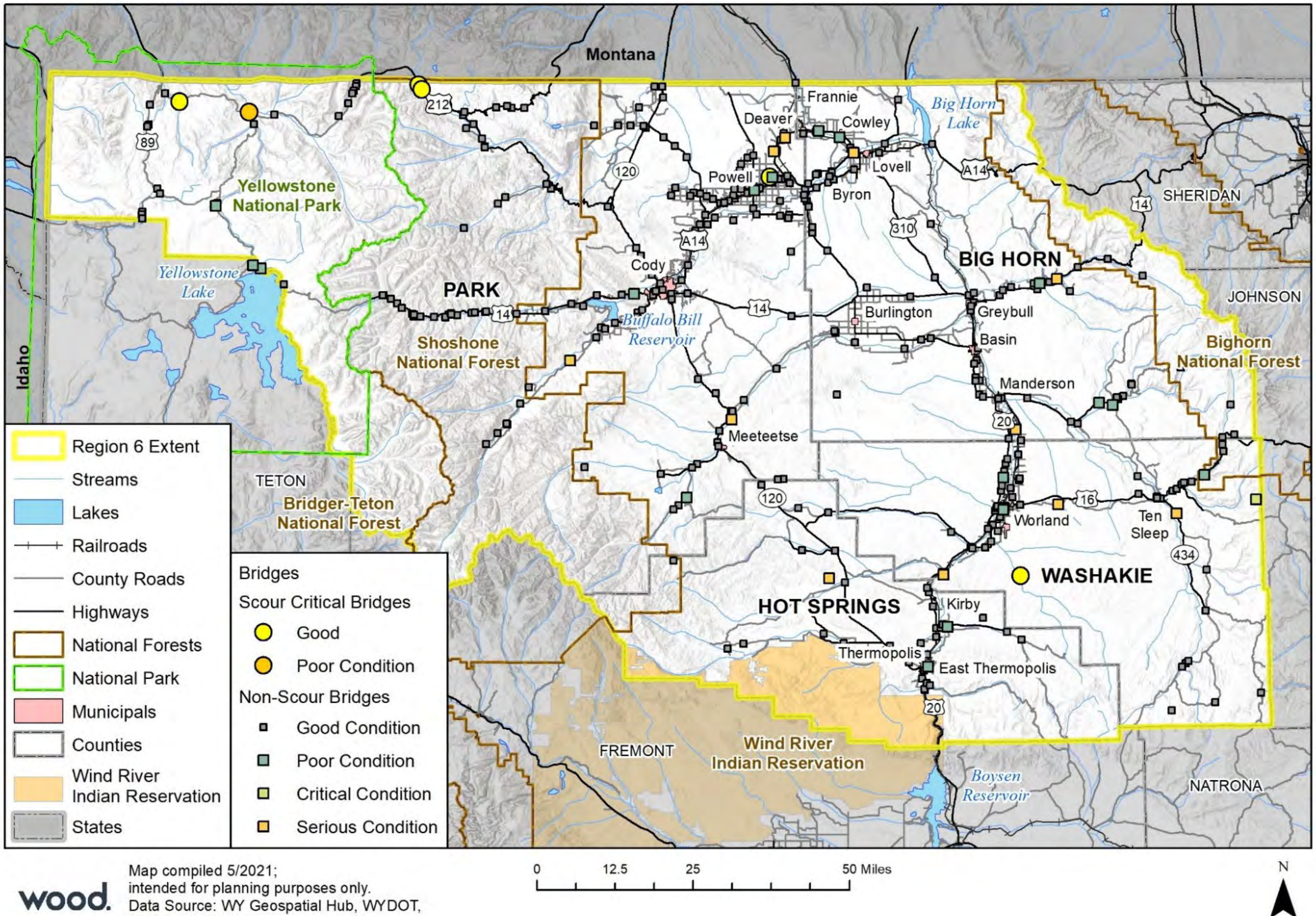
Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Hot Springs County								
Thermopolis	**5**	**-**	**-**	**-**	**-**	**2**	**-**	7
Total	5	0	0	0	0	2	0	7
Washakie County								
Worland	**4**	**7**	**-**	**-**	**-**	**1**	**1**	13
Total	4	7	0	0	0	1	1	13

Source: State Assets, HIFLD, FEMA NFHL, Wood GIS Analysis

Transportation routes could be cut off due to floodwaters, isolating portions of the planning area. These impacts may last after the floodwater recedes as flash floods commonly cause extensive damage to roadway infrastructure.

Region 6 does have a number of bridges of concern, including scour critical (a bridge with a foundation element determined to be unstable for the observed or evaluated scour condition), structurally deficient (when key components like the superstructure are inspected and rated 'poor' or worse by a bridge engineer), and functionally obsolete (when design components are outdated) facilities. Figure 4-27 shows the locations and condition of bridges throughout Region 6.

Figure 4-26 Region 6 Bridges



wood.

Map compiled 5/2021; intended for planning purposes only. Data Source: WY Geospatial Hub, WYDOT, National Bridge Inventory

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. 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.

Environmental and Cultural Resources

Natural resources are generally resistant to flooding and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in or in areas after periods of previous disasters such as drought and fire, flooding can impact the environment in negative ways. Wetlands, for example, exist because of natural flooding incidents. Areas that are no longer wetlands may suffer from oversaturation of water, as will areas that are particularly impacted by drought. Areas recently suffering from wildfire damage may erode because of flooding, which can permanently alter an ecological system. Migrating 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, 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.

Tourism and outdoor recreation are an important part of the Region’s economy. If part of the planning area were damaged by flooding, tourism and outdoor recreation could potentially suffer. Portions of the Hot Springs State Park in Thermopolis are within the floodplain, including a motel.

Development Trends

As the communities of Region 6 develop and expand in the future, mapping of the floodplain and managing growth within it will be important for reducing future flood risk. For NFIP participating communities, floodplain management practices implemented through local floodplain management ordinances should mitigate the flood risk to new development in floodplains. Lack of adequate flood hazard mapping can make it a challenge to assess risk to future development, particularly in Hot Springs County which is not mapped.

Risk Summary and Overall Significance by Jurisdiction

Overall, flooding presents a **medium-high risk** for the counties and communities of Region 6. Somewhere in the region floods every 2-7 years. Flooding has damaged homes, infrastructure (roads and bridges), and caused agricultural losses in the region in the past. Ice jam flooding has caused problems on the Big Horn River in all counties except Park. Big Horn County has levees and thus a greater risk to floods that exceed the 1% annual chance event or events that cause levee failure. Hot Springs County is provided some flood protection by Boysen Reservoir. Flood risk varies by jurisdiction and this risk is detailed further in the county annexes.

Table 4-34 Flood Hazard Risk Summary

County	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/ Severity	Overall Significance
Big Horn	Significant	Likely	Catastrophic	High
Hot Springs	Significant	Highly Likely	Limited	Medium
Park	Significant	Highly Likely	Critical	Medium
Washakie	Significant	Highly Likely	Critical	High

4.2.9 Hail

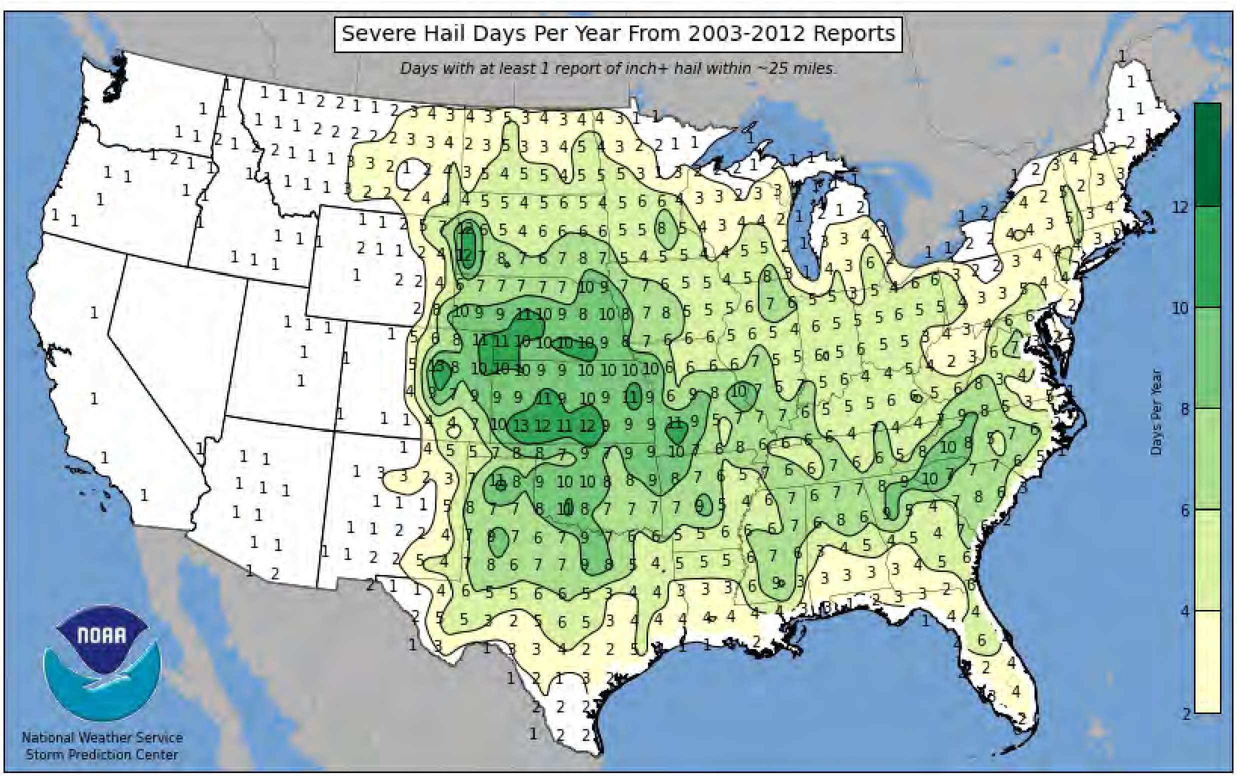
Hazard Description

Damaging hail events occur sporadically throughout Region 6, usually associated with severe summer storms and wind events. Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the backside of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are "frozen" in place, leaving cloudy ice. Hailstones can have layers like an onion if they travel up and down in an updraft, or they can have few or no layers if they are "balanced" in an updraft. One can tell how many times a hailstone traveled to the top of the storm by counting its layers. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail.

According to the NWS Storm Prediction Center, on average Region 6 experiences only one to two severe hail days a year (Figure 4-25).

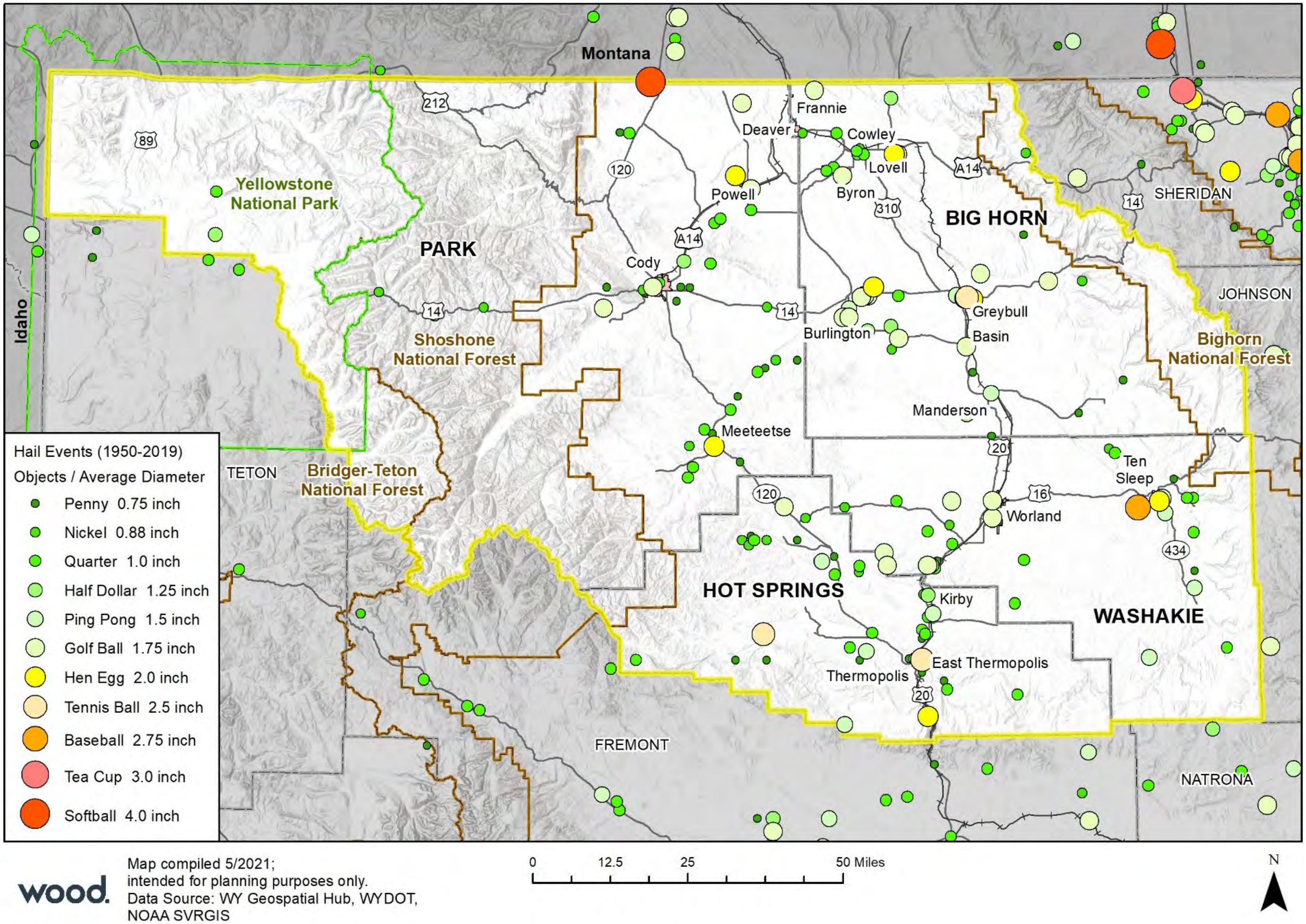
Figure 4-27 Severe Hail Days per Year (2003-2012)



Geographic Area Affected

Hail can strike anywhere in the Region. Hailstorms occur during severe storms, which are regional in nature. However, just as the amount of precipitation in the form of snow or rain may vary significantly within a single storm, so may the amount, size, and duration of hail within a severe storm. Figure 4-26 shows the location past hail events in the region.

Figure 4-28 Past Hail Events in Region 6 1950-2019



Past Occurrences

Climatologically, Wyoming averages five to nine days of hail annually. A summary of the history of damaging hailstorms historically affecting the counties in Region 6 is included in Table 4-38 and events that have caused impacts are listed in Table 4-39. The data was derived from the NCEI Storm Events Database from 1955 and 2019. There has been one USDA Disaster Designation in 2018 related to hail that impacted Big Horn, Park and Washakie counties.

The NCEI records any hail events with hailstones that are .75 inch or larger in diameter, or any hail of a smaller diameter which causes property and/or crop damage, or casualties. According to the NCDC definition, there have been 163 separate hail incidents affecting at least one of the four counties in the region since 1955. The cumulative hail incidents had a total recorded property damage of $1,724,000 and a total recorded crop damage of $1,355,500. No deaths and one injury have been associated with these storms in the region during this timeframe. During 2021 planning meetings each CPT noted that the NCEI numbers and losses seemed low from their perspective.

Table 4-35 Summary Hail History, Region 6

County	Incidences	Property Damage	Crop Damages	Deaths	Injuries
Big Horn	30	$89,000	$310,500	0	1
Hot Springs	51	$1,020,000	0	0	0
Park	49	$585,000	$1,020,000	0	0
Washakie	33	$30,000	$25,000	0	0
Total	**163**	**$1,724,000**	**$1,355,500**	**0**	**1**

Table 4-36 Region 6 Hail History with Impacts 1955-2019

County	Location	Date	Time	Hail Size	Deaths	Injuries	Property Damage	Crop Damage
Park	-	07/20/1995	14:00	0.00	0	0	$50,000	$0
Park	Cody	07/01/1998	13:43	1.75	0	0	$35,000	$0
Park	Powell	06/09/2000	12:40	1.75	0	0	$500,000	$0
Big Horn	Lovell	06/14/2006	12:25	2.00	0	0	$12,000	$500
Big Horn	Lovell	06/14/2006	12:25	1.75	0	0	$12,000	$275,000
Park	Meeteetse	06/05/2009	16:25	1.00	0	0	$0	$20,000
Big Horn	Burlington	08/07/2009	15:44	1.25	0	0	$0	$25,000
Big Horn	Greybull	08/07/2009	16:10	2.00	0	1	$75,000	$0
Big Horn	Greybull	08/07/2009	16:17	2.00	0	0	$2,000	$0
Washakie	Ten Sleep	08/30/2010	12:57	1.50	0	0	$20,000	$25,000
Park	Ralston	07/30/2013	17:15	0.50	0	0	$0	$1,000,000
Big Horn	Hyattville	08/01/2013	15:41	0.75	0	0	$0	$10,000
Hot Springs	East Thermopolis	06/16/2015	13:22	2.00	0	0	$20,000	$0
Hot Springs	Anchor Reservoir	7/1/2019	12:15	2.25	0	0	$1,000,000	$0
				Total	**0**	**1**	**$1,726,000**	**$1,355,000**

Source: National Center for Environmental Information

Historically, 14 of the 163 NCEI recorded incidents had some level of recorded impact. While most storms don't have much impact, history shows a few outliers, summarized below:

On June 9, 2000, a severe thunderstorm produced a swath of large hail from the Cody area northeast to Powell and into extreme northwest Big Horn County. The largest hail fell in the vicinity of Powell, with official reports of golf ball size hail, and unofficial reports of softball size hail. Preliminary crop damage estimates were expected to reach in the millions of dollars. Severe damage to sugar beet, barley and bean crops was experienced. NCDC recorded $500,000 in property damage due to this storm.

On June 14, 2006, a severe thunderstorm developed quickly near Byron and tracked northeast over Lovell toward the Bighorn Canyon National Recreation Area. Large hail of around two inches in diameter fell five to six miles east of Lovell, where two homes sustained roof and siding damage. Approximately 900 acres of sugar beets, over 100 acres of corn, and about 40 acres of alfalfa were destroyed by the large hail.

On July 30, 2013, a strong storm developed over the northern Absaroka Mountains and moved east across open country in northern Park County. The storm produced 50 mph wind, one-half inch diameter hail, and a little more than one-half inch of rain. Extensive crop damage occurred in the Powell Valley north of Ralston to areas near Garland. A combination of hail, wind and rain caused extensive damage to crops in the Powell Valley. Most of the damage occurred to barley, but beans and beets were also impacted. NCDC records $1 million in damage to crops for this storm.

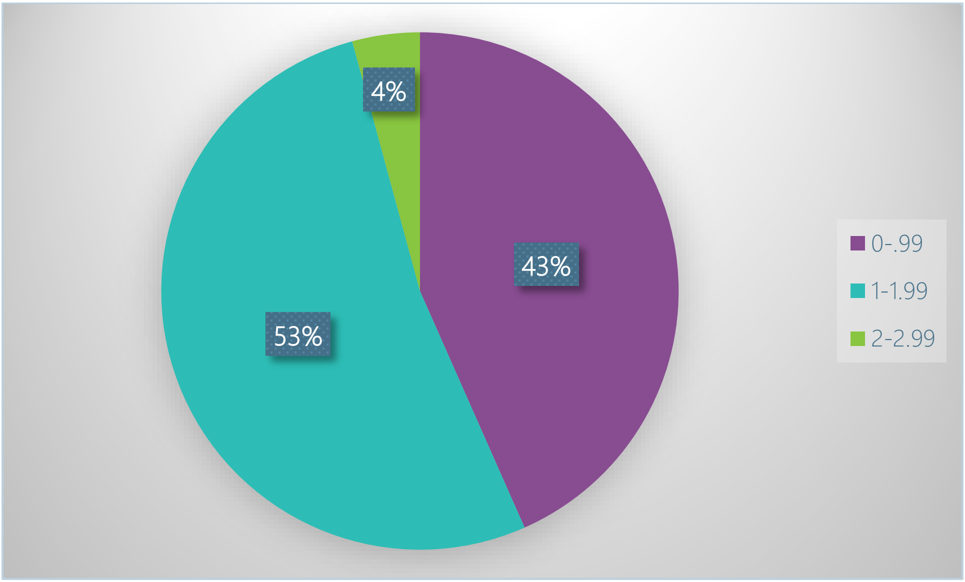
On June 16, 2015, thunderstorms erupted during the early afternoon as an upper-level disturbance passed over the area and combined with the moist, upslope flow north of the boundary. The favorable wind profile enabled one thunderstorm to become a supercell as it moved east-southeast across Hot Springs County. Two-inch diameter hail fell in the Wind River Canyon knocking out windows in vehicles traveling State Highway 789.The storm produced large hail which damaged car windows in the Wind River Canyon south of Thermopolis.

On July 1, 2019 a storm developed over the Lee of the Absarokas and quickly became severe as it moved eastward into Hot Springs County. On a long path there were numerous reports of golf ball sized hail, with a maximum size of over two inches in diameter at Hot Springs State Park, just east of Thermopolis, Wyoming. There were numerous reports of broken windows on homes and cars as well as damaged siding in the Town of Thermopolis.

Frequency/Likelihood of Future Occurrences

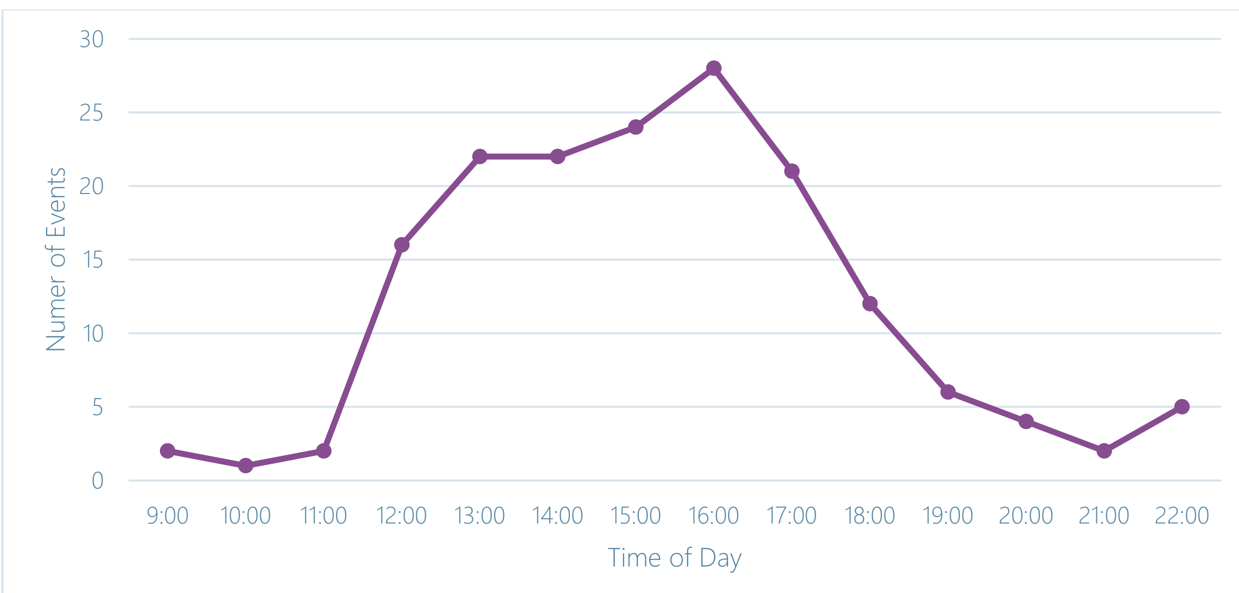
Region 6 has experienced 163 separate hail incidents over 64 years; this correlates to 2.4 incidents or a 39 percent chance of an event somewhere in the region each year. Based on historical data, an average hail event in the Region occurs in between June and August, somewhere between 12 p.m. and 5 p.m. It drops hail with a diameter less than two inches. While most historical hailstorms in the Region don't result in major damage, recordable damage to property and crops could be in the hundreds of thousands of dollars, with up to $1 million in crop damage recorded. Insured loss related to hailstorms could be in the millions, depending on the location and parameters of the storm.

Figure 4-29 Hail Incidents by Hail Diameter Region 6 1955-2020



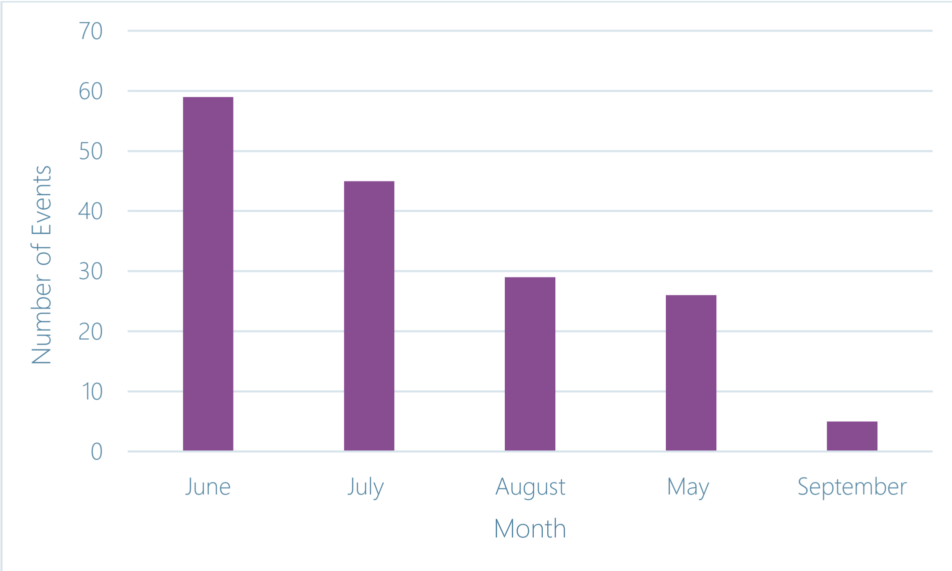
Source: National Center for Environmental Information

Figure 4-30 Time of Day Hail Events in Region 6 1955-2020



Source: National Center for Environmental Information

Figure 4-31 Month of Occurrence - Hail Events in Region 6 1955 to 2015



Source: National Center for Environmental Information

Changing Future Conditions

As the atmosphere warms further due to climate change, the increased heat in the atmosphere provides more energy for severe storms. The frequency of severe weather events has increased steadily over the last century. The number of weather- related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate. The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

Potential Magnitude (Extent)

Severe hailstorms can be quite destructive to property and crops. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans and occasionally has been fatal. The incident of record for crop damage occurred July 30th, 2013 in Park County. The storm caused extensive crop damage in the Powell Valley, with most damage to barley crop, beets and beans. Damages were estimated at $1 million.

The National Weather Service (NWS) classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4 33 indicates the hailstone measurements utilized by the NWS. There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground. Multi-cell thunderstorms produce many hailstones, but not usually the largest hailstones. In the life cycle of the multi-cell thunderstorm, the mature stage is relatively short so there is not much time for growth of the hailstone. Supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud. In general, hail 2 inches (5 cm) or larger in diameter is associated with supercells (a little larger than golf ball size which the NWS considers to be 1.75 inch.). Non-supercell storms are capable of producing golf ball size hail.

Hail up to 2.75 inches in diameter has been recorded by the NCEI in the Region (Washakie County, 1978). The incident of record occurred in Park County near Powell on June 9th, 2000. Hail up to 1.75 inches in diameter caused $500,000 in property damage. Softball sized hail was reported, but unconfirmed.

Table 4-37 National Weather Service Hail Severity

Severity	Description	Hail Diameter Size (in inches)
Non-Severe Hail Does not typically cause damage and does not warrant severe thunderstorm warning from NWS.	Pea	1/4"
	Marble/mothball	1/2"
	Penny	3/4"
	Nickel	7/8"
Severe Hail Research has shown that damage occurs after hail reaches around 1” in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from NWS.	Quarter	1" (severe)
	Half Dollar	1 1/4"
	Walnut/Ping Pong Ball	1 1/2"
	Golf Ball	1 3/4"
	Hen Egg/Lime	2"
	Tennis Ball	2 1/2"
	Baseball	2 3/4"
	Teacup/Large Apple	3"
	Softball	4”
	Grapefruit	4 1/2"

Source: National Weather Service

Vulnerability Assessment

People

Exposure is the greatest danger to people from hail, for those caught outside in the open without shelter. Large hail has the potential to cause significant bruising, concussions, the potential for broken bones, and even death. The impacts of hail on vulnerable populations can be more severe. People without shelter can also be injured by exposure to hailstorms, though there is very little historical reference for this occurring in the Region. Most injuries caused by hail are minor and go unreported.

Property

Hail can strike anywhere in the region, and all structures are vulnerable. Hail can damage roofs, shingles, windows, siding, unsheltered vehicles and any other property unprotected from the storm. Hail causes more than a billion dollars of property damage nationally each year. Most of this damage is to crops, but hail can also decimate structural sidings, shatter windows, peel paint, and severely damage automobiles and equipment not protected or stored inside. The Regional Steering Committee noted that hail has caused damages to vehicles traveling along interstates in the Region.

Critical Facilities and Lifelines

Hail can lead to the temporary incapacitation of roads when small hail stones build up so deep, they block roads. Hail has also been observed to block storm drains and prevent proper runoff, potentially resulting in flooding as a secondary hazard. Most structures, including the Region’s critical facilities, should be able to provide adequate protection from hail but the structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Economy

The economic impact from hail can be severe on impacted areas, and potentially long lasting. As mentioned throughout this section, hail is the costliest hazard experienced in the planning area. Direct damages have totalled $1 million over the last 64 years, but severe indirect economic impacts can also be felt through businesses forced to close for repairs. A review of the USDA Risk Management Agency records shows between 2007 and 2020 the Region has had a total of $6,418,507 indemnity payments for a total 64,639,983 acres lost to hail. The estimated average annualized losses due to hail is $493,731.

Environment and Cultural Resources

While hail is a natural environmental process, it can cause significant environmental damage, breaking tree limbs, damaging trees and other plants in bloom, and destroying crops. Some cultural and historic properties may also potentially be at risk of damage from hail.

Development Trends

Hail can strike anywhere in the Region, so any growth or new development in the counties will increase exposure to hail damage. Insurance will be an important tool to offset the potentially substantial dollar losses associated with hail.

Risk Summary and Overall Significance by Jurisdiction

The counties in Region 6 will continue to experience on an annual basis. During the 2021 plan update Hot Springs adjusted the significance rating from Low to High based on recent storms and an uptick in events. Hail damage to property is expected to be highest in the municipalities; much of the damage to both property and crops is covered under insurance policies.

Table 4-38 Hail Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Significant	Highly Likely	Critical	High
Hot Springs	Limited	Highly Likely	Critical	High
Park	Limited	Highly Likely	Critical	High
Washakie	Limited	Highly Likely	Limited	Medium

4.2.10 Hazardous Materials

Hazard/Problem Description

Generally, a hazardous material is a substance or combination of substances which, because of quantity, concentration, or physical, chemical, or infectious characteristics, may either (1) cause or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous material incidents can occur while a hazardous substance is stored at a fixed facility, or while the substance is being transported.

The U.S. Department of Transportation, U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) all have responsibilities with regards to hazardous materials and waste. The Emergency Planning and Community Right-to-Know Act (EPCRA) requires certain regulated entities to report information about hazardous chemicals and substances at their facilities to federal, state, and local authorities. The objective is to improve the facilities, or government agency's ability to plan for and respond to chemical emergencies, and to give residents information about chemicals present in their communities. EPCRA also mandates the creation of State Emergency Response Commissions (SERCs) and Local Emergency Planning Committees (LEPCs). The Right to Know Network (RTK NET) is a primary source of information on the use and storage of hazardous materials, as well as data regarding spills and releases.

The U.S. Department of Transportation has identified the following classes of hazardous materials:

- Explosives
- Compressed gases: flammable, non-flammable compressed, poisonous
- Flammable liquids: flammable (flashpoint below 141 degrees Fahrenheit) combustible (flashpoint from 141 - 200 degrees)
- Flammable solids: spontaneously combustible, dangerous when wet
- Oxidizers and organic peroxides
- Toxic materials: poisonous material, infectious agents
- Radioactive material
- Corrosive material: destruction of human skin, corrodes steel

Region 6 is home to several gas plants, refineries and mines, and numerous pipelines and rail lines run across the Region, creating a likely potential for hazardous materials releases.

It is also common to see hazardous materials releases as escalating incidents resulting from other hazards such as floods, wildfires, and earthquakes. The release of hazardous materials can greatly complicate or even eclipse the response to the natural hazards disaster that caused the spill.

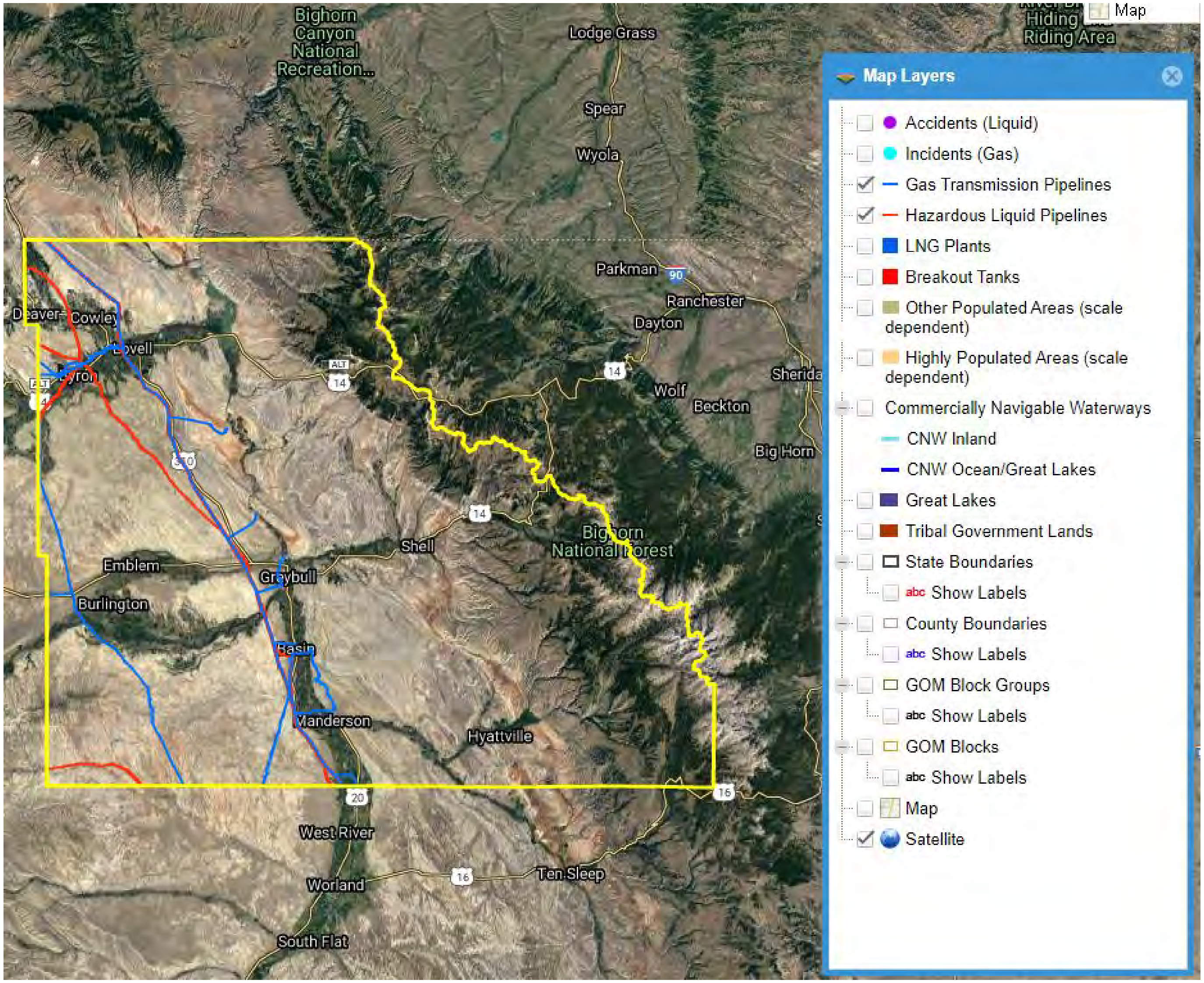
Geographical Area Affected

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. Some facilities contain extremely hazardous substances; these facilities are required to generate Risk Management Plans (RMPs) and resubmit these plans every five years. According to the Right-to-Know network database, there is 1 such facility in Big Horn County, 6 in Park County, and 3 in Washakie County. RMP facility information can be found within individual county annexes. During the 2021 planning process it was noted that each county also has access to an online propriety database of Tier II facilities that is updated regularly. The CPT's noted the following regarding facilities and incidents during the 2021 planning process:

- Park CPT noted concerns with oilfield chemicals in Elk Basin, a fertilizer plant near Powell, 2 gas processing plants, and a propane distributor near the airport. Pharmaceutical production in Cody shut down in 2020, mitigating a potential hazard.
- Big Horn CPT noted concerns with oil company pipelines in the county that sometimes leak into ditches and the Shoshone River
- Washakie CPT noted a commodity flow study that was being finalized
- Washakie noted concern for gas facility 2 mi S of Boys School

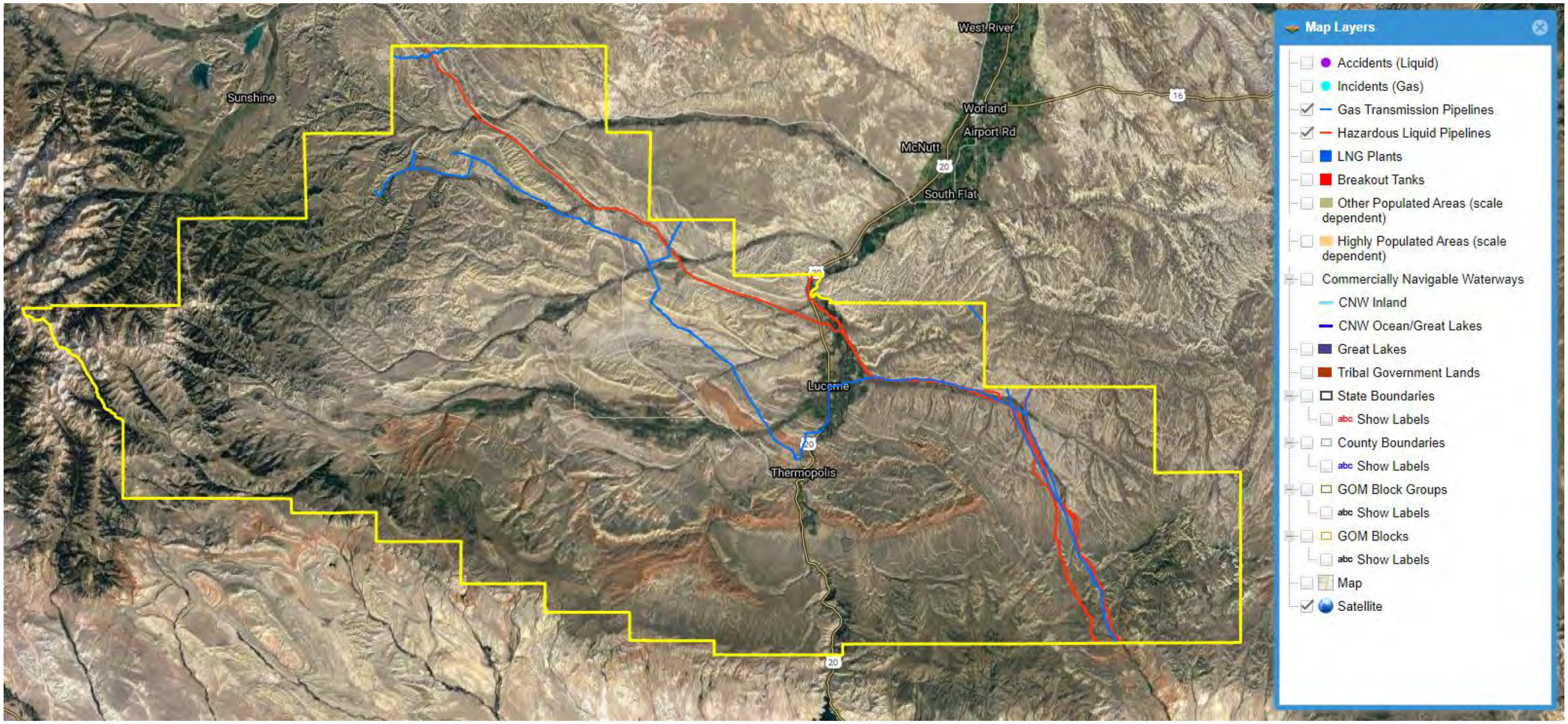
In transit, hazardous materials generally follow major transportation routes, including road, rail and pipelines, creating a risk area immediately adjacent to these routes. Information provided by the National Pipeline Mapping System (NPMS) indicate several pipelines conveying gas or hazardous liquids cross the planning area, these are shown in Figure 4-33 through Figure 4-36 below. Pipeline ruptures can result in major spills, or even explosions.

Figure 4-32 National Pipeline Mapping System, Big Horn County



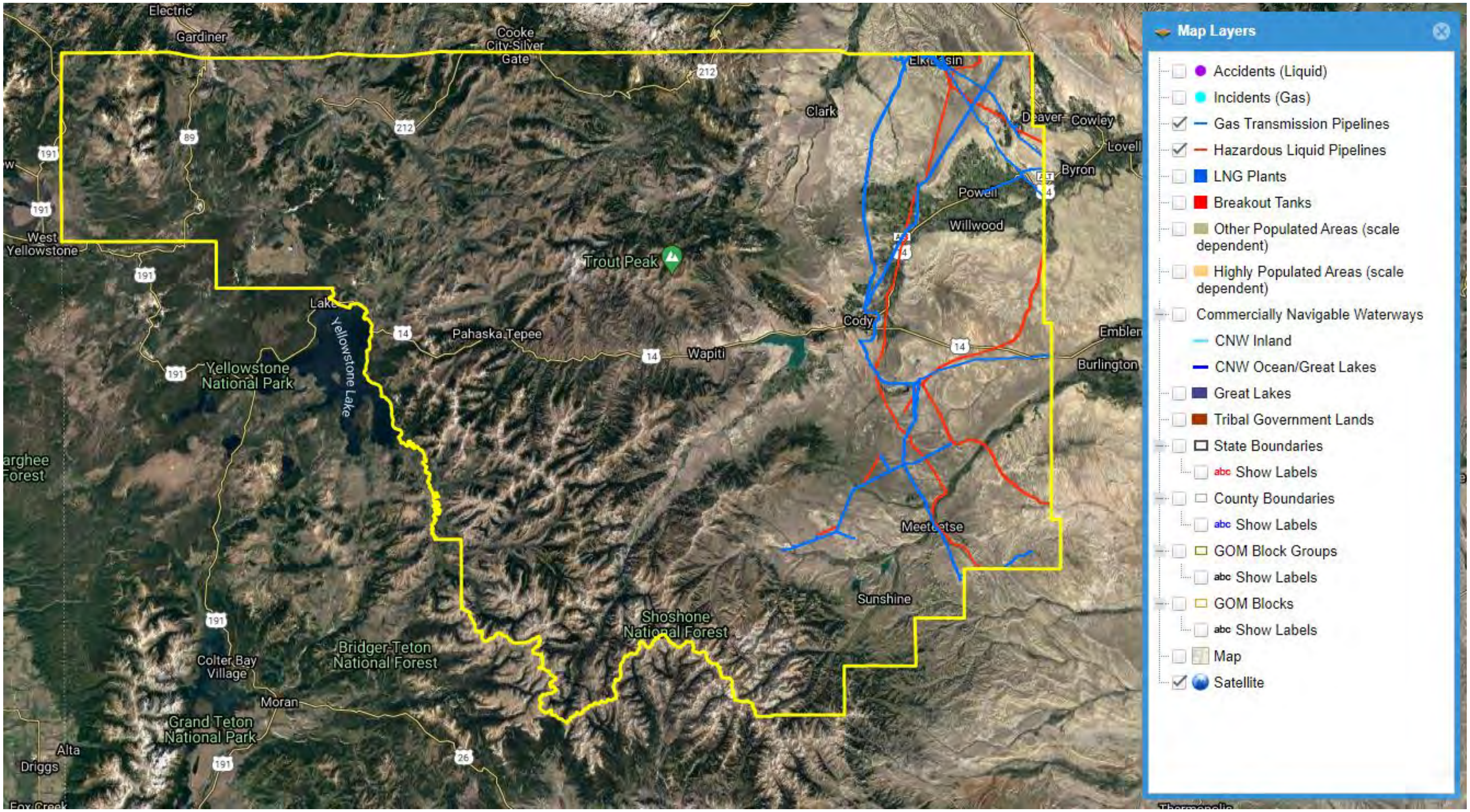
Source: National Pipeline Mapping System

Figure 4-33 National Pipeline Mapping System, Hot Springs County



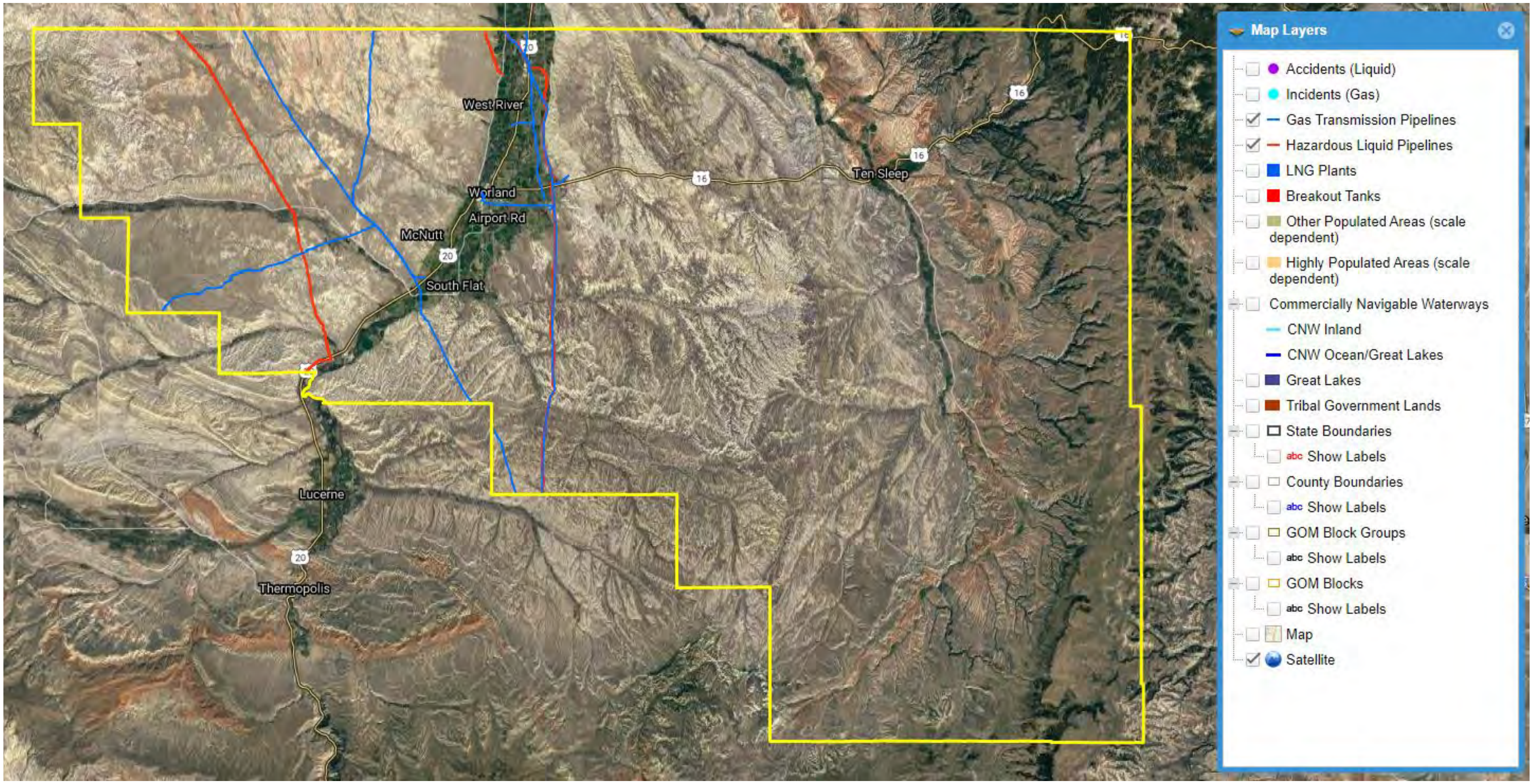
Source: National Pipeline Mapping System

Figure 4-34 National Pipeline Mapping System, Park County



Source: National Pipeline Mapping System

Figure 4-35 National Pipeline Mapping System, Washakie County



Source: National Pipeline Mapping System

Past Occurrences

There are a variety of mechanisms to get an idea of the number and types of historical hazardous materials spills in the 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 2019 there were 411 incidents reported across the 4 counties which make up Region 6. (http://www.rtknet.org/db/erns)

According to the data, during the time period between 2014 and 2019 the Region saw anywhere from 2-12 NRC-reported incidents per year, which means that each county can reasonably expect multiple hazardous materials responses annually. The county data is further broken down in the table below:

Table 4-39 NRC-Reported Incidents by County: 2014-2019

	2014	2015	2016	2017	2018	2019	6-Year Total
Big Horn	1	1	0	0	1	1	7
Hot Springs	1	0	1	0	5	0	7
Park	6	3	4	2	6	1	22
Washakie	2	0	2	0	0	0	4

Source: National Response Center Incident Report Database

According to the NRC site, the incident types with the highest rates of reports included fixed-site incidents, pipeline incidents, railroad incidents and mobile incidents. Small-level hazardous materials incidents occur frequently throughout Region 6 and these numbers of past events almost certainly exclude a number of these very small spills which go unreported to the NRC.

In addition to local first responders, eight Regional Emergency Response Teams (RERT) across the State of Wyoming respond to a variety of incidents, including those incidents involving hazardous materials. The Region 6 RERT is located in Worland, in Washakie County.

The Hot Springs CPT in 2021 noted that a spill from a train incident near Kirby in the late 1980's had men in hazmat suits cleaning up for 2 days.

Frequency/Likelihood of Future Occurrence

Each county in the Region experiences multiple hazardous materials incidents each year, with various degrees of impact; there is a 100% chance that the counties in the Region will see a hazardous materials incident in any given year. Hazardous material spills and releases, both from fixed facilities and during transport, will continue to occur in each county in Region 6 annually.

Changing Future Conditions

Changes in future conditions are unlikely to impact the rates of occurrence for human-caused hazards, such as hazardous material incidents. However, 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 releases from transportation incidents.

Potential Magnitude (Extent)

Impacts 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

Numerous factors go into the ultimate 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 difficult to nail down precise impacts. Materials found in Region 6 will have at least one of the impacts listed above, and probably more.

Vulnerability Assessment

The counties in Region 6 contain energy pipelines, railroad tracks which carry many types of hazardous materials, and state highways running through the counties. 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.

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 and hospitalization, 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.

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 significant, 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

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities.

There are 10 RMP facilities located in four counties in Region 6, as noted in Table 4-46 below. Hot Springs County does not have any listed RMP facilities. Some of these are discussed in more detail in the County Annexes.

Table 4-40 RMP Facilities in Region 6

County	Community	Number of Facilities
Big Horn	Byron	1
Hot Springs	N/A	0
Park	Powell	4
	Meeteetse	2
Washakie	Worland	3
	Total	10

Source: http://www.rtknet.org/db/erns

Economy

The primary economic impact of hazardous material incidents result in lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and recreationists too. If incidents occur along major transportation corridors, they can temporarily close routes and result in traffic delays. Economic effects from major transportation corridor closures can be significant.

Environment and Cultural 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 the municipal 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 Merced County.

Development Trends

Future development is expected to increase the number of people potentially exposed to the impacts of hazardous materials incidents. The amount of hazardous materials that are stored, used, and transported across the County may continue to increase over the coming years if regional growth continues. However, according to the 2021 Wyoming State Hazard Mitigation Plan, the number of hazardous materials incidents occurring annually have been trending downward since a statewide peak in 2005.

Risk Summary and Overall Significance by Jurisdiction

Table 4-41 Hazardous Materials Hazard Risk Summary

County	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Significant	Occasional	Critical	Medium
Hot Springs	Significant	Likely	Limited	High
Park	Limited	Likely	Limited	Medium
Washakie	Limited	Likely	Limited	Medium

4.2.11 Winds and Downbursts

Hazard Description

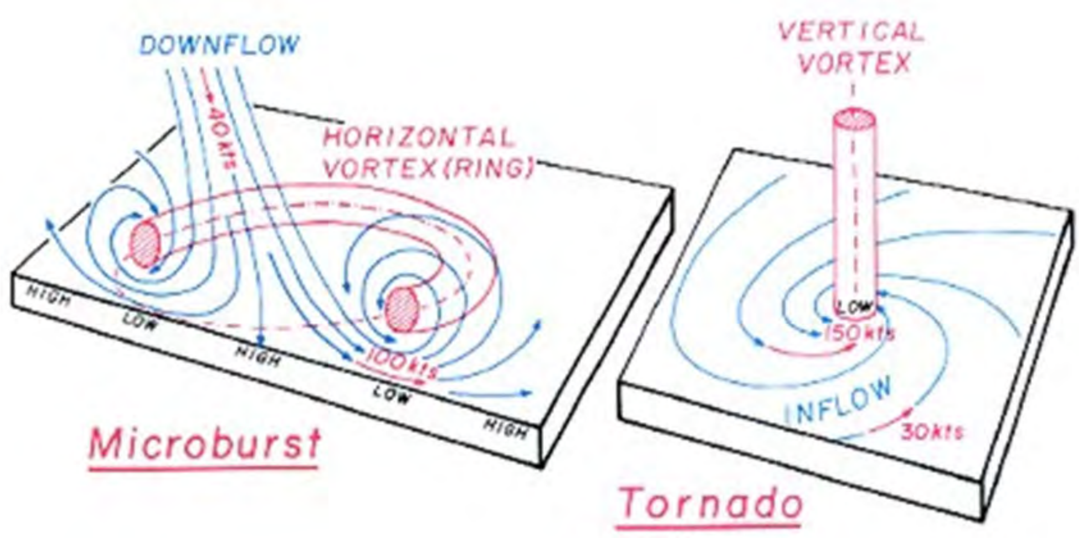
Wind, because of its constant presence in Wyoming, can be overlooked as a hazard. Upon analysis, wind can be a damage-inducing hazard and warrants review in Region 6. Wyoming's wind is also becoming an economic factor as renewable wind energy is developed around the state. High winds exacerbate snow conditions and cause road conditions to deteriorate

This profile examines the hazard that high winds present including downbursts, a subcategory of high winds. A downburst is a strong down draft which causes damaging winds on or near the ground. Downbursts are much more frequent than tornadoes, and for everyone tornado there are approximately 10 downburst damage reports. Downbursts can be associated with either a heavy precipitation or non-precipitation thunderstorm (dry or wet downbursts), and often occur in the dissipating stage of a thunderstorm. Microbursts and macrobursts are categories of downbursts, classified by length of duration, velocity of wind, and radius of impact.

Microbursts generally last between five and 15 minutes and impact an area less than three miles wide. Macrobursts can last up to 30 minutes with winds up to 130 miles per hour and can impact areas larger than three miles in radius. Microbursts and macrobursts may induce dangerous wind shears, which can adversely affect aircraft performance, cause property damage and loss of life.

A downburst can occur when cold air begins to descend from the middle and upper levels of a thunderstorm (falling at speeds of less than 20 miles an hour). As the colder air strikes the Earth's surface, it begins to 'roll' outward. As this rolling effect happens, the air expands causing further cooling and having the effect of pulling the shaft of air above it at higher and higher speeds.

Figure 4-36 Schema of Microburst and Tornado



Source: www.erh.noaa.gov

Downbursts can be mistaken for tornadoes by those that experience them since damages and event characteristics are similar. Tornado winds can range from 40 mph to over 300 mph. Downbursts can exceed winds of 165 mph and can be accompanied by a loud roaring sound. Both downbursts and tornadoes can flatten trees, cause damage to homes and upend vehicles. In some instances, aerial surveying is the best method to determine what kind of event has taken place.

Figure 4-37 Aerial Image of Downburst Damage

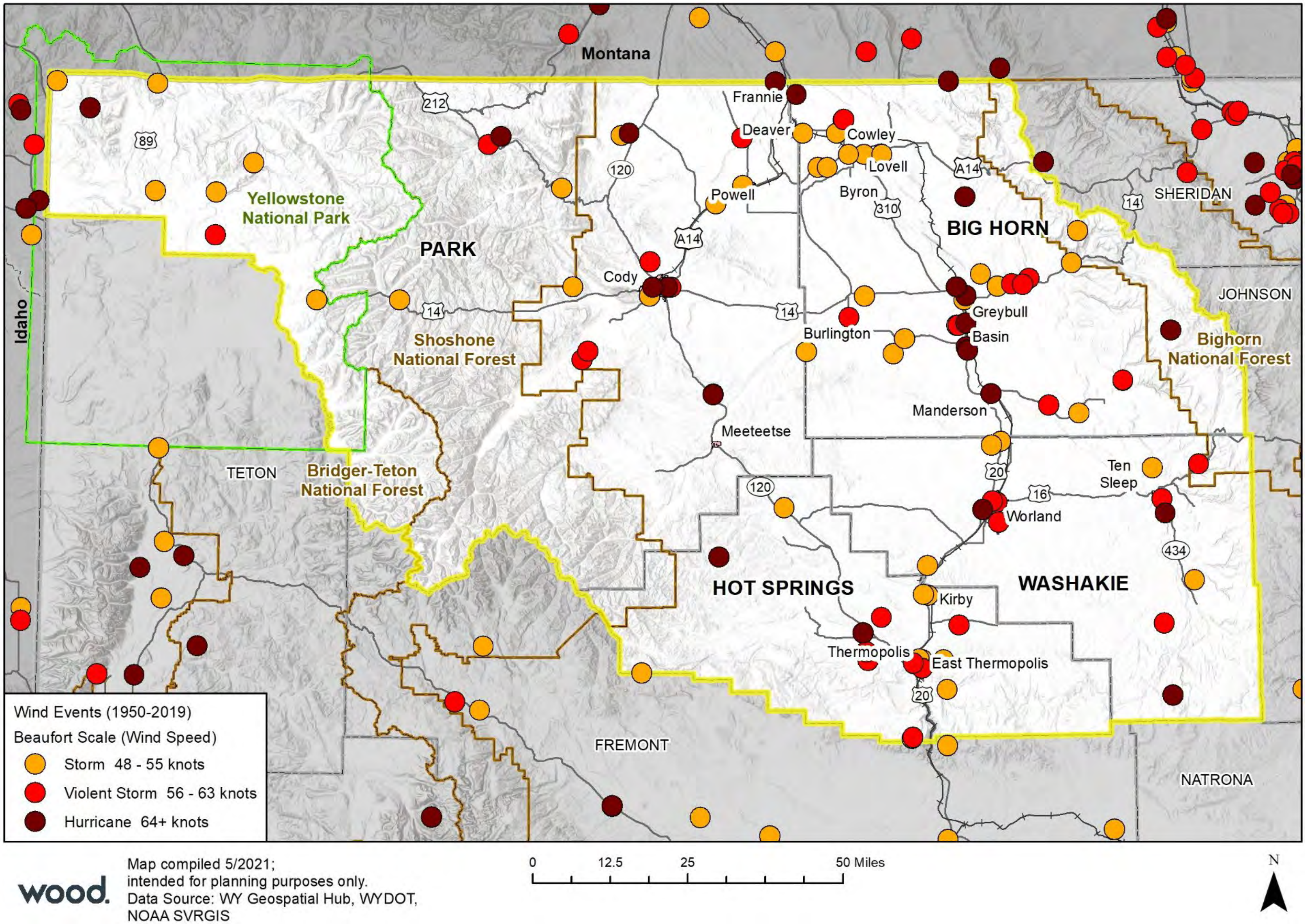
Source: T. Fujita

In this photograph, trees are blown down in a straight line - a very strong indication of a downburst as opposed to a tornado.

Geographical Area Affected

All counties in the Region can experience damaging wind events. Park County in particular has areas along the eastern front of the Absaroka Range that are susceptible to strong downslope winds. The Park County planning team noted that winds along the mountain from Clark to Meeteetse are especially strong, especially the Clark area, which experiences very high winds. Shows the locations of past events in the Region.

Figure 4-38 Past Wind Events in Region 6 1950-2019



Past Occurrences

In the counties in Region 6, most documented wind events causing damage typically range between 58 and 88 mph; max wind speeds of up to 110 mph have been recorded. It should be noted that the data is limited by what the NCEI is able to record, and what equipment was in place at the time, and that the timespan of available records for each county differs. The county planning teams noted that high winds are a consistent issue in the four counties.

NCEI also records wind damage on a zonal basis; while these zones show up in search results, they are not always tied to specific counties. NCEI records an additional 348 wind incidents from 1996 to 2020 in these zones. The zones may contain multiple counties, both within and outside the regional boundaries.

Table 4-42 Summary of Wind Weather Events and Impacts

Region 6 (1962-2020)						
Total Number of High Wind Events	**Total Property Damage**	**Total Crop Damage**	**Total Fatalities**	**Total Injuries**	**Average Recorded Wind Speed**	**Max Recorded Wind Speed**
514	$992,200	$1.001M	1	6	72 mph	127 mph
Big Horn County (1975-2020)						
51	$341,200	$1M	0	1	53 mph	78 mph
Hot Springs County (1975-202019)						
27	$3,000	$0	0	0	64 mph	70 mph
Park County (1964-2020)						
44	$30,000	$0	0	0	66 mph	82 mph
Washakie County (1962-2020)						
44	$90,200	$1M	0	1	52 mph	74 mph
Zonal Incidents (1996-2020)						
348	$727,000	$0	2	5	63 mph	110 mph

Source: NCEI

Damages recorded by the NCEI for the county include downed power lines, torn off roofs and building damage, and downed tree limbs and debris.

Specific examples from high wind incidents that caused damages or casualties include:

- **Park County, November 1999** – Strong gusty crosswinds caused a two-vehicle accident between Cody and Meeteetse on WY Highway 120; one fatality and one injury was recorded.
- **Big Horn County, June 2006** – A severe thunderstorm cut a path of damage more than 60 miles long across Park and Big Horn Counties. Damaging wind was responsible for snapping seven power poles along U.S. Highway 14A east of Lovell. A storm damage survey revealed numerous trees snapped mid-trunk in the Bighorn Mountain foothills.
- **Hot Springs County, July 2009** – Microburst winds of 50 to 60 mph uprooted a 50-foot cottonwood tree and blew a one-inch diameter branch about 50 feet into Hot Springs State Park. The wind was also responsible for moving a metal shed across a street near the Hot Springs County fairgrounds.
- **Washakie County, July 2013** – Wind gusts estimated at 60 mph combined with one-half inch diameter hail to devastate barley and corn fields in northern Washakie County. There were a few cottonwood trees downed by the wind, one of which fell across State Highway 433. The same thunderstorm caused one irrigation ditch to fill quickly and produce minor flooding of a nearby road. The storm caused $1 million in damage to crops.
- **Park County, February 2015** - The Town of Meeteetse water system was shut down by a power failure that lasted a week. The town purchase a generator in response to this event.
- **Big Horn County, May 2018** - Very strong winds developed along a line from Manderson northward to Greybull. At the Greybull airport, a wind gust of 78 mph was recorded before the power failed. In

Basin 15 to 20 trees were downed or uprooted, some falling on houses and power lines. In addition, a roof was blown off of a building and a power pole was snapped. In Greybull, numerous trees were uprooted. One tree fell on a house, causing some structural damage. Another tree was uprooted at a motel. Total property damages were estimated to be $75,000.

The Washakie CPT noted the Norco building lost siding in 2020 event and that roof replacements have been required after some wind events. The Hot Springs CPT noted damage to cottonwood trees in the Hot Springs State Park and wanted to change the severity rating from Negligible to Limited, and overall significance for each jurisdiction from Low to Medium.

Frequency/Likelihood of Future Occurrences

The NCEI Strom Events Database records 514 confirmed and documented high wind incidents specifically impacting the Region since 1962. This means that the region can expect multiple high wind incidents each year. The Region experiences an average of six significant high wind events per year somewhere in the four counties, with a damaging event being recorded by NCEI approximately once every 1.3 years. Based on the best available data, incidence of recorded events appears to spike between May and September, with another spike in January.

Changing Future Conditions

There presently is not enough data or research to quantify the magnitude of potential change that changing future conditions may have on windstorms. Future updates to the mitigation plan should include the latest research on how the windstorm hazard frequency and severity could change. The level of significance of this hazard should be revisited over time.

Potential Magnitude (Extent)

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Windstorms in the Region are rarely life threatening, but do disrupt daily activities, cause damage to buildings, and structures, and increase the potential for other hazards, such as wildfire. Winter winds can also cause damage, close highways (blowing snow), and induce avalanches. Winds can also cause trees to fall, particularly those killed by pine beetles or wildfire, creating a hazard to property or those outdoors.

Damaging wind is measured using the Beaufort Wind Scale as shown in Table 4-50. This scale only reflects land-based effects and does not take into consideration the effects of wind over water. Winds up through Beaufort 12 can be experienced in the Region.

Table 4-43 Beaufort Wind Scale

Beaufort Number	Description	Windspeed (MPH)	Land Conditions
0	Calm	<1	Calm. Smoke rises vertically.
1	Light air	1 – 3	Wind motion visible in smoke.
2	Light breeze	3 – 7	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	8 – 12	Leaves and smaller twigs in constant motion.
4	Moderate breeze	13 – 17	Dust and loose paper raised. Small branches begin to move.
5	Fresh breeze	18 – 24	Branches of a moderate size move. Small trees begin to sway.

Beaufort Number	Description	Windspeed (MPH)	Land Conditions
6	Strong breeze	25 – 30	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	High wind, Moderate gale, Near gale	31 – 38	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	Gale, Fresh gale	39 – 46	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9	Strong gale	47 – 54	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	Storm, Whole gale	55 – 63	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	Violent storm	64 – 72	Widespread vegetation damage. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	Hurricane	≥ 73	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.

Source: National Oceanographic and Atmospheric Association

Vulnerability

Vulnerability as it relates to location is mostly random, as damaging winds have occurred everywhere in the Region. Damage from high winds is often described in regional or broad areas, but downburst damage will impact a small area most generally less than three miles in diameter.

People

It can be assumed that the entire planning area is exposed to some extent to thunderstorm, high wind, and hail events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out. It is not uncommon for residents living in more remote areas of the county to be isolated after such events.

Vulnerable populations are 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 can be life threatening to those dependent on electricity for life support. Regionwide, 8% of Medicare Beneficiaries rely on electricity to live independently in their homes.

Property

All property is vulnerable during high wind events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Generally, damage is minimal and goes unreported. Property located at higher elevations and on ridges may be more prone to wind damage. Property located under or near overhead lines or near large trees may be damaged in the event of a collapse.

Critical Facilities and Lifelines

High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Cascading hazards caused by high winds can result in power loss; depending on the time of year, winds can also exacerbate snow and blizzards by creating deep snow drifts over roads and affecting the normal flow of traffic.

The county planning teams provided additional information on historical impacts of high winds. The Park County planning team noted the prevalence of power outages due to high winds breaking power poles; the team noted a high rate of power outages for Cody. These power outages can also have secondary impacts, such as the water system issue in Meeteetse. Additionally, the planning teams noted impacts including semi-truck blow overs and snowdrifts. The Park County planning team also noted winds strong enough to blow asphalt off the roads around Clark.

Economy

Economic impacts of severe wind are typically short term. These events can disrupt travel into and out of all areas of the county and create perilous conditions for residents, tourists, and nature alike. Wind can also damage crops and impact the regional agricultural industry. A review of the USDA Risk Management Agency records shows between 2007 and 2020 the Region has had a total of $417,055 indemnity payments for a total 2,886 acres lost to hail. The estimated average annualized losses due to hail is $32,081.

Environment and Cultural Resources

The environment is highly exposed to high winds. Environmental impacts include the downing of trees and localized flattening of plants by high wind. Natural habitats such as streams and trees risk major damage and destruction.

Development Trends

Historical data demonstrates that the most critical area of the state for high wind hazards is the eastern one third, excluding the counties of Region 6. Nevertheless, future residential or commercial buildings built to code should be able to withstand wind speeds of at least 150 miles per hour.

Risk Summary and Overall Significance by Jurisdiction

Many areas of the United States are prone to damaging wind events, and while the counties of Region 6 may not be counted in a high category for occurrences across the nation, it does have a history of such episodes which should be anticipated for the future. Primary damage is structural and utility borne. Although minimal deaths and injuries have been reported, the frequency of occurrence is due consideration, as well as the hazard to rural citizens and town populations from falling trees, power poles, and flying debris. Hot Springs CPT changed the significance from Low to Medium for all of its jurisdictions in 2021.

Table 4-44 High Winds and Downbursts Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Extensive	Highly Likely	Critical	High
Hot Springs	Significant	Highly Likely	Limited	Medium
Park	Significant	Highly Likely	Limited	Medium
Washakie	Significant	Highly Likely	Negligible	Low

4.2.12 Landslide/Rockfall/Debris Flow

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 damages and from 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 include saturation by water, erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions.

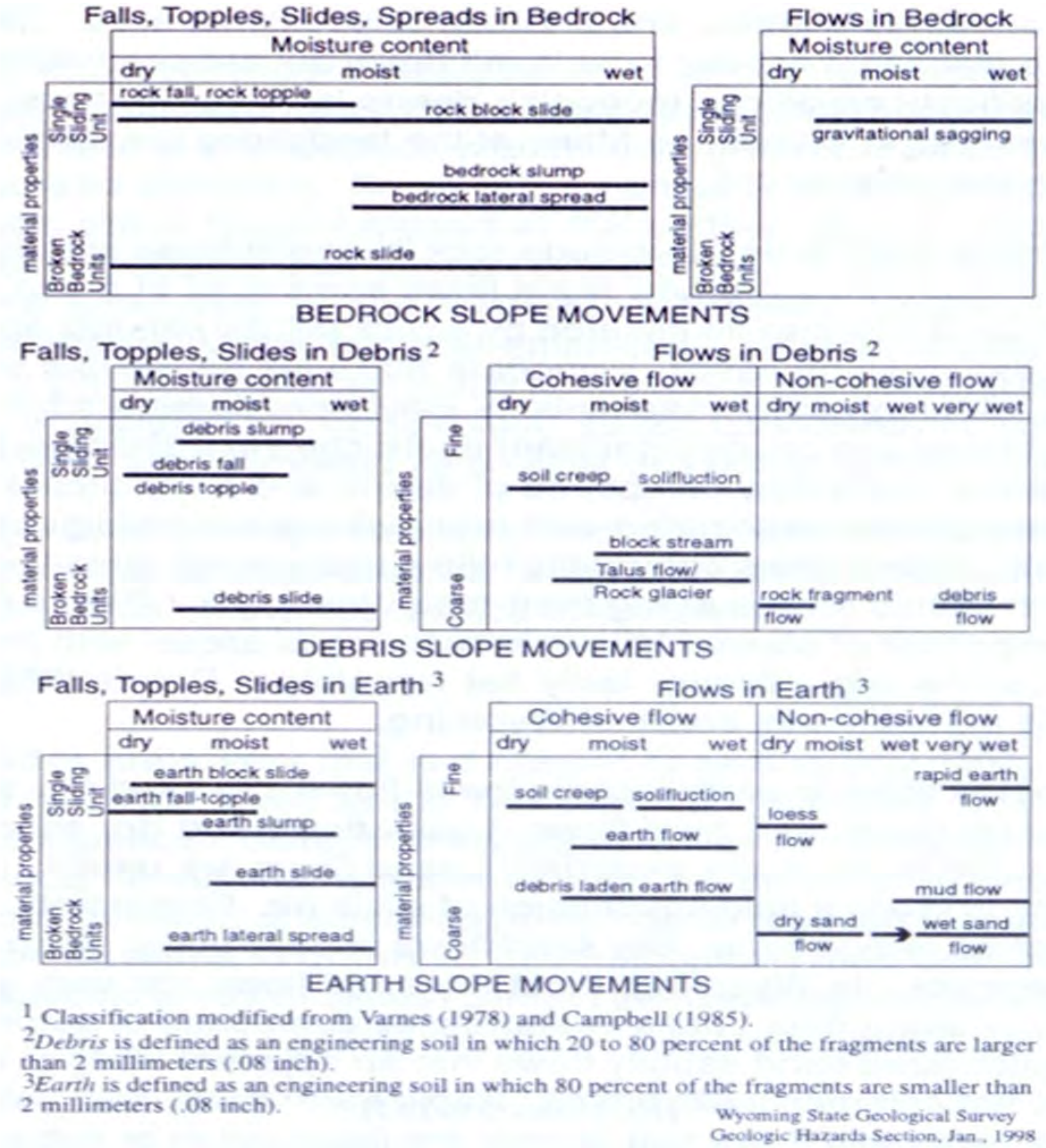
Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Generally significant landsliding follows periods of above-average precipitation over an extended period, followed by several days of intense rainfall. It is on these days of intense rainfall that slides are most likely.

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. Landslides are often a secondary hazard related to other natural disasters. Landslide triggering rainstorms often produce damaging floods. Earthquakes often induce landslides that can cause additional damage.

Slope failures typically damage or destroy portions of roads and railroads, sewer and water lines, homes and public buildings, and other utility lines. Even small-scale landslides are expensive due to clean up costs that may include debris clearance from streets, drains, streams and reservoirs; new or renewed support for road and rail embankments and slopes; minor vehicle and building damage; personal injury; and livestock, timber, crop and fencing losses and damaged utility systems.

There are many types of landslides present in Wyoming. In order to properly describe landslide type, the Geologic Hazards Section developed a landslide classification modified from Varnes (1978) and Campbell (1985). As can be seen in Figure 4-43, there are five basic types of landslides that occur in three types of material. Falls, topples, slides, lateral spreads, and flows can occur in bedrock, debris, or earth. While individual landslide types can occur in nature, most landslides are complex, or composed of combinations of basic types of landslides.

Figure 4-39 Wyoming Landslide Classifications



Rockfall

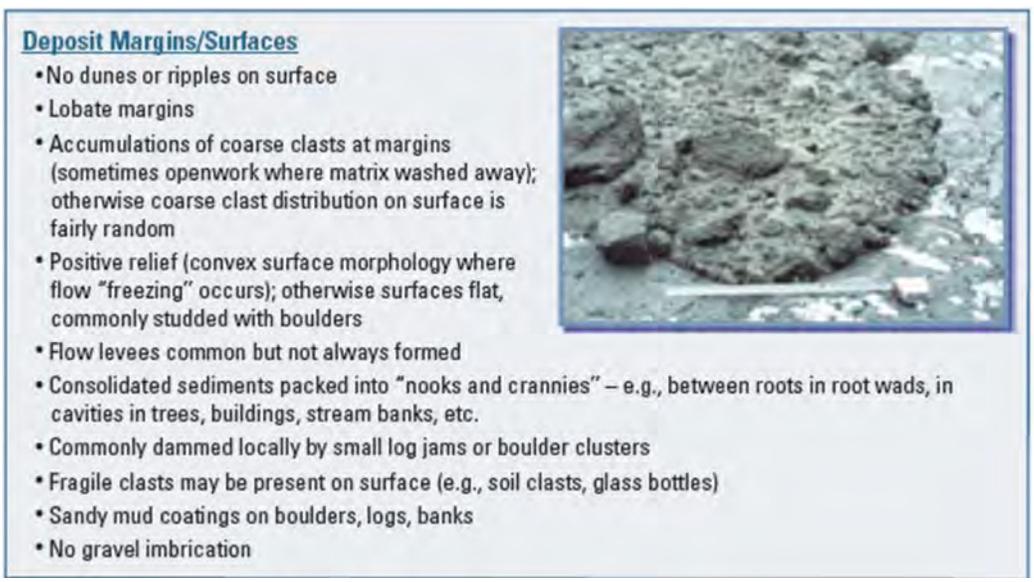
A rockfall is the falling of a detached mass of rock from a cliff or down a very steep slope. Weathering and decomposition of geological materials produce conditions favorable to rockfalls. Rockfalls are caused by the loss of support from underneath through erosion or triggered by ice wedging, root growth, or ground shaking. Changes to an area or slope such as cutting, and filling activities can also increase the risk of a rockfall. Rocks in a rockfall can be of any dimension, from the size of baseballs to houses. Rockfall occurs most frequently in mountains or other steep areas during the early spring when there is abundant moisture and repeated freezing and thawing. Rockfalls are a serious geological hazard that can threaten human life, impact transportation corridors and communication systems and result in other property damage.

Spring is typically the landslide/rockfall season in Wyoming as snow melts and saturates soils and temperatures enter into freeze/thaw cycles. Rockfall and landslides are influenced by seasonal patterns, precipitation and temperature patterns. Earthquakes could trigger rockfalls and landslides too.

Debris Flow

Debris flows, sometimes referred to as mudslides, mudflows, lahars, or debris avalanches, are common types of fast-moving landslides. They are a combination of fast-moving water and a great volume of sediment and debris that surges down slope with tremendous force. These flows generally occur during periods of intense rainfall or rapid snowmelt and may occur with little onset warning, similar to a flash flood. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that are typically about 10 miles per hour but can exceed 35 miles per hour. Figure 4-44 describes identifying characteristics of debris flows. The consistency of debris flow ranges from watery mud to thick, rocky mud that can carry large items such as boulders, trees, and cars. Debris flows from many different sources can combine in channels, and their destructive power may be greatly increased. When the flows reach flatter ground, the debris spreads over a broad area, sometimes accumulating in thick deposits that can wreak havoc in developed areas. Mudflows are covered under the National Flood Insurance Program; however, landslides are not.

Figure 4-40 Field Evidence of Debris Flow



Geographical Area Affected

Landslides are one of the most common geologic hazards in Wyoming, with some of the highest landslide densities found in Region 6 counties notably Park County. Figure 4-45 below shows mapped landslides in the Region. Note the relatively high concentration of landslide deposits in Park County and northwestern Wyoming in general. Many of these slide areas have been studied by the Wyoming Geological Survey, WYDOT and others.

Washakie County Landslide Areas

In Washakie County the primary area of concern is along Highway 16 about 10 miles east of Ten Sleep. The County Planning Team estimates that the highway through Ten Sleep Canyon is partially blocked three times per year by landslides, primarily rock falls, with boulders varying in size up to 1,000 or more pounds. Additionally, the Gallatin Canyon Campgrounds area along highway 16 could be affected by landslides. The Region 6 Landslide Attachment includes descriptions of geologic investigations of specific problem areas with more details. Many areas studied include the risk of landslide dams

Park County Landslide Areas

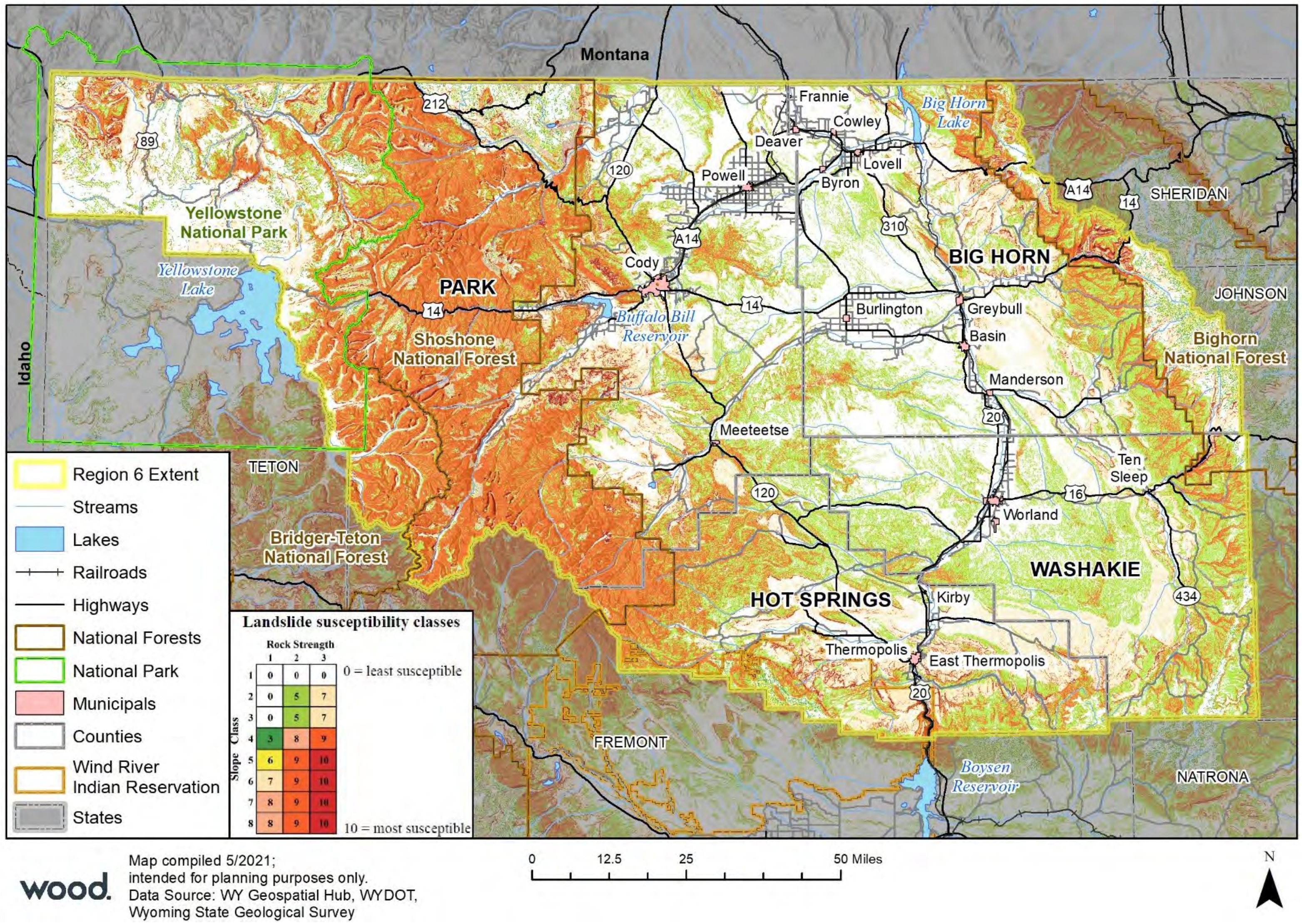
One of the largest landslide complexes in the country is located southwest of Cody. The Carter Mountain landslide was more than 5 miles wide and 20 miles long. Based on WGS studies, debris flows near Highway 14/16/20 are a recurring problem. A water plant near Cody may also be affected if the landslide reactivates. Power transmission lines could also be affected in parts of the county. Rockslide and debris flow/alluvial fan complexes have apparently dammed many creeks and rivers in the area, including the South Fork of the Shoshone River and Marston Creek. State Highway 296 crosses through a blockslide in T55N R103W Sections 23 and 24. In 2021 the Park CPT also noted:

- The Stagecoach Trail area west of the tunnels was also an area of rockfall concern.
- The Chief Joseph Highway near the intersection of 296 is an area where WYDOT does a lot of mitigation work.

Hot Springs County Landslide Areas

The Wind River Canyon has had several landslides destabilize and cause damage to the railroad. The railroad, U.S. Highway 20, and several homes and structures are at risk of being damaged if any of the landslides in the Wind River Canyon activate. There is also a remote possibility that a large debris flow reactivation may dam or partially dam the Wind River, and many smaller creeks within the county could be dammed as well by landslide activity. This could create a flash flood hazard downstream if the landslide dam fails or is overtopped.

Figure 4-41 Region 6 Landslide Areas



Past Occurrences

Since landslides, debris flows, and rockfalls occur regularly in Wyoming, previous occurrences are limited to those that caused a particular high amount of damage or incurred some other cost or unique impact. Selected incidents that occurred in or near the planning area are profiled below. Refer to each County's annex for specific incidents within each county.

In September - October of 2015 a giant 'crack' in the earth formed near Lysite in the southern portion of Washakie County. This was caused by landslide activity that was associated with a wet spring and movement across a cap rock. Due to its size and unique appearance the incident received nationwide attention. However, it did no damage as it occurred in an undeveloped area.

On July 22, 2011, President Obama declared a major disaster for the State of Wyoming for emergency work and the repair or replacement of facilities damaged by the severe storms, flooding, and landslides in Albany, Big Horn, Carbon, Crook, Fremont, Goshen, Johnson, Lincoln, Platte, Sheridan, Sublette, Teton, Uinta, Washakie, and Weston Counties, and the Wind River Indian Reservation. This declaration made Public Assistance funding available.

The Wind River Canyon in Hot Springs County has been impacted by several landslide, debris flow and rockfall events over the years. In June of 2015 mudslides closed some roads in Sunlight Basin near Cody in Park County and in the Wind River Canyon in Hot Springs County. According to the State Hazard Mitigation Plan in July 1937 landslides in the Big Horn Basin destroyed large sections of railroad tracks, and washouts swept away a large number of highway bridges. Railroads and highways were washed out and mining property was damaged. Heavy flood damage also occurred in the Big Horn Basin, particularly in the Wind River Canyon and in the vicinity of Shoshoni. The damage in the Wind River Canyon resulted from landslides, which took out several sections of highway and railroad. In all, highways suffered damage in 12 counties. Severe damage occurred in the Upper Big Horn Basin. There were more than 3,000 feet of railway washed out and much was covered by landslides. The highway was badly damaged from Riverton to Thermopolis and traffic was suspended temporarily. Near Shoshoni traffic was possible only by long detours. Highways were considerably damaged in ten other counties in the eastern half of the state (WYOES 2021).

During the 2021 update the following incidents were noted:

- The Park County CPT noted that a landslide on Squaw Creek Rd circa 2018 destroyed two cabins near Crandall.
- Washakie CPT noted the Black Mountain landslide that affected oil and gas infrastructure (this may have been in Hot Springs County) circa 2019.
- The Big Horn CPT noted sloughing at Hwy 14A had gotten worse and that Sheep Canyon was affected in winter 2021; the Shell Canyon Road landslide issues took several months to fix.
- The Hot Springs CPT noted that closures of Hwy 20 in the Wind River Canyon due to landslides and rockfall create large and costly detours.

Frequency/Likelihood of Occurrence

The probability of a landslide causing damage in the Region is difficult to determine because of the poor historic data. However, given it is reasonable to assume that damaging events have between 10 and 100 percent chance of occurrence in next year, or a recurrence interval of 10 years or less. Therefore, landslides, rockfalls or debris flows are likely to occur. Hazard areas discussed in the Landslide Hazard Attachment note that heavy periods of precipitation or significant development could have an effect on slope stability. Typically, there is a landslide/rockfall 'season' that coincides with increased freeze-thaw cycles and wetter weather in the spring and early summer.

Changing Future Conditions

Winter and spring precipitation are projected to increase for Wyoming (NOAA 2016). In addition, increased temperatures are projected to contribute to more water evaporation making drought more common, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. Wildfires and earthquakes destabilize soil on steep slopes increasing landslide and debris flow risk. Erosion caused by development on steep hillsides increases risk of landslides.

Potential Magnitude (Extent)

There are three measures of future landslide impacts – historic dollar damages, estimated yearly damages, and building exposure values. There are not enough current data to estimate historic or yearly dollar damages. In general terms, landslides can threaten human life, impact transportation corridors and communication systems, and cause damage to property and other infrastructure. Actual losses can range from mere inconvenience to high maintenance costs where very slow or small-scale destructive slides are involved. The potential magnitude of landslides, rockfall and debris flows would typically be isolated in most counties in the region limited. 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.

Vulnerability Assessment

People

The overall vulnerability of population is low. The general population is not overly vulnerable to landslides, but rockfall can cause serious injury or death. There are areas prone to rockfall in Ten Sleep Canyon along Highway 16 in Washakie County. According to GIS analysis updated during the 2021 planning process there are an estimated 5,686 residents exposed to landslide hazard areas. Park County has the greatest number 4,234 of residents exposed, a majority of which, 2,885, are located in the unincorporated areas of the County. Table 4-43 summarizes the population exposure in the Region.

Table 4-45 Estimated Population Exposed to Landslide Hazard Areas

County	Jurisdiction	Population
Big Horn	Basin	34
	Burlington	-
	Byron	31
	Cowley	5
	Deaver	-
	Frannie	-
	Greybull	55
	Lovell	70
	Manderson	-
	Unincorp.	707
	Total	902
Hot Springs	East Thermopolis	23
	Kirby	-
	Thermopolis	232
	Unincorp.	288

County	Jurisdiction	Population
	Total	543
Park	Cody	1,074
	Meeteetse	275
	Powell	-
	Unincorp.	2,885
	Total	4,234
Washakie	Ten Sleep	2
	Worland	5
	Washakie Unincorp.	-
	Total	7
Grand Total		5,686

Source: Wood Analysis using WYGS Landslide susceptibility data

Property

During the 2021 development of this Regional plan a GIS analysis of exposure to landslide hazard areas was performed. Table 4-44 summarizes landslide exposure in the Region, based on an intersect of improved parcels with landslide hazard areas. There are 2,961 parcels in landslide hazard zones based on this analysis. This analysis does not necessarily mean these properties are at imminent risk, but it does indicate potential exposure to damage. More site-specific investigations would be needed to determine risk. The greatest potential exposure to risk for general property is in Park County.

Table 4-46 Landslide Exposure by County

County	Jurisdiction	Parcels within the Highest Susceptibility	Parcels within Moderately High Susceptibility	Parcels within Moderate Susceptibility	Total Parcel Count	Improved Value	Estimated Content Value	Total Value
Big Horn	Basin	-	8	5	13	$1,796,159	$898,080	$2,694,239
	Burlington	-	-	-	-	-	-	-
	Byron	-	16	-	16	$1,271,827	$654,904	$1,926,731
	Cowley	-	3	-	3	$471,342	$364,275	$835,617
	Deaver	-	-	-	-	-	-	-
	Frannie	-	-	-	-	-	-	-
	Greybull	-	10	12	22	$3,390,526	$1,719,713	$5,110,239
	Lovell	-	29	-	29	$4,298,878	$2,275,269	$6,574,147
	Manderson	-	-	-	-	-	-	-
	Unincorp.	25	206	82	313	$47,123,037	$26,984,730	$74,107,767
	Total	**25**	**272**	**99**	**396**	**$58,351,769**	**$32,896,969**	**$91,248,738**
Hot Springs	East Thermopolis	-	11	-	11	$988,528	$494,264	$1,482,792
	Kirby	-	-	-	-	-	-	-
	Thermopolis	2	114	-	116	$13,246,172	$7,123,913	$20,370,085
	Unincorp.	18	79	56	153	$27,331,923	$15,330,140	$42,662,063
	Total	**20**	**204**	**56**	**280**	**$41,566,623**	**$22,948,317**	**$64,514,940**
Park	Cody	64	457	40	561	$163,508,381	$105,377,494	$268,885,875
	Meeteetse	2	32	95	129	$12,697,857	$7,040,794	$19,738,651
	Powell	-	-	-	-	-	-	-
	Unincorp.	234	662	391	1,287	$362,611,434	$199,574,795	$562,186,229
	Total	**300**	**1,151**	**526**	**1,977**	**$538,817,672**	**$311,993,082**	**$850,810,754**
Washakie	Ten Sleep	-	-	1	1	$435,329	$217,665	$652,994
	Worland	-	3	-	3	$755,906	$932,410	$1,688,316
	Unincorp.	68	119	117	304	$63,028,571	-	-

County	Jurisdiction	Parcels within the Highest Susceptibility	Parcels within Moderately High Susceptibility	Parcels within Moderate Susceptibility	Total Parcel Count	Improved Value	Estimated Content Value	Total Value
	Total	**68**	**122**	**118**	**308**	**$64,219,806**	**$1,150,075**	**$2,341,310**
	Grand Total	**413**	**1,749**	**799**	**2,961**	**$702,955,870**	**$368,988,442**	**$1,008,915,741**

Source: Wood Analysis based on WYGS data

Critical Facilities and Lifelines

An analysis of the potential total exposure of critical facilities was conducted to examine the potential losses in the event of a landslide. Regionwide the communication lifeline has the greatest number facilities located in a landslide hazard area. There is a total of 386 critical facilities located in the highest susceptibility landslide hazard areas; the greatest number is located in Park County. The majority are communications, transportation, and energy facilities. Table 4-45 summarizes the results of the GIS analysis.

Table 4-47 Critical Facilities within Landslide Hazard Areas

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Highest Susceptibility Landslide Hazard Areas									
Big Horn	Unicorp.	23	-	-	-	-	-	1	24
	Total	**23**	**0**	**0**	**0**	**0**	**0**	**1**	**24**
Hot Springs	Unicorp.	7	-	-	-	-	-	1	8
	Total	**7**	**0**	**0**	**0**	**0**	**0**	**1**	**8**
Park	Cody	2	-	-	-	-	2	-	4
	Unicorp.	119	6	-	-	-	-	9	134
	Total	**121**	**6**	**0**	**0**	**0**	**2**	**9**	**138**
Washakie	Unicorp.	22	-	-	-	-	-	1	23
	Total	**22**	**0**	**0**	**0**	**0**	**0**	**1**	**23**
	Grand Total	**346**	**12**	**0**	**0**	**0**	**4**	**24**	**386**
Moderately High Susceptibility Hazard Areas									
Big Horn	Greybull	-	-	-	-	-	-	1	1
	Unicorp.	39	5	1	-	-	-	11	56
	Total	**39**	**5**	**1**	**0**	**0**	**0**	**12**	**57**
Hot Springs	East Thermopolis	-	-	-	-	-	1	-	1
	Thermopolis	3	1	-	-	-	1	-	5
	Unicorp.	16	4	-	-	-	-	6	26
	Total	**19**	**5**	**0**	**0**	**0**	**2**	**6**	**32**
Park	Cody	8	1	-	-	2	1	1	13
	Meeteetse	-	-	-	-	-	1	-	1
	Unicorp.	34	2	2	1	-	6	37	82
	Total	**42**	**3**	**2**	**1**	**2**	**8**	**38**	**96**
Washakie	Unicorp.	10	1	-	-	-	-	5	16
	Total	**10**	**1**	**0**	**0**	**0**	**0**	**5**	**16**

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
	Grand Total	**220**	**28**	**6**	**2**	**4**	**20**	**112**	**402**
Moderate Susceptibility Land Hazard Areas									
Big Horn	Greybull	1	-	-	-	-	-	-	1
	Unicorp.	6	1	-	-	-	-	2	9
	Total	**7**	**1**	**0**	**0**	**0**	**0**	**2**	**10**
Park	Meeteetse	1	2	2	-	1	-	-	6
	Unicorp.	114	114	-	2	1	1	19	251
	Total	**115**	**116**	**2**	**2**	**2**	**1**	**19**	**257**
Washakie	Unicorp.	11	2	-	-	-	-	8	21
	Total	**11**	**2**	**0**	**0**	**0**	**0**	**8**	**21**
	Grand Total	**226**	**238**	**4**	**4**	**4**	**2**	**58**	**576**

Source: Wood Analysis

Transportation networks are the most exposed aspect of the Region to rockfall, landslide and debris flow incidents. Residents and visitors alike are impacted by landslides when roads are damaged by landslides. This includes Highway 14 in Park and Big Horn counties and A14 in Big Horn, Highway 16 in Washakie east of Ten Sleep, and Highway 20 in the Wind River Canyon south of Thermopolis. 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. A water plant near Cody may also be affected if a landslide nearby reactivates. Power transmission lines could also be affected in parts of Park County.

During the 2016 development of this regional plan a GIS analysis of highway and county road infrastructure risk was conducted. The exposure to landslide hazard areas was estimated by overlaying road networks on hazard areas and summarizing results. The results are summarized by county in the following tables. Park County has the greatest exposure of road networks on landslide areas.

Table 4-48 Major Road Infrastructure Exposed to Landslide Hazards

County	Road Type	Segment Count	Length (ft)	Length (m)
Big Horn	County Road	4	16,965	3.2
	US Highway	16	84,721	16.0
	Total	20	101,686	19.3
Hot Springs	County Road	14	14,397	2.7
	State Highway	7	7,498	1.4
	Total	21	21,895	4.1
Park	County Road	43	159,944	30.3
	State Highway	4	4,103	0.8
	US Highway	51	111,209	21.1
	Total	98	275,256	52.1
Washakie	County Road	2	3,538	0.7
	State Highway	1	91	0.02
	US Highway	2	3,419	0.6
	Total	5	7,048	1.3
	Grand Total	144	405,884	76.9

Economy

Economic impacts typically center around transportation routes temporarily closed by rockfall, debris flow, mudflow, or landslide activity. These roads may be used to transport goods across the county or provide access by visitors and tourists. Depending on the amount of damage, the road may simply need to be cleaned off, or may need some level of reconstruction and affect the local economy indirectly.

Environment and Cultural Resources

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard. While typically a natural process, some environmental problems can result from mass movements. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time.

Development Trends

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Human activities such as property development and road construction can also exacerbate the occurrence of landslides. Landslide areas tend to be picturesque and often within mountainous locations and therefore attract development. Development in landslide areas frequently consists of vacation homes and represents a potential risk for injury, loss of life and property. There are small landslide areas near Cody. Future development in these areas should be done carefully to prevent landslide damage to property or people. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. Improving mapping and information on landslide hazards and incorporating this information into the development review process could prevent siting of structures and infrastructure in identified hazard areas.

Risk Summary and Overall Significance by Jurisdiction

Overall, landslides, rockfalls and debris flows range from a **low to high** significance hazard in the region. Landslides have the potential for direct property impacts including residential structures but more likely infrastructure corridors including roads and highways, power line corridors, and gas lines. Hot Springs ranked the significance as high to reflect risk to transportation (highway and rail) and travelling public in Wind River Canyon and economic impacts of highway and rail closures, as well as the potential to trigger a transportation hazardous materials incident. Secondary impacts could include landslide dams forming on creeks and overtopping, causing flash flooding in valleys below.

Table 4-49 Landslide Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Limited	Highly Likely	Limited	Medium
Hot Springs	Limited	Likely	Critical	High
Park	Limited	Likely	Limited	Medium
Washakie	Limited	Likely	Negligible	Low

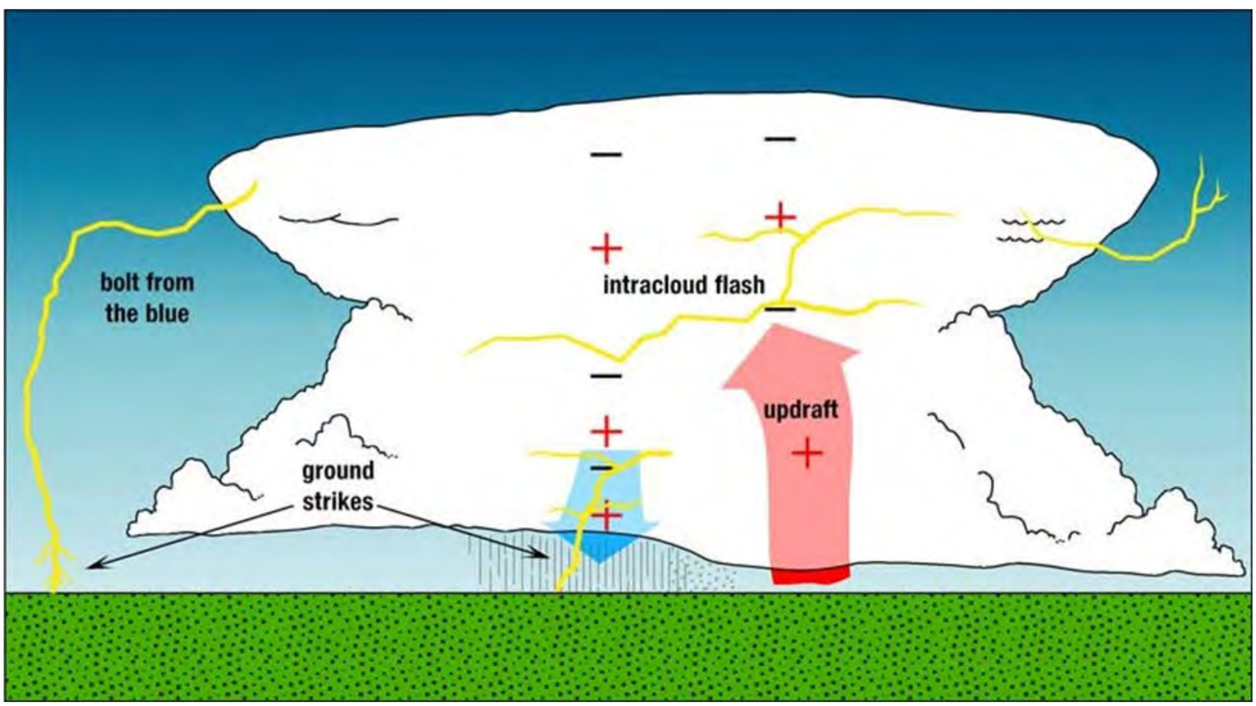
4.2.13 Lightning

Hazard Description

Lightning is a danger across Wyoming. Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four strokes per flash. The length and duration of each lightning stroke vary, but typically average about 30 microseconds. Lightning is a sudden electrical discharge released from the atmosphere that follows a course from cloud to ground, cloud to cloud, or cloud to surrounding air, with light illuminating its path. Lightning's unpredictable nature causes it to be one of the most feared weather elements.

cloud-to-ground lightning is the most damaging and dangerous form of lightning. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

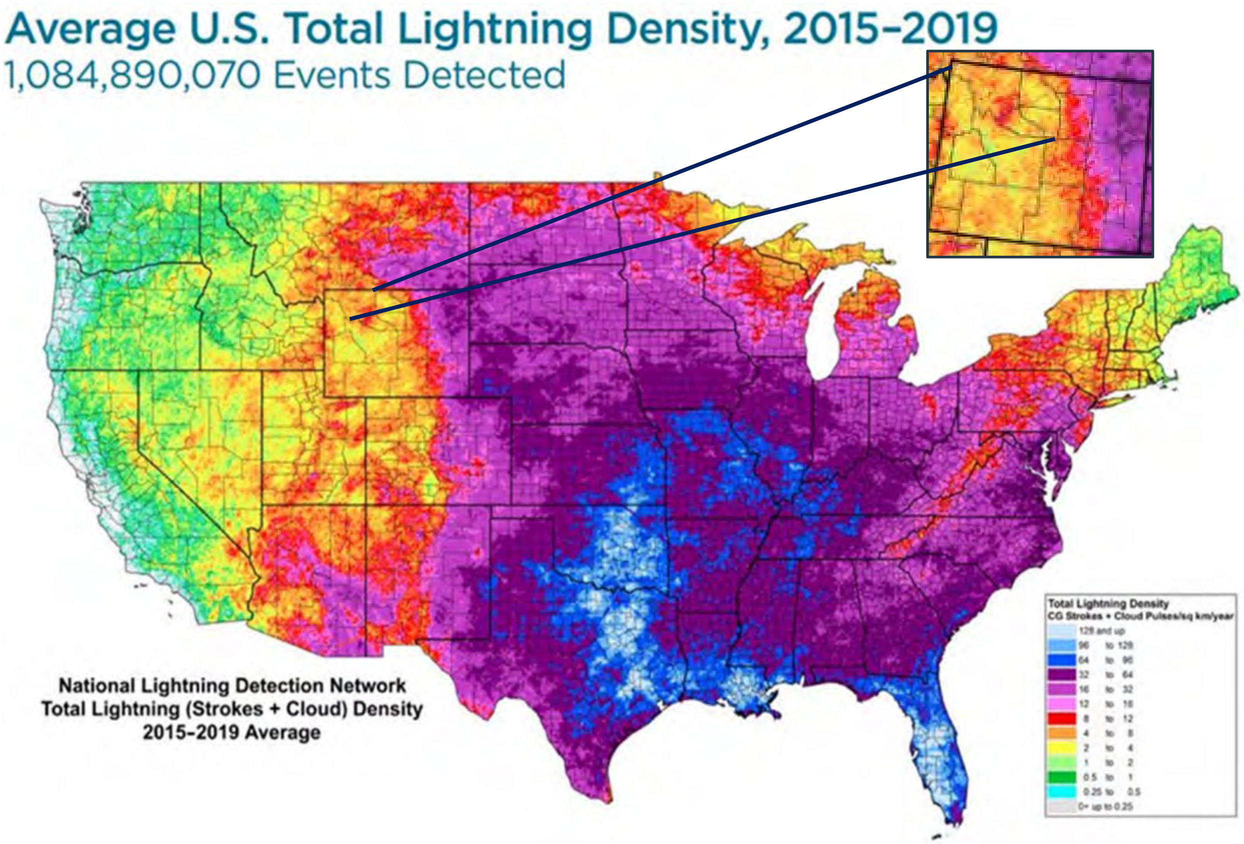
Figure 4-42 Cloud-to Ground Lightning



Source: National Weather Service

Nationwide lightning strikes are routinely monitored by Vaisala, Inc. with accuracies to within a 1-kilometer resolution. In 2019, statewide there were 3,383,728 lighting counts. Figure 4-69 shows the total lightning density between 2015 and 2019. These values probably vary by 50 percent in a year depending on whether there is a drought or enhanced monsoonal flow. However, the locations of maximum and minimum strikes do not change much from year to year.

Figure 4-43 Average U.S. total Lightning Density 2015-2019



Source: Vaisala Annual Lightning Report 2019

Geographical Area Affected

All of the region is susceptible to lightning impacts, particularly the higher elevation mountainous areas.

Past Occurrences

According to the NCEI Storm Events Database, lightning has been responsible for 1 death, 9 injuries, $80,000 in property damage in Wyoming between 1996 and 2020. During the 2021 planning process the following was noted:

- Big Horn CPT noted the Lovell sewer lagoon was out of service for a period of time from a lightning strike circa 2019.
- Washakie County CPT noted SCADA repeater sites have been hit, affecting local water systems, some residences have been struck, and that several fires annually are sparked by lightning

The NCEI records lightning incidents that have some sort of measurable impact; Table 4-57 includes all lightning incidents recorded by the NCEI for the four counties in Region 6. Washakie and Hot Springs counties had no damaging lightning incidents recorded during this timeframe.

Table 4-50 Region 6 Lightning History 1969– 2020

County	Date	Fatalities	Injuries	Property Damage	Crop Damage
Big Horn	08/18/1996	0	0	$0	$0

County	Date	Fatalities	Injuries	Property Damage	Crop Damage
Park	08/01/2000	0	5	$0	$0
Park	06/16/2010	0	0	$20,000	$0
Park	06/20/2010	1	0	$0	$0
Park	06/25/2014	0	4	$0	$0
Park	6/27/2017	0	0	$10,000	$0
Park	7/16/2019	0	0	$50,000	$0
Totals		**1**	**9**	**$80,000**	**$0**

Frequency/Likelihood of Future Occurrence

Changing Future Conditions

As the atmosphere warms further due to climate change, the increased heat in the atmosphere provides more energy for severe storms. The frequency of severe weather events has increased steadily over the last century. The number of weather- related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate. The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

Potential Magnitude (Extent)

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL is a common parameter that is part of fire weather forecasts nationwide. Due to the high elevation and varied topography of the Region, the counties in Region 6 are at risk to experience lightning in any of these categories. The LAL is reproduced in Table 4-58.

Table 4-51 Lightning Activity Level of Scale

Lightning Activity Level	
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning.

Source: National Weather Service

Lightning can cause deaths, injuries, and property damage, including damage to buildings, communications systems, power lines, and electrical systems. It also causes forest, brush and structural fires. Damage from lightning occurs in four ways:

- Electrocution, severe electrical shock, and burns of humans and animals
- Vaporization of materials in the path of the strike
- Fire caused by the high temperatures associated with lightning
- Power surges that can damage electrical and electronic equipment

When people are struck by lightning, the result is deep burns at the point of contact (usually on the head, neck and shoulders). Approximately 70 percent of lightning survivors experience residual effects such as vision and hearing loss or neuropsychiatric issues. These effects may develop slowly and only become apparent much later. Death occurs in 20 percent of lightning strike victims.

Lightning strikes cause intense but localized damage. In contrast to other hazards, lightning does not cause widespread disruptions with the community. Structural fires, localized damage to buildings, damage to electronics and electrical appliances, and electrical power and communications outages are typical consequences of a lightning strike. Additionally, indirect fatalities may result via electrocution when a person steps from a vehicle into standing water that was previously “charged” by a live powerline that was knocked loose by a lightning strike.

The indirect social and economic impacts of lightning damage are typically associated with the loss of electrical power. Since society relies heavily on electric power, any disruption in the supply, even for a short time period, can have significant consequences. Wildfires can also be an indirect result of a lightning strike.

Past events in Region 6 indicate that the potential magnitude of lightning events will likely be limited—isolated deaths and/or injuries and illnesses may occur; major or long-term property damage that threatens structural stability due to structural damage or fires; and/or interruption of essential facilities and services for 24-72 hours due to structural damage or utility outages.

Vulnerability Assessment

People

Anyone that is caught in an exposed area during a thunderstorm could be at risk to a lightning strike. In Wyoming, outdoor enthusiasts venturing to high and exposed areas should be especially cautious because rapid thunderstorm development with associated lightning can place even the most experienced persons in jeopardy without warning. Outdoor recreation is a major economic contributor to Region 6. People may often find themselves outside and need to be especially watchful of the weather during the summer months when afternoon thunderstorms are more common. Any persons caught in the open without cover during a lightning storm are vulnerable to strikes. Lightning caused one fatality and nine recorded injuries between 1996 and 2019; these injuries were to people caught unprotected during a lightning storm. The 2010 Pitchfork strike killed a 70-year-old man southwest of Meeteetse while on a camping and fishing trip. The 2000 strike in Cody injured 5 campers near Yellowstone Park, and the 2014 Garland strike injured four golfers. The Hot Springs County planning team noted an additional lightning fatality – a tourist near the Middle Forks Corrals.

Aspects of the population who rely on constant, uninterrupted electrical supplies may have a greater, indirect vulnerability to lightning. As a group, the elderly or disabled, especially those with home health care services relying on rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, Community Based Residential Facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. Regionwide 8% of Medicare Beneficiaries rely on electricity to live independently in their homes. Isolation of these populations is a significant concern. Isolation of these populations is a significant concern. These populations face isolation and exposure during thunderstorm, wind, and hail events and could suffer more secondary effects of the hazard. If they do not have a back-up power source, rural residents and agricultural operations reliant on electricity for heating, cooling, and water supplies are also especially vulnerable to power outages.

Property

According to the event details collected in the NCEI database, in the past 24 years lightning has resulted in $80,000 in property damages. The majority of reported damages from lightning are fires to private structures, damage to chimneys or steeples, or small grass fires. Property is more vulnerable to lightning than population because of the exposure ratios. Buildings remain exposed. Mitigation techniques such as choice of building materials or landscaping help reduce the vulnerability of these properties, but there is not data available to segment these properties out of the overall vulnerability assessment.

Critical Facilities and Lifelines

Some essential infrastructures and facilities can be impacted by lightning. Emergency responders, hospitals, government services, schools, and other important community assets are not more vulnerable to lightning than the general vulnerabilities established for property and population. Some aspects of infrastructure are constructed of materials and/or located in places that increase their vulnerability to lightning. Sometimes, communications and infrastructure are interrupted by lightning strikes. These events raise the vulnerability of the essential functions by delaying response times, hindering interagency communication efforts, or endangering or damaging communication networks.

Economy

Economic impact of a severe thunderstorm is typically short term. Lightning events can cause power outages and fires. Generally, long-term economic impacts center more around hazards that cascade from a severe thunderstorm, including wildfires ignited by lightning. Similarly with the previous section, lightning can cause structural damage or damage to electrical systems to private buildings as well as critical infrastructure.

Environment and Cultural Resources

There are no indications that cultural or historic resources are more vulnerable to lightning than as previously accounted for as general structures. Natural resources may be vulnerable to indirect impacts of lightning, such as wildfires caused by lightning strikes. The presence of large areas of water, or of wide, open spaces in natural habitats may increase the danger of lightning strikes to trees, people, or structures, but these vulnerabilities are not directly related to natural resources. Campgrounds are areas where lightning strikes have more dangerous impacts, so populations utilizing the campgrounds may have a higher vulnerability.

Lightning doesn’t just strike unprotected people, as both the NCEI and the CPTs reported that lightning causes the death of unprotected livestock. The 1996 strike in Burlington killed 11 head of cattle.

Structure fire ignition is also a concern; the 2010 strike in Wapiti started an attic fire, culminating in extensive damage to the home.

Development Trends

Any development built above ground will be susceptible to lightning strikes. Buildings should be built with grounding when possible, to prevent the ignition of structure fires. New critical facilities such as communications towers should be built with lightning protection measures. A greater number of people exposed to this hazard is likely to occur as the region continues to experience a higher influx of visitors that are drawn to the outdoor recreation opportunities. Hot Springs County and Thermopolis in particular is promoting the area with the development of new mountain biking and hiking trails. Construction of lightning shelters at outdoor venues and increased public awareness campaigns may help minimize increased effects of lightning on growing numbers of visitors recreating outdoors.

Risk Summary and Overall Significance by Jurisdiction

Lightning is an annual occurrence in the four counties in Region 6, although strikes with recorded impacts are much rarer. Anything that can conduct electricity and is exposed is vulnerable to lightning strikes and their effects. Future impacts from lightning are difficult to determine because of the erratic nature of storms. Region 6 will remain vulnerable to lightning strikes for the foreseeable future. Unsheltered outdoor workers, outdoor enthusiasts and livestock will remain susceptible to lightning strikes. Lightning caused wildland fires may result in more extensive damage. Hot Springs County changed significance from Low to Medium during the 2021 planning effort.

Table 4-52 Lightning Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Significant	Highly Likely	Limited	Low
Hot Springs	Significant	Highly Likely	Limited	Medium
Park	Significant	Highly Likely	Limited	Medium
Washakie	Significant	Likely	Limited	Low

4.2.14 Mine Subsidence

Hazard/Problem Description

Underground coal mining began in Wyoming during the 1860s. Many of the early coal mines were not designed and constructed well. Many were also shallow, and often had minimal ground support in the form of mine timbers. As a result, the underground pillars can fail. If enough pillars fail, the caprock in the mine will collapse. The effect of the collapse reaches the surface in some cases. If the effect of the collapse reaches the surface, a subsidence pit or trough forms. Not all subsidence from mining is due to poor design, however. Most underground mines eventually have roof failures due to lack of maintenance and continuous loading of the unsupported rock layers overhead. In some cases, the pillars were pulled as mining retreated from an area. In other cases, fires occurred in the mines, resulting in a loss of strength in the pillars and caprock, as well as consumption of remaining coal in seams supporting workings.

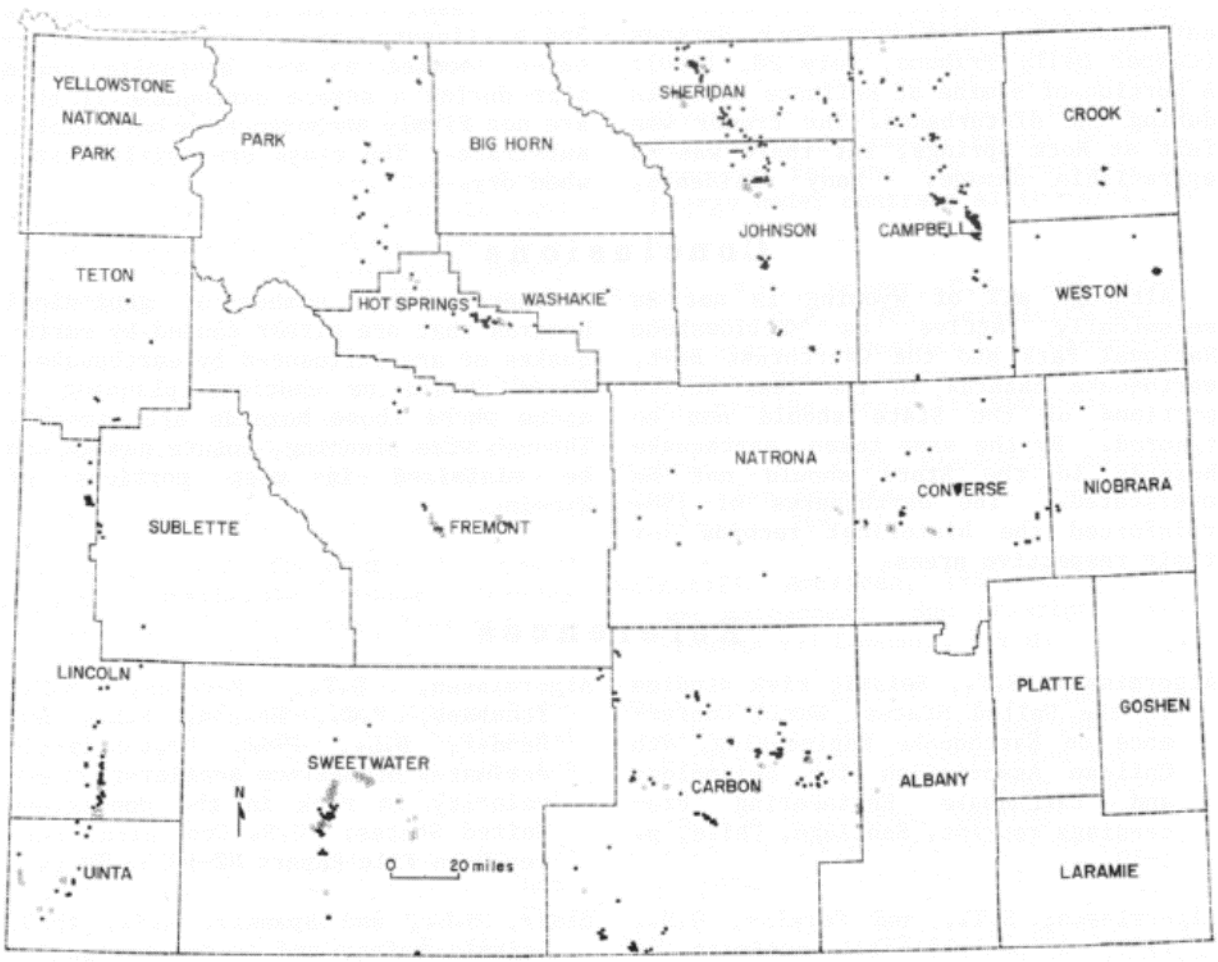
Significant areas of Wyoming have abandoned underground mines present. Mine subsidence has been threatening those areas since the onset of mining in the 1860s. Due to the long history of underground mining in the state, many more undermined areas have subsided than most people imagine. A written history of mine subsidence in or near urban areas was published in the Governor's Workshop on Mine Subsidence proceedings held on October 31, 1986 at the University of Wyoming. The WSGS generated a report for each county in Wyoming on abandoned underground coal mines and hard rock mines which have been identified. Mining sites and subsidence have been reported through multiple avenues including the US Geological Survey, Wyoming Geological Survey, US Forest Service personnel, BLM personnel, hunters, and other private individuals.

The Abandoned Mine Land Division (AML) of the Wyoming Department of Environmental Quality (DEQ) maintains an inventory of abandoned mines in the state and have recorded and actively pursued mitigation of mined out areas throughout the state. Two AML GIS inventory projects have been completed, one in 2001 and the other in 2004, where staff physically visited and geolocated mined out areas. One recent mitigation project included generating GIS layers using historic mine maps to identify mined out abandoned coal mines. The layer was then overlaid with known infrastructure such as pipelines, power lines, roads, and other utilities, as well as general developed areas to provide GIS mapping of areas with potential subsidence risks due to mined out sites. Since then, a further refinement of underground coal mine boundaries' intersection with infrastructure has occurred under AML Project 17.6B – Mine Subsidence Mitigation. Project 17.6B targets undermined infrastructure in order to be proactive in addressing mine subsidence. Many of the projects include grouting in the past five years (Table 4-64). The Wyoming AML Program has accurately mapped approximately 3,000 of the nearly 4,000 reported abandoned mining sites. A high-level map showing numbers of abandoned coal mines in areas around the state is included below in Figure 4-49. More detailed, local information is available through the Wyoming AML Program upon request.

Geographical Area Affected

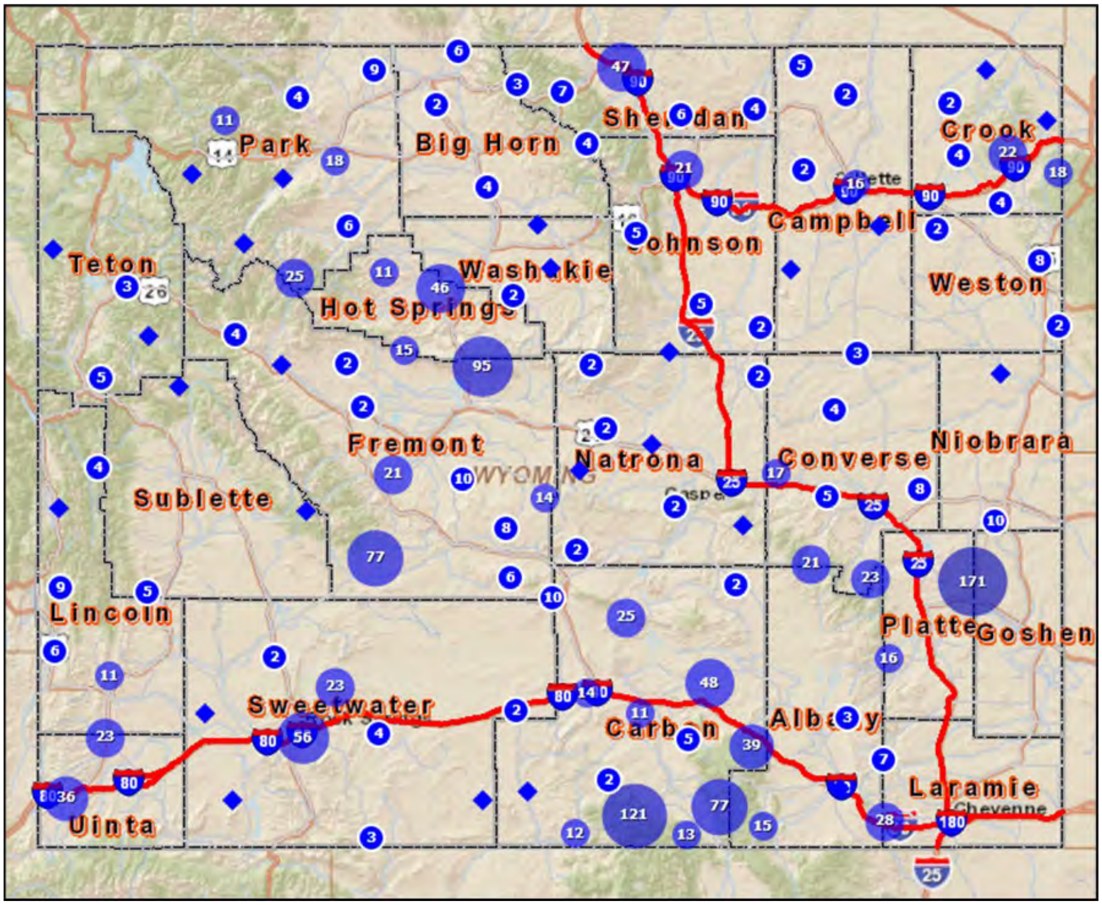
A map showing documented subsidence is shown in Figure 4-48 and Figure 4-49 shows the location of known abandoned coal mines throughout the state, as coal mine sites are generally more susceptible to subsidence than mines for other materials because many of these were underground mines.

Figure 4-44 Mine Subsidence in Wyoming



Solid areas represent mined-out areas with no known subsidence.
Source: 2016 Wyoming Multi-Hazard Mitigation Plan

Figure 4-45 Known Abandoned Coal Mines in Wyoming



Source: Wyoming Department of Environmental Quality AML, 2021 Wyoming State HMP

Sites where mine subsidence may occur are located throughout the state in both populated and unpopulated areas. There are numerous abandoned underground coal mines in Hot Springs County, with some near the Town of Kirby. In 2021 the Hot Springs CPT noted that a lot of reclamation has been done by the state in coal mined areas. The Big Horn CPT noted that most mines in the county are uranium and did not note issues with subsidence. The BLM has marked entrances to these mines with signs warning of the presence of radon gas.

Abandoned mine sites identified within the Kirby USGS 1:24,000 scale map quadrangle include:

- Burnell No. 2 - T44N R95W Section 10
- Cowboy Mine – T44N R94W Section 22
- Crosby Mine – T44N R94W Section 7 and 18; T44N R95W Sections 12 and 13
- Eagle Mine – T44N R94W Sections 17,18,19, 20
- Gebo Mine – T44N R94W Sections 3, 4, 9-14
- Price and Jones Mine – T44N R94W Section 22
- Steins No. 1 – T44N R94W Section 18
- Steins No. 2 – T44N R94W Section 19
- Wyckoff Mine – T44N R94W Section 22
- 3 Unnamed mines – T44N R95W Section 10
- 3 Unnamed mines – T44N R95W Section 11
- 3 Unnamed mines – T44N R95W Section 13

Although some of these may have been reclaimed, no development should be allowed at the sites until it can be shown that reclamation has occurred, and that the reclamation has been successful.

Past Occurrences

Coal subsidence problems have occurred in and around Rock Springs, Hanna, Glenrock, Superior, Reliance, Evanston, Kemmerer, Sheridan, Buffalo, Arvada, and Gillette. Some massive hardrock mines and uranium mines have also experienced mine subsidence, although these mines are in more remote rural areas and have less potential to produce economic damage. Property and infrastructure damage associated with mine subsidence in Wyoming communities is on-going. The Wyoming Abandoned Mine Land Division received reports of 17 new mining related subsidence issues during 2019, mostly during spring and early summer (OSMRE 2019). This is typical timing for new subsidence features appearing due to heavy precipitation events or springtime runoff from snowmelt.

Frequency/Likelihood of Future Occurrence

Although many areas of the state have already had mitigation projects designed to reduce or remove the impacts from underground mining and subsidence, subsidence may still occur in some areas. The rating for this hazard is occasional (between a 1 and 10 percent probability of occurrence in the next year or has a recurrence interval of 11 to 100 years).

Changing Future Conditions

Continued aging of long abandoned underground coal mines increases the likelihood that mine subsidence will eventually reach the ground surface. Recent studies by the Wyoming AML Program have revealed that even deep mine voids will eventually reach the surface as expressions of subsidence and may require mitigation if they threaten infrastructure and improvements or pose risks to human health and safety. Water movement and fluctuation in old mines and surface hydrology of overburden material are both factors that influence mine subsidence. Rainfall or other precipitation recharges overburden, increasing its weight per soil volume, and water percolation decreases strength of rock, aggravating the proneness of subsidence. Rainfall often triggers subsidence and a majority of subsidence events take place in spring during the rainy season (Prakash et al. 2010). Winter and spring precipitation is projected to increase for Wyoming (NOAA 2016).

Potential Magnitude (Extent)

The extent of subsidence prone underground workings near infrastructure and improvements is statewide, but within Region 6 the highest density is found in Hot Springs County. Although infrequent, subsidence may occur abruptly - virtually instantly - as dangerous sinkhole openings that could swallow any part of a structure that happens to lie at that location or leave a dangerous steep-sided hole. There are many factors that affect the extent of a subsidence hazard. These may include the size of a mine, height of the underground workings, the susceptibility of caprock to collapse, and composition of the soil. Areas may appear to be free of subsidence for many years, and then undergo renewed gradual or even drastic subsidence.

Vulnerability Assessment

There has been property and infrastructure damage associated with mine subsidence in Wyoming communities. The dollar amounts of the damage are not readily available. Underground coal fires can also happen in abandoned mines.

The dollar impact is difficult to predict. An indirect measure of the impacts is the existing cost of mitigating the hazards. The AML Program has spent $303.4 million through 2013 mitigating the effects of mine subsidence alone, as part of the abandoned mine reclamation program. In the time since 2016 an additional $65 million has been spent on mitigation projects statewide, although none have been in Region 6.

People

According to the Wyoming Department of Environmental Quality Abandoned Mine Land division, an average of 20 to 30 people die each year in abandoned mines nationwide. Information on injuries and deaths specific to subsidence incidents in Region 6 are not readily available. Hunters, hikers, cave explorers, and others recreating on public and private lands are at risk of death or serious injury. The Abandoned Mine Land Division has cataloged many abandoned mine sites in Wyoming, but many more exist in remote areas and on private land.

Property

Subsidence of abandoned mine shafts can cause damage to property located above undermined areas. The city of Rock Springs has seen numerous instances of damage to residential buildings. Sagging and sinking of land resulting from mine subsidence can damage building foundations, cause sagging and cracking of roads, driveways, and sidewalks, and compromise the integrity of entire structures. The State of Wyoming has implemented a Mine Subsidence Insurance program to help protect residents from damage to structures in areas with current or past mining activity.

Critical Facilities and Lifelines

Damage to critical facilities and lifeline infrastructure is also possible from mine subsidence. Pipelines, above and below ground utility lines, roads, bridges, and communication infrastructure may all be vulnerable to the effects of mine subsidence.

Economy

Economic impacts of mine subsidence are largely the result of direct property damages and the costs of recovery and rebuilding. The Wyoming Mine Subsidence Insurance Program (WMSIP) provides coverage to eligible residential and commercial property owners throughout the state for damages resulting from mine subsidence.

Environment and Cultural Resources

Abandoned mines and resultant subsidence can result in significant negative impacts on the environment. According to the USGS, ground subsidence can result in disturbances to the surface environment, damage to vegetation, and disruptions of the historical hydrological patterns. Additionally, fires can start by spontaneous ignition when water and air enter abandoned mine workings via subsidence cracks and pits. These fires can in turn spread to unmined coal as they create more cavities, more subsidence, and more cracks and pits through which air can circulate.

Development Trends

Locations where mine subsidence may occur are located throughout the state in both populated and unpopulated areas. Development in locations where mine subsidence occurs certainly has the potential to impact individual homes or neighborhoods. While it is believed all mined out areas in Wyoming have been mapped, it is unknown if all locations of potential subsidence have been located. The uncertainty regarding the locations of more potential subsidence areas means there is the possibility development may occur in a subsidence-prone location without the knowledge of contractors or developers prior to development. Given this fact, there is no way to determine with certainty the likelihood development will occur in a subsidence-prone location. Therefore, it is difficult to put a risk factor to this hazard as it relates to development within Wyoming's borders.

Businesses seeking to lay pipelines, electrical transmission lines, develop a well site, or build another type of business structure in an area subject to subsidence hazards are typically referred to the AML during the environmental review process. This contact helps ensure new, developing infrastructure can be routed around problem areas, or if more efficient and possible, the area can be mitigated for subsidence hazards before structures or individuals are exposed to the hazard.

Risk Summary and Overall Significance by Jurisdiction

Wyoming's long history of underground coal mining has resulted in the hazard of mine subsidence for communities across the state and in Region 6. Many of Wyoming's coal mines are along and near railroad routes through Wyoming. Mapping of Wyoming's mined areas is considered reasonably complete, though periodically a previously unmapped area is discovered and mapped. While the impacts to individual properties and structures can be significant, this hazard is generally considered to be of low significance to the communities of Region 6.

Table 4-53 Mine Subsidence Hazard Risk Summary

County	Likelihood	Spatial Extent	Potential Magnitude	Significance
Big Horn	Unlikely	Limited	Negligible	Low
Hot Springs	Occasional	Limited	Negligible	Low
Park	Occasional	Limited	Negligible	Low
Washakie	Occasional	Limited	Negligible	Low

4.2.15 Pandemic/Epidemic

Hazard/Problem Description

A pandemic can be defined as a disease that attacks a large population across great geographic distances. Pandemics are larger than epidemics in terms of geographic area and number of people affected. Epidemics tend to occur seasonally and affect much smaller areas. Pandemics, on the other hand, are most often caused by new subtypes of viruses or bacteria for which humans have little or no natural resistance. Consequently, pandemics typically result in more deaths, social disruption, and economic loss than epidemics.
There are three conditions that trigger a pandemic declaration:

1. A new virus subtype must emerge that has not previously circulated in humans (and therefore there is no pre-existing immunity),
2. This new subtype must be able to cause disease in humans, and
3. The virus must be easily transmissible from human to human.

Since March 2020, Region 6, the nation, and the world are dealing with the COVID-19 pandemic (caused by the SARS-CoV-2 virus), confirming that pandemic is a key public health hazard in the planning area. This hazard risk assessment includes an analysis of pandemic risk across Region 6 and an analysis of the impacts of the hazards profiled in this plan on public health.

Unlike seasonal flu, a pandemic has much greater potential for loss of life and significant social disruption due to higher rates of transmission and more severe health impacts. The SARS-CoV-2 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission of droplets/bodily fluid. 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 in the United States and a fatality rate between 1-2%. Because the virus can be transmitted by people who are asymptomatic, containing the spread has been a significant challenge across the globe.

Geographical Area Affected

Pandemics occur not only on a county or state level, but on a national and global scale. It is likely that most communities in the Region would be affected, either directly or by secondary impacts. Some indirect consequences may be the diversion of resources that may be otherwise available.

The Wyoming Department of Public Health has reported 62,572 laboratory-confirmed cases of COVID-19 and 858 deaths as of September 1, 2021, statewide. Table 4-54 below the total cases and deaths specific to Region 6. Region 6 comprises approximately 9% of the statewide total of cases, and 12.4% of the statewide total of deaths. In general, it is likely that the more-populated areas municipal areas may be affected sooner and may experience higher infection rates.

Table 4-54 COVID-19 Cases and Deaths by County (as of September 1, 2021)

County	Cases	Cases Per Total Pop*.	Deaths	Deaths Per Total Pop.
Big Horn	1,114	9%	38	0.3%
Hot Springs	442	10%	4	0.1%
Park	3,270	11%	38	0.1%
Washakie	821	10%	27	3%

Source: Wyoming Dept. of Public Health *Population total are based on U.S. Census Bureau ACS 5-Year Estimates 2015-2019: Big Horn County 11,882; Hot Springs County 4,607; Park County 29,148; Washakie County 8,027

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 percent of the American workforce was bedridden.

- **1957-1958 Asian Flu:** The 1957 Asian Flu pandemic killed 1-2 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 34,000 Americans. 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 U.S. on April 26. By June, approximately 18,000 cases had been reported in the U.S. 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 a number of deaths. The CDC estimates that 43-89 million people were infected worldwide, with an estimated 8,870 to 18,300 H1N1 related deaths, including 12,469 deaths in the United States.
- **2020-Ongoing COVID-19**: The COVID-19 or novel coronavirus outbreak began in December 2019 and was declared a pandemic in March of 2020. As of October 30th, 2020, 45 million cases have been reported around the world with over 1 million deaths, including 9 million cases and 229,000 deaths in the U.S. As of September 1, 2021, this figure has increased to over 218 million cases and approximately 4.53 million deaths reported globally, according to the World Health Organization (WHO). Within the U.S. (as of September 1, 2021), over 39.3 million cases and approximately 641,000 deaths have been reported, which is more than double since October 2020. Several COVID-19 vaccines had been given emergency approval by the FDA and in August 2021 the Pfizer vaccine was fully approved by the FDA. Vaccine hesitancy has resulted in 52% of the U.S. population to be fully vaccinated (as of August 2021). It may take months for the entire population to receive a vaccine and achieve herd immunity. In addition, many other countries do not have access or the capabilities to disseminate vaccines as the U.S. does; thus, the pandemic is expected to continue for an indefinite period of time.

Frequency/Likelihood of Future Occurrence

As noted in the list above there have been 5 pandemics since 1918 that have affected the United States. Based on these historical incidents and the recurrence interval calculation described in 4.1.1 Results and Methodology, there is a 5% probability that a pandemic that affects the entire United States will occur in any given year.

Changing Future Conditions

Additional research is needed to determine the effects of climate change on the frequency and duration of epidemics and pandemics. Climate change may influence vector-borne disease transmission, although the direction of the effects (increased or decreased incidence) will be location- and disease-specific. The intensity and extent of certain diseases is projected to increase.

Ongoing efforts to reduce greenhouse gas emissions, building climate resiliency, and creating robust public health campaigns to prevent or prepare for possible increased vector-borne diseases may help to reduce the impacts of climate change on pandemics.

Potential Magnitude (Extent)

A much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, growth in air travel means the virus could spread around the globe within hours. Under such conditions, there may be very little time for counties, states, and countries to prepare. Most experts believe we will have just one to six months 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 and many other aspects make pandemics unlike any other public health emergency or community disaster. Pandemics typically last for several months to 1-2 years and have even longer lasting effects on the economy and communities.

As described by the WHO, the Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of a pandemic. This framework is used to guide pandemic planning and provides recommendations for risk assessment, decision-making, and action. These intervals provide a common method to describe pandemic activity which 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. Phase 6 was reached in Region 6 during the COVID-19 outbreak.

Pre-Pandemic Interval

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

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.

Pandemic Interval

Phase 4 involves community-wide outbreaks as the virus continues to mutate and become more easily transmitted between people (for example, transmission through the air).

Phase 5 represents human-to-human transmission of the virus in at least two countries.

Phase 6 is the pandemic phase, characterized by community-level influenza outbreaks.

The magnitude of a public health emergency will range significantly depending on the transmissivity and mortality rate of the virus. For example, pandemic influenza is easily transmitted from person-to-person, however advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Preparing for, responding to, and recovering from a pandemic requires a strategy that includes a holistic suite of public health activities designed to lessen the impact on morbidity and mortality. These activities include education, vaccination, prophylaxis, isolation/quarantine, a robust contact tracing program, and the closure of public facilities. In addition, clear, concise communication with the public and with other agencies remains a critical component, as does the ability of the involved agencies to achieve collaboration and coordination. By their very nature, most pandemics, once started, will not be stopped until they have run their course. This course can be shortened and weakened by a number of factors, with vaccination being the most effective method for protecting the population. Pandemic plans describe strategies of preparedness, response, and recovery to attempt to decrease illnesses and deaths during the pandemic period to manageable levels (i.e., that do not overwhelm the critical infrastructures of the State), and to promote community resiliency and rapid recovery.

Vulnerability Assessment

People

Pandemics have the ability to affect large segments of the population for long periods of time. 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 true for all influenza strains. People without health coverage or access to good medical care are also likely to be more adversely affected. Mental health of the public could also be impacted depending on the length of the event and public health guidance on prevention.

As previously described in the Past Events section above, the COVID-19 pandemic has resulted in over 218 million cases and approximately 4.53 million deaths globally. The U.S. has reported over 39.3 million cases and approximately 641,000 deaths. Region 6 has reported 5,647 cases and 107 deaths as of September 1, 2021. In addition to the direct impacts, the pandemic has completely disrupted life for many people. Most large gatherings have had to be cancelled, and many schools have closed. Sheltering in place and social distancing have been highly encouraged and, in some places, mandated, leaving some individuals isolated for months.

Property

For the most part, property itself is not generally impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Additionally, traditional sheltering facilities including homeless shelters or facilities stood up to support displaced persons due to an evacuation or other reason due to a simultaneous disaster occurring cannot be done in a congregate setting. This requires additional planning considerations or use of facilities that allow for non-congregate shelter settings which may require an approval of a request to FEMA for non-congregate sheltering and may have an increased cost (such as the use of individual hotel rooms) as opposed to traditional congregate sheltering facilities. Hot Springs County was more vulnerable to the COVID-19 outbreak due to the highest median age population of any county in the state. The local nursing home did well to mitigate outbreaks according to the CPT.

Critical Facilities and Lifelines

In the event of a pandemic, especially one with high transmission rates and mortality rates such as COVID-19, hospitals and morgues will be heavily affected and may be overwhelmed. Outbreaks in small cities and counties may cause medical facilities to reach capacity very quickly. Other critical facilities and infrastructure are not directly affected by a pandemic but may have difficulty maintaining operations and maintenance activities due to a significantly decreased workforce. Schools may be forced to close.

The Park CPT felt that the local medical capacity was prepared, and outbreaks were noted as low compared to the record high visitation in Yellowstone in the fall of 2020. A phone bank was stood up to provide public information.

Economy

Pandemics can have extensive economic impacts, as evidenced by the COVID-19 pandemic and associated restrictions on social gatherings. Social distancing requirements have affected nearly every segment of the local and national economy, most notably the restaurant and hospitality industries. Park County had notable economic impacts associated with the public health restrictions during the COVID-19 pandemic that reduced the number of visitors travelling to Yellowstone National Park.

Environment and Cultural Resources

Impacts to these resources are typically minimal. However, reduced tourism during outbreaks could lead to additional economic impacts, such as those experienced during COVID-19 with fewer visits to Yellowstone National Park.

Development Trends

Limited expected population growth and development is not expected to increase pandemic exposure, but growth in tourism industry and out of state visitors makes the Region uniquely susceptible.

Risk Summary and Overall Significance by Jurisdiction

- Pandemics affecting the U.S. occur roughly once every 20 years but cannot be reliably predicted.
- Effects on people will vary, but as much as 30% of the population could become ill, and 10% may need to be hospitalized
- Effects on property are typically minimal, although quarantines could result in short-term closures. Critical facilities may have difficulty maintaining operations due to staffing shortages.
- 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.
- The hazard is considered low to medium significance across all participating jurisdictions.
- 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 care givers; and issuing advisories and warnings.

Table 4-55 Risk Summary by Jurisdiction

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Significant	Occasional	Critical	Low
Hot Springs	Significant	Occasional	Critical	Medium
Park	Significant	Occasional	Critical	Medium
Washakie	Significant	Occasional	Critical	Medium

4.2.16 Tornado

Hazard Description

A tornado is a swirling column of air extending from a thunderstorm to the ground. Maximum winds in tornadoes are often confined to extremely small areas, and vary tremendously over very short distances, even within the funnel itself. Tornadoes can have wind speeds from 40 mph to over 300 mph, the majority displaying wind speeds of 112 mph or less. Erratic and unpredictable, they can move forward at up to 70 miles per hour, pause, slow down and change directions. Most have a narrow path, less than 100 yards wide and a couple of miles long. However, damage paths from major tornadoes can be more than a mile wide and 50 miles long.

In 2007, the NWS began rating tornadoes using the Enhanced Fujita Scale (EF-scale). The EF-scale is a set of wind estimates (not measurements). The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis, better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado. Table 4-61 describes the EF-scale ratings versus the previous Fujita Scale used prior to 2007 (NOAA 2007).

The U.S. experiences more tornadoes than any other country. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S. In a typical year, the U.S. averages 1,200 tornadoes annually. Between 1985 and 2019, Wyoming averaged an annual number of 7 tornadoes statewide (WYOES 2021).

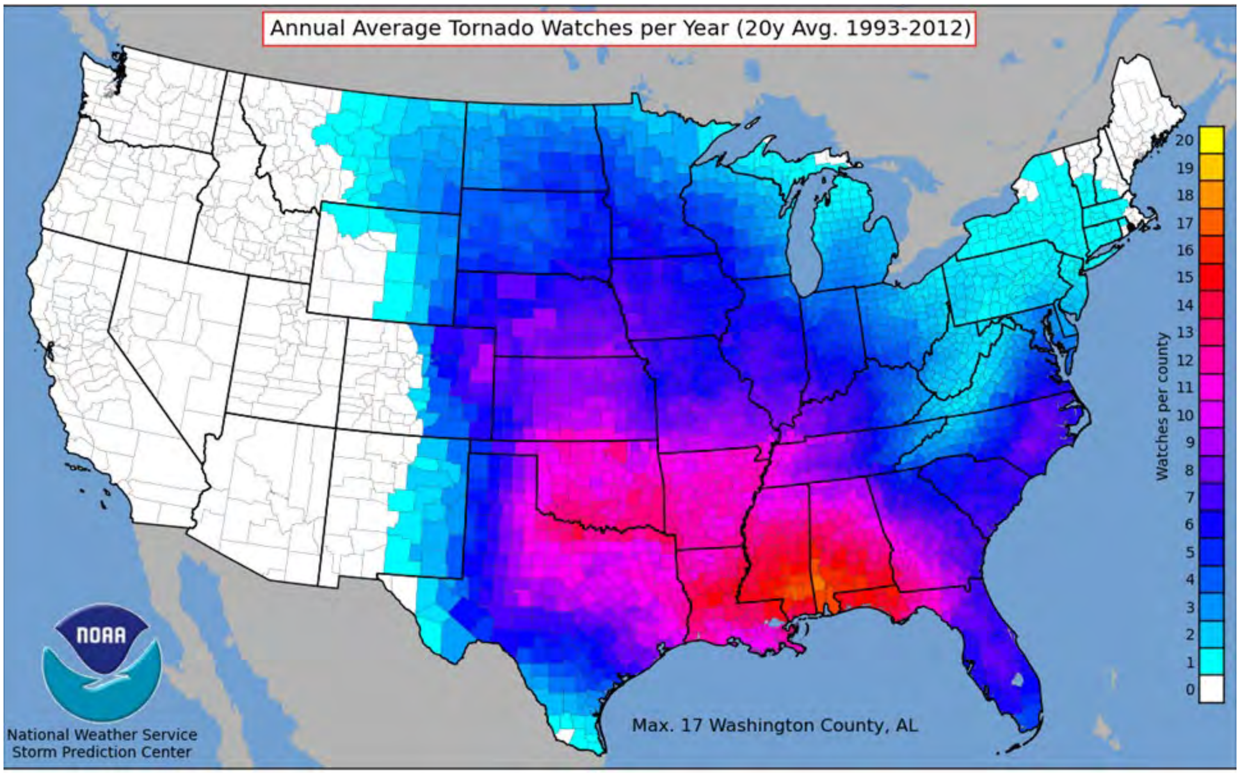
A study from NOAA's National Severe Storms Laboratory used historical data to estimate the daily probability of tornado occurrences across the U.S., regardless of tornado magnitude. Figure 4-43 shows the estimates. The density per 25 square miles in the map's legend indicates the probable number of tornadoes for each 25 square mile cell within the contoured zone that can be expected over a similar period of record. It should be noted that the density number does NOT indicate the number of events that can be expected across the entire zone on the map.

Table 4-56 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

Figure 4-46 Total Annual Tornado Watches in the U.S. (1993-2012)



Source: NOAA

Geographical Areas Affected

The entire area of the Region is susceptible to tornadoes. While some areas may see more tornadoes than others, this is more of a statistical anomaly than a causal result.

Past Occurrences

Tornado statistics, especially prior to the 1970s, must be viewed as incomplete since many twisters have occurred without being witnessed. Wyoming's open rangelands experience little if any damage from these storms, so many go unreported. Many documented tornadoes occurring in the counties in Region 6 are given low ratings on the Fujita Scale (F0s and F1s) simply because these tornadoes are often formed over open land and result in little or no damage.

Since 1950, there have been 49 tornadoes between the four counties in Region 6, as documented by the NCEI Storm Event Database. From 1950-2020, there was two injuries, one fatality, and $773,750 in total recorded property damage in Region 6.

Table 4-57 Tornado History by County, Region 6

County	Incidences
Big Horn	26
Hot Springs	5
Park	10
Washakie	8
Total	49

Source: NCEI

Table 4-58 Tornado History, Region 6

Location (City or County)	Date	Time	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Big Horn	6/3/1958	1600	F2	0	0	$25,000	0
Big Horn	6/26/1959	1600	F2	1	1	$2,500	0
Big Horn	7/28/1959	1730	-	0	0	$2,500	0
Big Horn	6/12/1962	1600	F2	0	0	$2,500	0
Big Horn	7/9/1962	1600	F2	0	0	$2,500	0
Big Horn	6/5/1964	1510	-	0	0	$25,000	0
Park	6/26/1964	1600	F2	0	0	$25,000	0
Big Horn	7/24/1967	1600	F2	0	0	$2,500	0
Big Horn	6/20/1974	1530	F1	0	0	$2,500	0
Big Horn	7/20/1974	2030	F1	0	0	$2,500	0
Washakie	6/18/1975	1709	F0	0	0	0	0
Washakie	6/17/1976	1540	F0	0	0	$2,500	0
Park	6/26/1976	1830	F1	0	0	$2,500	0
Big Horn	7/4/1976	1700	F1	0	0	0	0
Big Horn	6/18/1978	2100	F1	0	0	$25,000	0
Big Horn	7/4/1978	1430	F2	0	1	$250,000	0
Park	7/11/1978	1620	F2	0	0	$25,000	0
Big Horn	7/24/1981	1500	F1	0	0	0	0
Big Horn	5/3/1984	1830	F0	0	0	$2,500	0
Park	6/20/1984	1400	F0	0	0	$250	0
Hot Springs	6/20/1985	1744	F0	0	0	$25,000	0
Big Horn	8/2/1985	1330	F3	0	0	0	0
Park	8/25/1986	530	F1	0	0	$25,000	0
Washakie	5/18/1987	1509	F0	0	0	0	0
Big Horn	6/18/1987	1708	F0	0	0	0	0
Park	5/18/1991	1807	F1	0	0	0	0
Big Horn	7/12/1992	1255	F0	0	0	0	0
Big Horn, Greybull/ Basin	6/6/1997	1700	F0	0	0	0	0
Big Horn, Basin	6/13/1997	1825	F0	0	0	0	0
Big Horn, Basin	7/24/1997	1509	F0	0	0	0	0
Washakie	8/11/1999	1535	F0	0	0	0	0
Washakie	8/28/1999	1445	F0	0	0	0	0

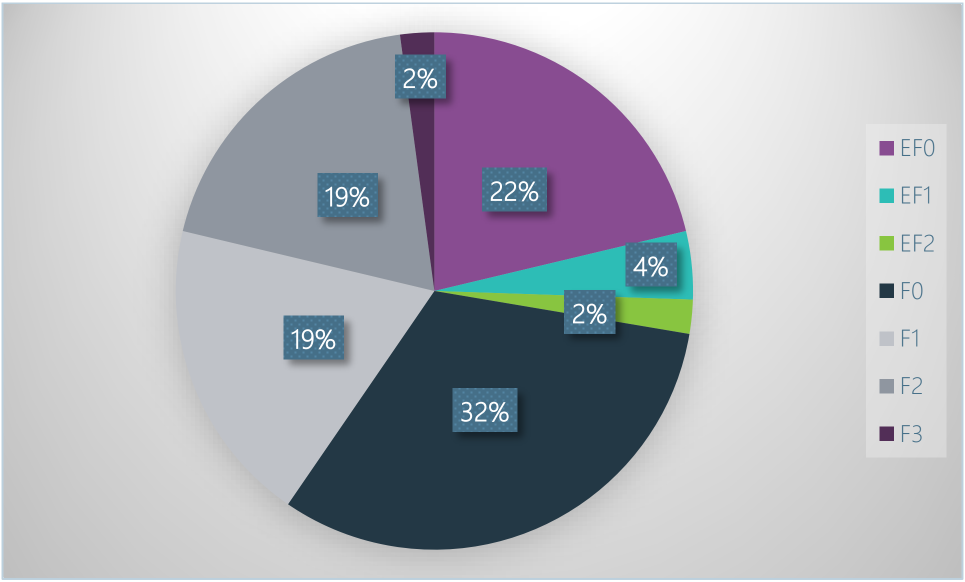
Location (City or County)	Date	Time	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Big Horn, Greybull, Basin	6/26/2001	1756	F1	0	0	0	0
Hot Springs, Kirby	7/10/2001	1530	F2	0	0	0	0
Park, Powell	6/1/2005	1217	F0	0	0	0	0
Big Horn, Byron, Lovell, Burlington	6/1/2005	1240	F0	0	0	0	0
Hot Springs	5/29/2008	1134	EF0	0	0	0	0
Big Horn	6/1/2009	1458	EF1	0	0	$5,000	0
Hot Springs	6/14/2009	1353	EF0	0	0	0	0
Washakie	8/14/2009	1627	EF0	0	0	0	0
Big Horn	8/12/2010	1411	EF0	0	0	0	0
Washakie	8/30/2010	1251	EF1	0	0	$70,000	0
Park, Meeteetse	5/27/2013	1000	EF0	0	0	0	0
Big Horn	5/24/2014	1336	EF0	0	0	0	0
Hot Springs	6/3/2014	1107	EF0	0	0	0	0
Park	5/16/2015	1213	EF0	0	0	0	0
Big Horn	6/12/2017	1714	EF0	0	0	0	0
Park	6/12/2017	1650	EF0	0	0	0	0
Washakie, Ten Sleep	6/1/2018	1111	EF2	0	0	$20,000	0
TOTALS				**1**	**2**	**$773,750**	**0**

Source: National Climatic Data Center

The Hot Springs County planning team noted an additional tornado occurring on May 25, 2016.

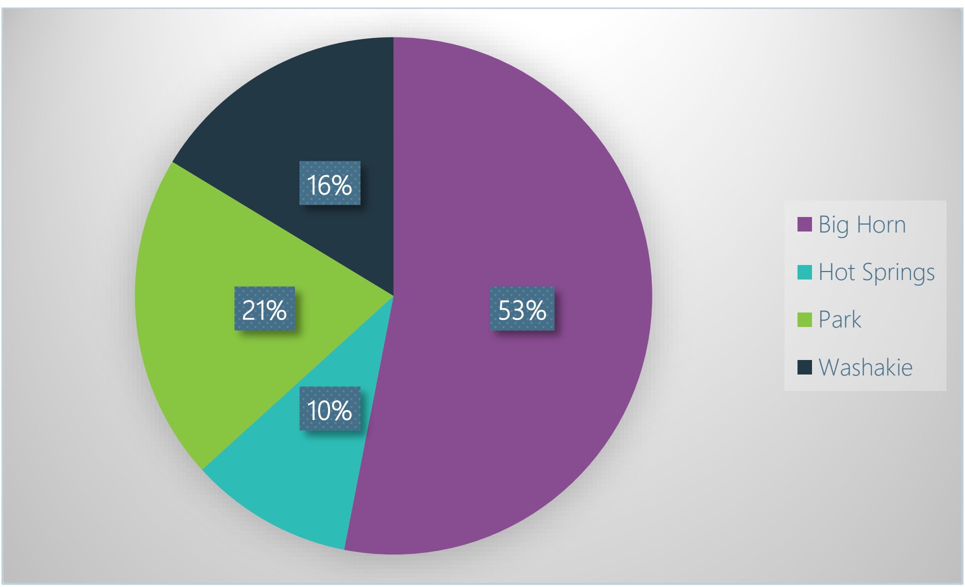
The NCEI data allows for examination and statistical analysis of tornadoes occurring in the county. Of the historical tornadoes, 32% were rated F0. Figure 4-44 shows the percentage breakdown of the tornado ratings.

Figure 4-47 F-Scale Tornadoes by Rating



Analysis can also be done on the ratings of tornadoes per county. Historically, Big Horn County has seen the majority of the tornadoes in the region, with 26 of the 49 twisters occurring in that county alone.

Figure 4-48 Rated Tornadoes by County



Finally, the data allows for the development of profiles on historical time periods of tornadoes. Figure 4-46 and Figure 4-47 give historical perspective on the time of year and time of day that tornadoes in the region have occurred.

Figure 4-49 Historical Tornadoes by Month: 1958-2020

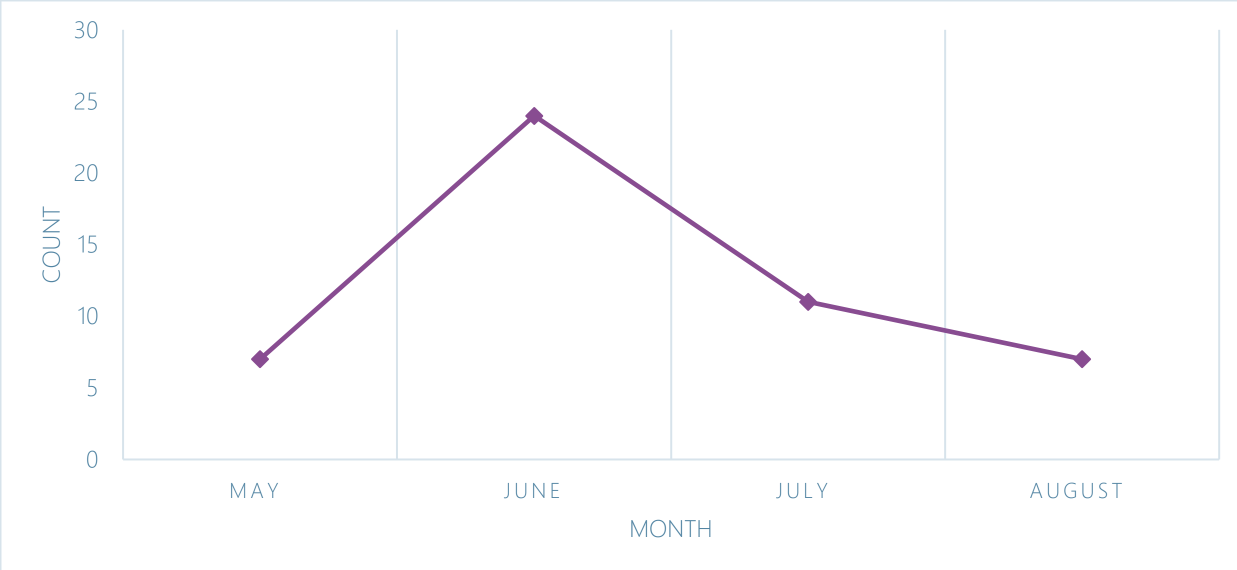
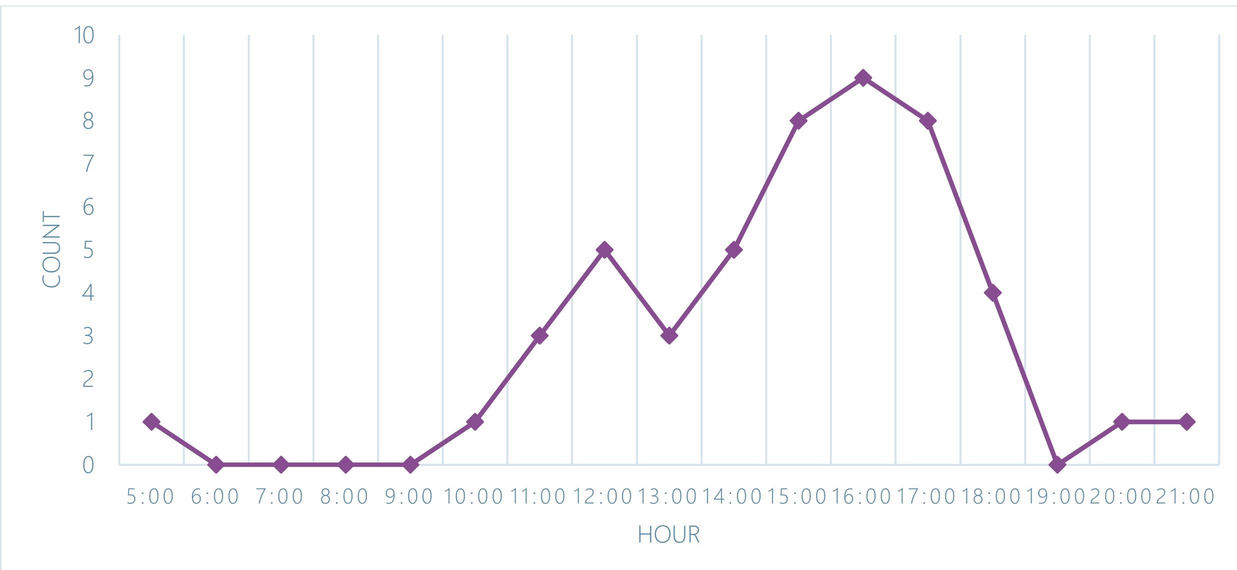


Figure 4-50 Historical Tornadoes by Time of Day: 1958-2015



Frequency/Likelihood of Future Occurrence

According to the NCEI Storm Events Database, a tornado occurs somewhere in the Region almost annually. An average tornado occurs in June in the evening, is rated EF-0 or EF-1, and causes less than $25,000 worth of damage to property, though it mostly strikes rural areas causing no damage. Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike within the populated areas of the Region, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed.

Changing Future Conditions

Climate change impacts on the frequency and severity of tornadoes are unclear. NASA's Earth Observatory has conducted studies which aim to understand the interaction between climate change and tornadoes. Based on these studies meteorologists are unsure why some thunderstorms generate tornadoes and others don't, beyond knowing that they require a certain type of wind shear. Tornadoes spawn from approximately one percent of thunderstorms, usually supercell thunderstorms that are in a wind shear environment that promotes rotation. Some studies show a potential for a decrease in wind shear in mid-latitude areas. The level of significance of this hazard should be revisited over time.

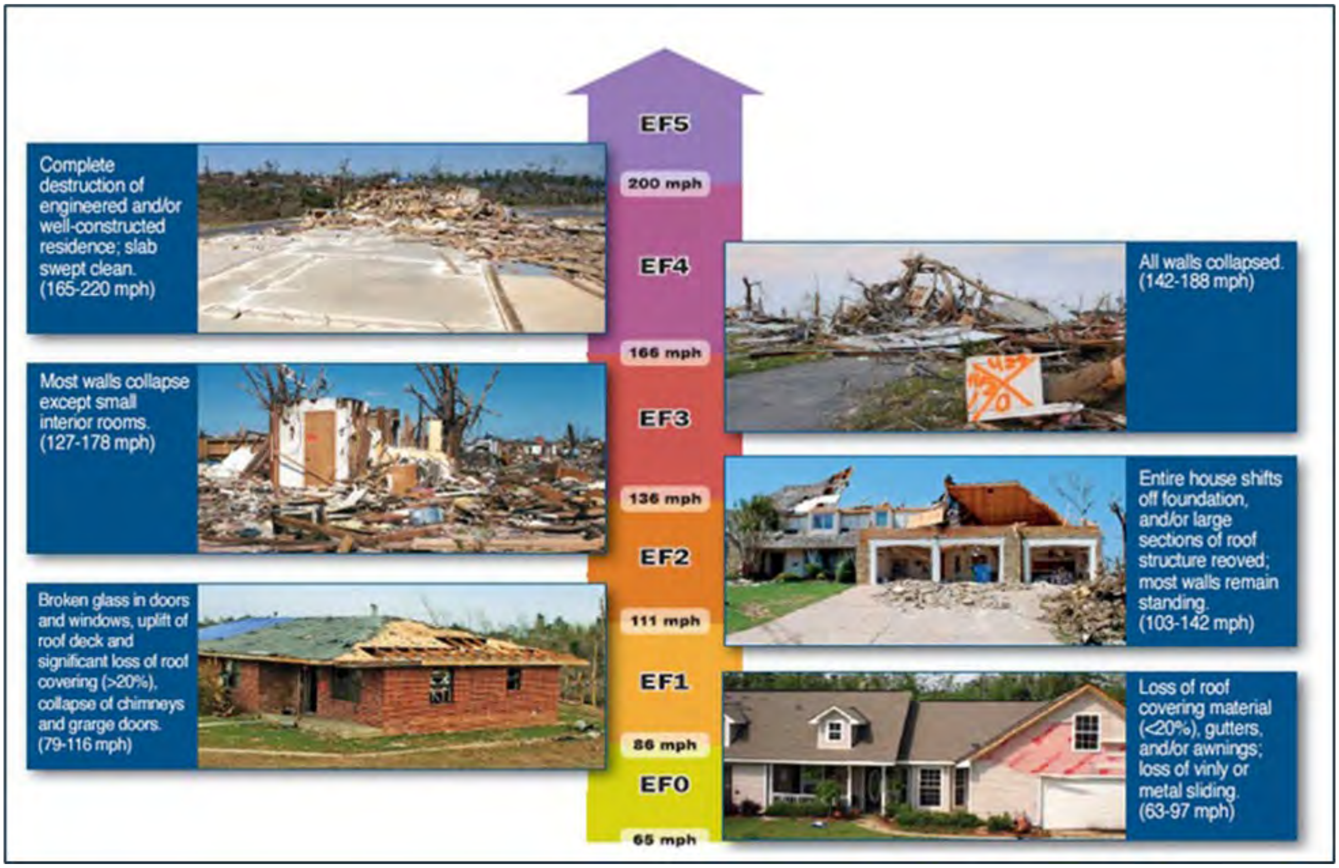
Potential Magnitude (Extent)

Table 4-61 shows the wind speeds associated with the Enhanced Fujita Scale ratings and the associated damage indicators associated with each rating. Visual examples of the degree of damage which could be expected with each EF rating are shown in Figure 4-49 below.

Table 4-59 Enhanced Fujita Scale with Damage Descriptions

Enhanced Fujita Scale			
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Figure 4-51 Potential Damage Impacts from a Tornado



Source: National Oceanic and Atmospheric Administration

Though the strength of the tornado often dictates the impacts, it is important to remember that the location (rural or urban) of the tornado is just as important when assessing these risks. Impacts can vary depending on multiple factors, including the size and strength of a tornado, and its path. The greatest magnitude tornado in the Region was an EF-2 in Washakie County on June 1, 2018. The tornado event reportedly damaged around 1,000 trees and is estimated to have caused $20,000 in total property damages.

Cumulatively, past tornado events have caused $773,750 in recorded property damage, and no recorded crop damage. The NCEI database describes the property damage as downed tree limbs and power outages, damage to homes, sheds and outbuildings to include roofs and chimneys, and downed timber on forest lands.

Vulnerability Assessment

Because of its rural composition, people or property within the county have not had a history of being severely impacted during past tornado incidents. While the F-Scale ratings of historical tornadoes in the counties in the Region are low, those ratings are partially based on recorded damage. Recorded damage may have been much more substantial if these tornadic events had impacted one of the many communities in the Region, rather than timber, outlying range, and farm acreage.

People

It can be assumed that the entire planning area is exposed to some extent to tornadoes. Certain areas are more exposed due to geographic location and local weather patterns. Likelihood of injuries and fatalities would increase if warning time was limited before the event or if residents were unable to find adequate shelter.

Vulnerable populations are 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 can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. As noted in in the Lightning vulnerability assessment subsection 4.2.13, 8% of Medicare Beneficiaries in the County rely on electricity-dependent medical equipment to be able to live independently in their homes. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard.

Individuals caught in the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or who do not have access to basements, cellars, or safe rooms.

Property

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Construction practices and building codes can help maximize the resistance of the structures to damage. Mobile homes are more vulnerable to the impacts of a tornado event compared to housing types due to methods of construction. Statewide, mobile homes represent about 13% of total housing compared to 6.1% Nationwide. Regionwide the percentage of mobile homes (12%) as the combined total housing in all four counties is just below the statewide average.

Of the 49 tornadoes that have been recorded in Region 6 from 1958 to 2020, 22 have caused property damage and none have caused crop damage. Figure 4-53 and Figure 4-54 show the breakdown of total damages by county.

Figure 4-52 Damage by County: 1958-2020

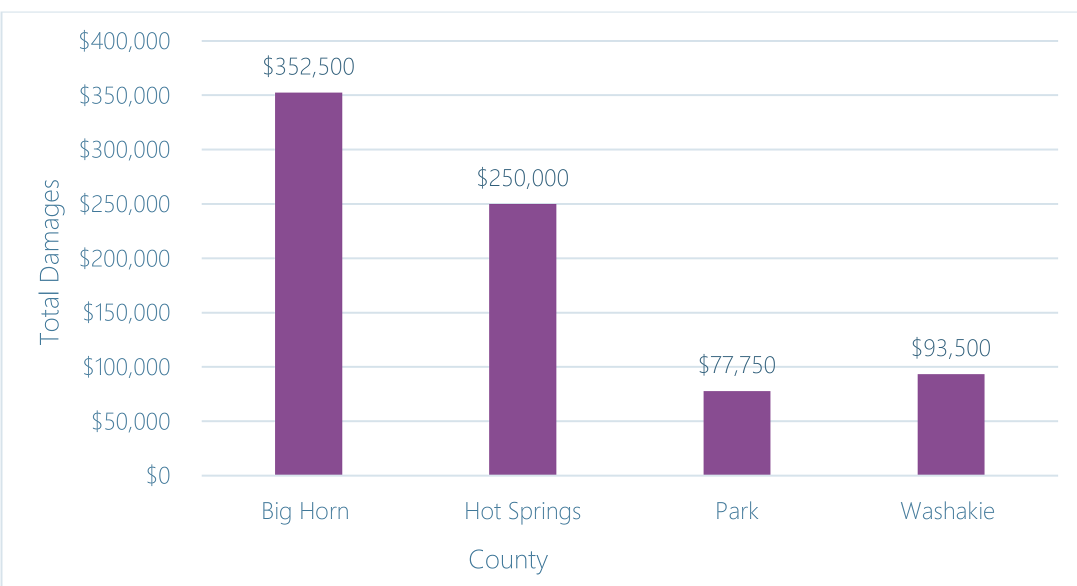
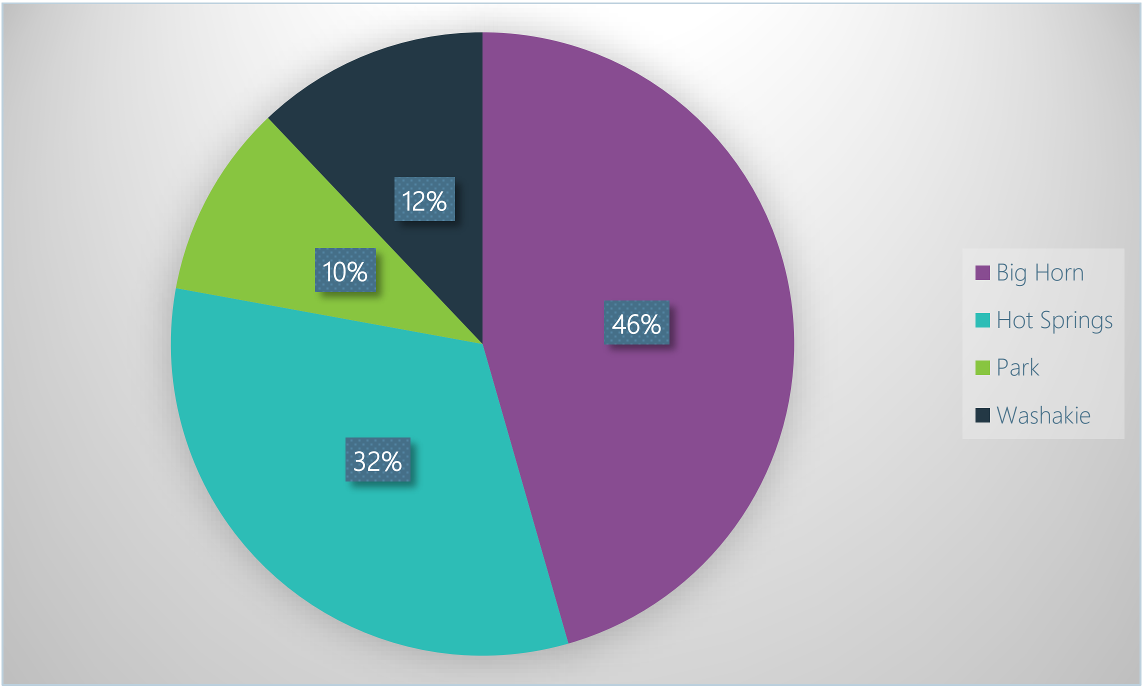


Figure 4-53 Percentage of Total Damages by County: 1958-2020



Critical Facilities and Lifelines

All critical facilities and infrastructure are likely exposed to tornadoes. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

Tornadoes can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Any facility that is in the path of a tornado is likely to sustain damage.

The most serious damage would be seen in the direct path of the tornado, but secondary effects could impact the rest of the county through loss of government services and interruptions in the transportation network.

Economy

Tornado events are generally short-lived, but the impacts may last longer. Damages to commercial structures have the potential to be significant. Debris from the tornado would need to be collected and properly disposed. Such an event would likely have substantial negative effects on the local economy. Tourism may also be interrupted after a tornado event.

Environment and Cultural Resources

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado. Historic buildings built prior to modern building codes would be more prone to damage.

Development Trends

Any future development that is exposed and above ground will be vulnerable to a direct or indirect hit by a tornado. Generally, most areas in the Region lack building codes. In areas where building codes are not in place and enforced, buildings may not be built to withstand tornado-force winds.

Risk Summary Overall Significance by Jurisdiction

Tornadoes are a credible threat and will continue to occur in the counties of Region 6. Depending on a tornado's size, ferocity and path, it can cause devastating damage to people, property and infrastructure, but due to the sporadic nature it is not possible to predict where or when they might affect populated areas in the Region. Hot Springs county raised the significance from Low to Medium during the 2021 planning process.

Table 4-60 Tornado Hazard Risk Summary

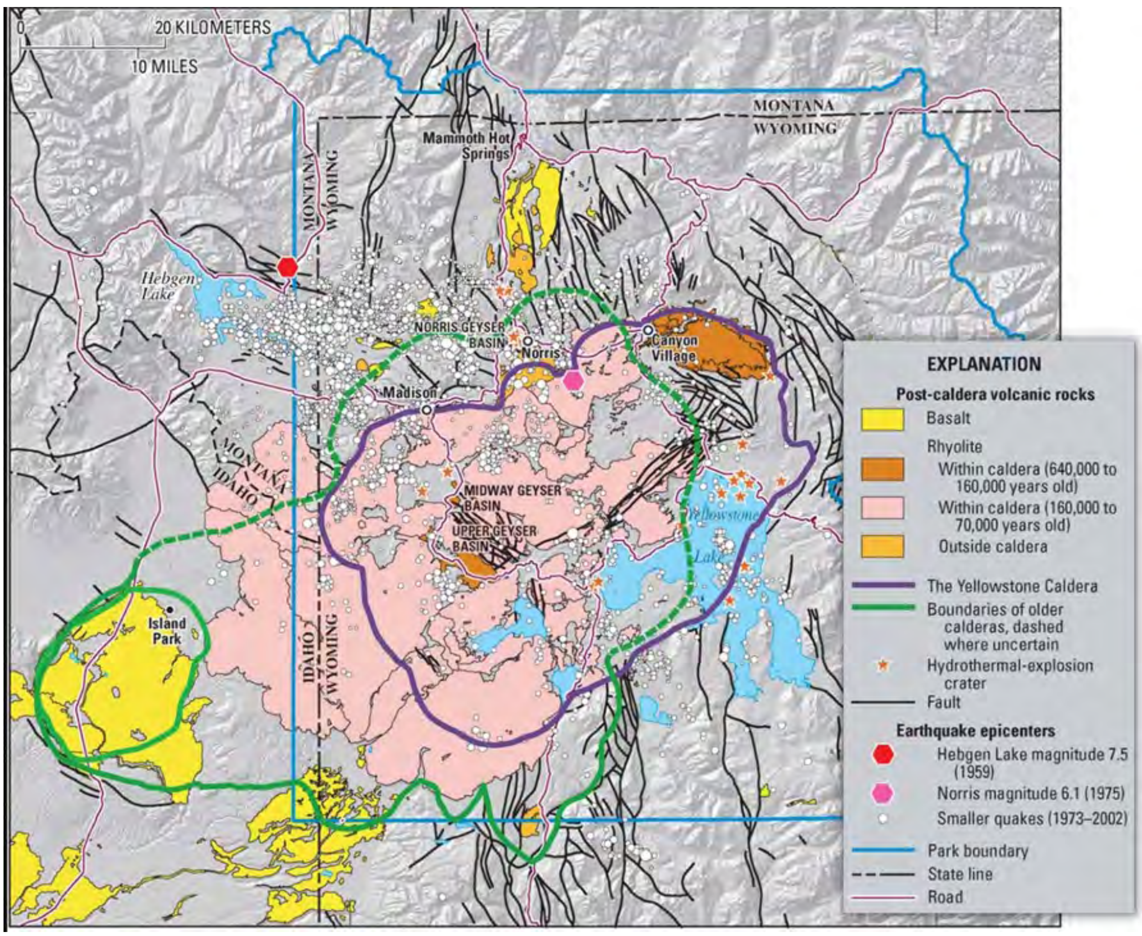
	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Extensive	Highly Likely	Critical	Medium
Hot Springs	Significant	Limited	Highly Likely	Medium
Park	Significant	Limited	Highly Likely	Medium
Washakie	Significant	Limited	Highly Likely	Medium

4.2.17 Volcano

Hazard/Problem Description

A dynamic magma chamber beneath Yellowstone National Park, combined with regional tectonic forces, yields significant seismic activity and a potential volcanic hazard threat in northwestern Wyoming. This is one of the world's largest active volcanoes. A series of cataclysmic eruptions in the past few million years formed large calderas (see Figure 4-57). The youngest is known as the Yellowstone Caldera and was formed 640,000 years ago. Since then, about 80 eruptions of lava (rhyolite and basalt) have occurred, with the latest about 160,000 years ago. Large hydrothermal (steam)-explosions craters have formed in the past 14,000 years near Yellowstone Lake and in major geyser basins in the park (USGS 2005).

Figure 4-54 Volcanic History in the Yellowstone Region



Source: U.S. Geological Survey Fact Sheet 2005-3024

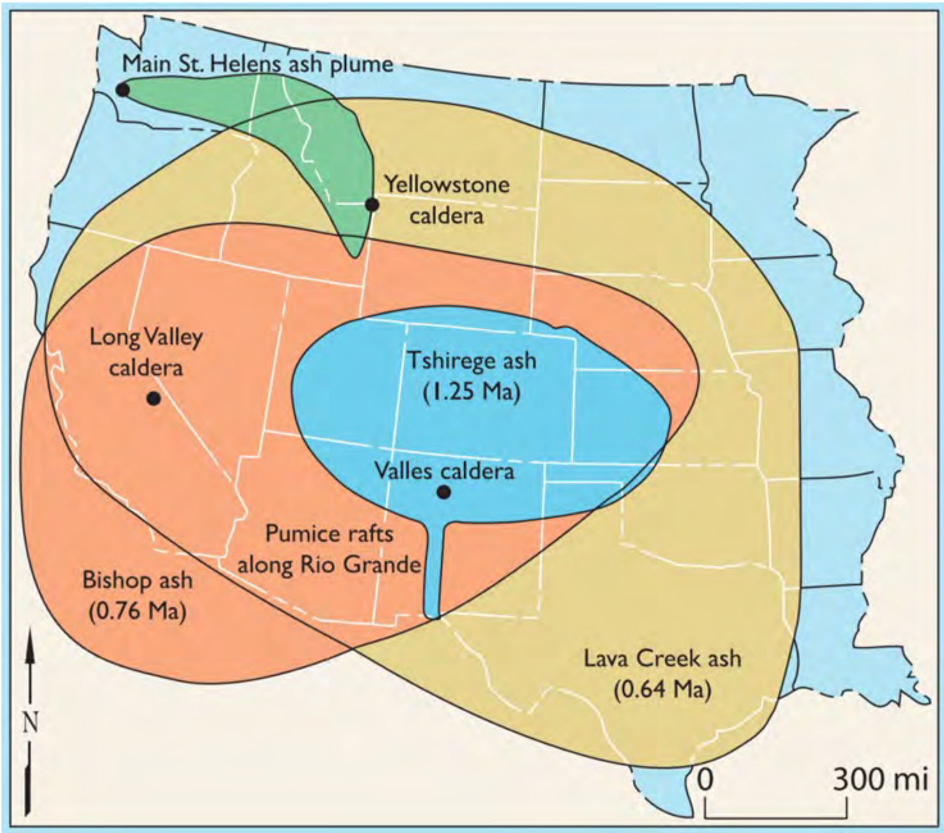
Geographical Area Affected

The only known volcano hazards within the state are located in the northwest corner in the area that is primarily the extent of Yellowstone National Park. It is possible Wyoming could also be affected by ashfall from volcanic activity in the Pacific Northwest.

Past Occurrences

Yellowstone is a super-volcano, and it has explosively erupted 0.64 million, 1.3 million, and 2.1 million years ago. The explosive eruptions led to the formation of three giant calderas, the collapse of which led to the formation of faults. In addition, after major eruptions, resurgent domes formed within the calderas. The Yellowstone Volcano Observatory continuously monitors the area for seismic, hydrothermal, and volcanic activity as well as regional uplift.

Figure 4-55 Ashfall Extent of Four Major Volcano Eruptions in the U.S.



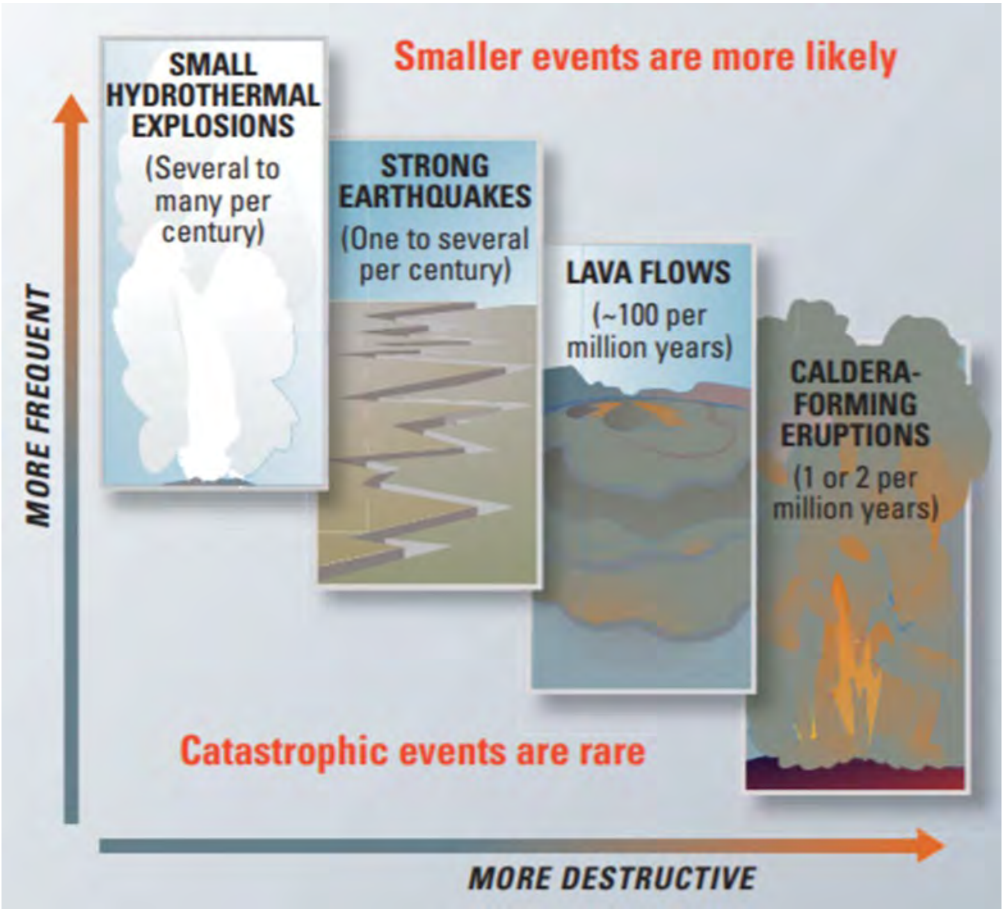
Source: USGS, Public Domain

Frequency/Likelihood of Future Occurrences

The Yellowstone Volcano Observatory (YVO) is a consortium of nine state and federal agencies who provide timely monitoring and hazard assessment of volcanic, hydrothermal, and earthquake activity in the Yellowstone Plateau region. The USGS arm of YVO is also responsible for monitoring and reporting on volcanic activity in the intermountain west U.S. states. The YVO began operations in 2001 with a mission to be able to detect dangerous events before they occur.

Based on the YVO partners' studies in the Yellowstone region, damaging hydrothermal explosions and earthquakes can occur several times a century. Lava flows and small volcanic eruptions occur only rarely—none in the past 70,000 years. Massive caldera-forming eruptions, though the most potentially devastating of Yellowstone's hazards, are extremely rare—only three have occurred in the past several million years. The YVO scientists see no evidence that another such cataclysmic eruption will occur at Yellowstone in the foreseeable future. Recurrence intervals of these events are neither regular nor predictable (USGS 2005).

Figure 4-56 Comparison of Probability of Hazardous Events Association with the Yellowstone Volcano



Source: U.S. Geological Survey Fact Sheet 2005-3024

Changing Future Conditions

The volcano hazard is not likely to be affected by changing future conditions; conversely a large-scale eruption could inject enough ash into the atmosphere to alter the future climate for years and possibly decades.

Potential Magnitude (Extent)

The extent and intensity of a volcanic event in Yellowstone has a broad range. On the low end small hydrothermal explosions and earthquakes could cause local impacts to the Park's natural resources and possibly road and building infrastructure. If these events coincide with the summer tourism season there could be injuries and deaths if the events happen without advanced warning.

According to the USGS, more likely than a large explosive caldera-forming eruption is the eruption of a lava flow, which would be much less devastating and have more local impacts to the limited road and building infrastructure within the park.

At the upper end of the extent spectrum the results would be catastrophic, not just for Wyoming but across North America and the world. This would include eruptions, pyroclastic flows, and ash fall (regional and worldwide) that could create changes to the global climate (from years to decades). A large-scale eruption would likely be preceded by small hydrothermal explosions and earthquakes.

Vulnerability Assessment

People

Volcanic ash poses a public health risk, especially to children, the elderly, and individuals with cardiac and respiratory considerations. As noted in the Vulnerability Assessment for Lightning hazards, 8% of Medicare beneficiaries in the Region rely on electricity to live independently in their homes. Many of these same individuals will be vulnerable to effects of volcanic ash. The abrasiveness of the volcanic ash particles can scratch the surface of skin and eyes and in general cause discomfort and inflammation.

Property

Ashfall can impact both the interior and exterior of buildings. The interior of buildings can be contaminated with ash that builds up in air vents and filters. The exterior of buildings can have abrasive damage to roofs and gutters can be blocked with ash which could lead to secondary flooding issues. If a rain event was to occur post eruption, it can turn ash into heavy, cement-like sludge that can lead to the collapse of roofs and difficulty when cleaning up.

Critical Facilities and Lifelines

Critical facilities and infrastructure are most vulnerable to the effects of ashfall. Volcanic eruption with ashfall can cause electricity outages and issues with power supply. The air intakes for generators will also be vulnerable to airborne ash post eruption. Telephone and radio communications can also be interrupted and electronic components and short-circuits especially high-voltage circuits and transformers can fail due to ashfall.

Wastewater collection systems are also vulnerable 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 including melting the inside of engines and solidifying the turbine blades ultimately causing the engine to stall. Ash can also lead to the failure of critical navigational and operational instruments.

Economy

In general, volcanic eruptions pose a risk to the tourism economy in the Region. Ashfall can disrupt travel into and out of all areas of the Region and create perilous conditions for residents, tourists and nature alike. Ashfall can also lead to widespread power loss which could have lasting impacts on local businesses. The precipitation of risk after a volcanic event could also lead to a downturn in visitors to the Region leading the local communities to advertise that they are safe to visit.

The agricultural economy is also vulnerable to the effects of ashfall. Crop damage from ashfall can range from negligible to severe, depending on thickness of ash, type and maturity of plants as well as the timing of subsequent rainfall.

Environment and Cultural Resources

Volcanic ash can call 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 that can result in decreased plant photosynthesis and poor pollination if flowers were damaged. Visual inspection of vegetation in a large area in 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 4-61 Typical Effects of Ashfall on the Quality of Surface Water Bodies

Turbidity	Ash suspended in water will increase turbidity in lakes, reservoirs, rivers and stream. 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. • In rivers and streams, there will be a short-lived pulse of dissolved constituents • In 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 https://volcanoes.usgs.gov/volcanic_ash/water_supply.html

Development Trends

Development trends are not anticipated to increase risk or exposure significantly.

Risk Summary and Overall Significance by Jurisdiction

While the probability of an event is extremely low, consequences could be of high magnitude and severity, thus the CPTs ranked the overall hazard significance as High. Smaller, less damaging hydrothermal events would likely precede any catastrophic eruptions.

Table 4-62 Volcano Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Extensive	Unlikely	Catastrophic	High
Hot Springs	Extensive	Unlikely	Catastrophic	High
Park	Extensive	Unlikely	Catastrophic	High
Washakie	Extensive	Unlikely	Catastrophic	High

4.2.18 Severe Winter Weather

Hazard/Problem Description

The National Weather Service defines a storm as "any disturbed state of the atmosphere, especially affecting the Earth's surface, and strongly implying destructive and otherwise unpleasant weather." Winter storms occur during the winter months and produce snow, ice, freezing rain, sleet, and/or cold temperatures. Winter storms are an annual occurrence in climates where precipitation may freeze and are not always considered a disaster or hazard. Disasters occur when the severe storms impact the operations of the affected community by damaging property, stalling the delivery of critical services, or causing injuries or deaths among the population.

Winter storm watches and warnings may be helpful for determining the difference between a seasonal winter storm and a severe winter storm. Warnings are issued if the storm is producing or suspected of producing heavy snow or significant ice accumulations. Watches are usually issued 24 to 36 hours in advance for storms capable of producing those conditions, though criteria may vary between locations. Winter Weather Advisories are issued when a low-pressure system produces a combination of winter weather that presents a hazard but does not meet warning criteria (NWS).

Heavy snow can immobilize the counties in Region 6, isolating communities, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until damages are repaired. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibilities to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents can result with injuries and deaths.

Winter storms in the counties of the Region, including strong winds and blizzard conditions, may cause localized power and phone outages, closures of streets, highways, schools, businesses, and non-essential government operations, and increase the likelihood of winter-weather related injury or death. People may be stranded in vehicles or other locations not suited to sheltering operations or isolated from essential services. A winter storm can escalate, creating life threatening situations when emergency response is limited by severe winter conditions. Other issues associated with severe winter storms include the threat of physical overexertion that may lead to heart attacks or strokes. Snow removal costs can pose significant budget impacts, as can repairing the associated damages caused by downed power lines, trees, structural damages, etc. Heavy snowfall during winter can also lead to flooding or landslides during the spring if the area snowpack melts too quickly.

Geographical Area Affected

Winter storms are a yearly feature of the Wyoming climate and may occur anywhere in the state. Generally, severe winter storm events are considered regional, which implies the storms impact multiple counties simultaneously, often for extended time periods. It is possible for the geographic extent of the hazard to vary significantly within a single county - a regional storm may directly impact only a small portion of the planning area while still extending over a large portion of the surrounding area. However, even in these instances, the impacts and effects of a regional hazard are still felt within the planning area. Therefore, while the percent of the planning area directly affected ranges from less than 10% to 100% depending on the specific circumstances, if any portion of the planning area is impacted by the storm, then the entire planning area suffers indirect impacts.

Past Occurrences

The winter storm history in the Region 6 counties extends from January 1996 to November 2020. According to the NCEI Storm Events Database, the counties in Region 6 experienced 439 separate days with a recorded winter weather incident. Total damages in the Region amounted to $1,015,000 in property damage; most of this occurred in a single storm on October 15th, 1998, and included tree damage, power outages and utility damage, and vehicle accidents. There has been no recorded history of crop damage due to severe winter weather.

Frequency/Likelihood of Occurrence

Winter storms are an annual occurrence in Wyoming, often occurring multiple times each winter, and affecting entire regions in their size and scope. Since 1996, the Region has averaged 18 days with a recorded severe winter incident per year.

Changing Future Conditions

Climate change has the potential to exacerbate the severity and intensity of winter storms, including potential heavy amounts of snow. A warming climate may also result in warmer winters, the benefits of which may include lower winter heating demand, less cold stress on humans and animals, and a longer growing season. However, these benefits are expected to be offset by the negative consequences of warmer summer temperatures.

Potential Magnitude (Extent)

On average the region experiences between 20 and 39 inches of snowfall annually. The following tables shows how winter weather can vary by each county.

Table 4-63 Average Snowfall Events in Region 6

County	Weather Station	Average Annual Snowfall (in.)	Highest Snowfall (in.)/Year
Big Horn	Greybull (484080)[1]	20	62.5 / 1978
Hot Springs	Thermopolis (488875) [2]	34.8	61 / 1955
Park	Cody Muni Airport (481840) [3]	39.3	70.7 / 2000
Washakie	Worland (489770) [4]	30.1	53.1 / 1985

Source: Western Regional Climate Center 1 1951-2016 2 1899-2016 3 1915-2016 4 1907-2016

The National Weather Service (NWS) describes different types of snow events as the following:

- Blizzard - Winds of 35 mph or more with snow and blowing snow reducing visibility to less than ¼ mile for at least 3 hours.
- Blowing Snow - Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- Snow Squalls - Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.

- Snow Showers - Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Snow Flurries - Light snow falling for short durations with little or no accumulation.

The damages caused by severe winter storms and blizzards very and are dependent on several factors: the duration of the storm; the geographic extent; the time of year; meteorological factors such as wind, moisture content of the snow, ground and air temperatures; and the advance warning of the storm. Impacts from the storm dictate the magnitude of the event, emphasizing that the amount snow may not always directly correlate to how bad the storm is. Damaged power lines and dangerous or impassable roadways may forestall the delivery of critical services such as medical and emergency assistance, the delivery of food supplies and medications, or even the provision of basic utilities such as heat and running water. When events happen with a long warning time, it is possible to pre-mitigate the effects of insufficient supply levels or to pre-test emergency generators, which may prevent some of the previously described impacts from occurring. Unanticipated storms increase the number of people stranded, both in cars and at public locations, which may increase the number of injuries and deaths attributed to the event (often caused by exposure) and place uneven and unanticipated strains on public sheltering capacities. The weight of the snow, driven by the water content of the fall, increases the potential for damages caused to structures and trees. Lighter snow caused by extreme cold increases the damages caused to livestock, agriculture and landscaping due to freezing conditions. Winter storms which go through periods of thaw and freeze prolong dangerous icy conditions, increasing the likelihood of frozen and damaged water pipes, impassable or dangerous roadways, damaged communication lines, or more extensive damages to infrastructure and structures caused by seeping water freezing under roofs, porches, patios, inside sidings, or causing damage to vehicles.

Winter storms usually cover a significant part of the State, and as such are easier to describe regionally than on a county-by-county basis.

Vulnerability Assessment

People

The threat to public safety is typically the greatest concern during severe winter storms. While virtually all aspects of the population are vulnerable to severe winter weather, there are segments of the population that are more vulnerable to the potential indirect impacts of a severe winter storm than others, particularly the loss of electrical power. As a group, the elderly or disabled, especially those with home health care services that rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes or other special needs housing may also be vulnerable if electrical outages are prolonged. If they do not have a back-up power source, rural residents and agricultural operations reliant on electricity for heating and water supplies are also especially vulnerable to power outages.

Severe winter weather also increases the vulnerability of the commuting population. While there is no way to quantify which of these accidents occur during severe winter storms versus regular winter storms, the numbers indicate that winter driving conditions raise the vulnerability of the commuting population.

Property

Property vulnerabilities to severe weather include damage caused by high winds, ice, or snowpack and subsequently melting snow. Vehicles may be damaged by the same factors, or temporarily un-useable due to the driving conditions created by severe winter weather. Contents of homes, storage units, warehouses and storefronts may be damaged if the structures are compromised or fail due to the weather, or during potential flooding caused by melting snow. Very wet snowpack down densely and is very heavy. This may create strains on structures, causing partial or entire collapses of walls, roofs, or windows. This is impacted both by architecture and construction material and should be assessed on a building-by-building basis. These records are probably tracked via insurance or other private vendors. Crops, livestock and other agricultural operations are also highly vulnerable to severe winter storms.

Critical Facilities and Lifelines

The physical structures which comprise essential infrastructure are as vulnerable as those outlined in the General Property subsection of this profile. Severe winter weather may also disrupt the availability of services from essential infrastructure, including utility delivery (gas, electric and water), telephone service, emergency response personnel capabilities, road plowing, and childcare availability. Severe winter storms may even halt the operation of an area for periods of time, making the vulnerability of the counties even higher.

As mentioned previously, ice or heavy accumulations of snow, particularly with blowing and drifting, can temporarily impact the roadway system. These accumulations also require vast amounts of overtime for County and local highway and streets departments to remove snow and melt ice. The Park CPT noted the pre-emptive closing of the road between Meeteetse and Cody during events has helped mitigate stranded travelers, but other highways such as 14A and 120 North are not closed and can have issues.

Ice storms or high winds in winter storms can cause extensive loss of overhead utility lines due to buildup either on the lines or on adjacent trees that either collapse due to the weight or blow down onto the utility lines. Services such as telephone, electricity, and cable TV are frequently affected by winter storms. The Washakie CPT noted power line damages with outages lasting 2-4 hours; lower income populations and homes with baseboard heaters are more vulnerable in these situations.

Economy

Closure of major transportation routes during severe winter storms could temporarily isolate communities and further isolate the more remote areas in the Region. Depending on the length of the closure it could also hinder the local economy by disrupting tourism and out of county visitors, and as well as the potential impacts to shipping delays from a closure. Snow removal costs can also impact budgets significantly.

According to NCEI records, since 1996 winter storm events have caused $1,015,000 in property damages. The Region is estimated to experience an average annual loss of $42,292 due to winter storm hazards.

Environment and Cultural Resources

Natural resources may be damaged by the severe winter weather, including broken trees and death of unsheltered wildlife. Unseasonable storms may damage or kill plant and wildlife, which may impact natural food chains until the next growing season. Historical areas may be more vulnerable to severe winter storms due to construction and age of structures. Cultural resources generally experience the same vulnerabilities outlined in General Property, in addition to lost revenue impacts due to transportation impacts. The overall vulnerability of these resources is medium.

Development Trends

Park County noted that the Badger Basin Highway between Cody and Powell is becoming busier with recent development and is not on the WY Road Report, which could mean more potential for stranded travelers.

Where building codes are applicable, future residential or commercial buildings built to code should be able to withstand snow loads from severe winter storms. Future power outages or delays in power delivery to future developments may be mitigated by construction considerations such as buried power lines. Future development will also require future considerations for snow removal capacity including equipment, personnel, and logistical support. Adequate planning will help establish the cost-effective balance.

Public education efforts may help minimize the risks to future populations by increasing knowledge of appropriate mitigation behaviors, clothing, sheltering capacities, and decision making regarding snow totals, icy roads, driving conditions, and outdoor activities (all of which are contributors to decreased public safety during severe winter storms). New establishments or increased populations who are particularly vulnerable to severe winter storms (such as those with health concerns or those who live in communities that may be isolated for extended periods of time due to the hazard) should be encouraged to maintain at least a 72-hour self-sufficiency as recommended by FEMA. Encouraging contingency planning for businesses may help alleviate future economic losses caused by such hazards while simultaneously limiting the population exposed to the hazards during commuting or commerce-driven activities.

Risk Summary and Overall Significance by Jurisdiction

Winter Storms are generally a medium to high significance hazard in the Region. Strategic road closing to prevent stranded motorists has helped mitigate losses in certain areas in the Region.

Table 4-64 Winter Storm Hazard Risk Summary

	Geographic Extent	Probability of Future Occurrence	Potential Magnitude/Severity	Overall Significance
Big Horn	Extensive	Highly Likely	Critical	Medium
Hot Springs	Extensive	Likely	Limited	Medium
Park	Extensive	Highly Likely	Limited	High
Washakie	Extensive	Likely	Limited	Medium

4.2.19 Wildfire

Hazard/Problem Description

Wyoming's semi-arid climate and rural character make the state vulnerable to frequent and sometimes catastrophic wildland fires. As defined by the National Interagency Fire Center (NIFC), a "wildland fire" is any non-prescribed, non-structure fire that occurs in the wildland. Other key terms include:

- **Wildland Urban Interface (WUI)** describes any area where man-made structures are constructed close to or within a boundary of natural terrain and fuel, where high potential for wildland fires exists.
- **Fuel** consists of combustible material, including vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire.
- **Aspect** refers to the direction in which a slope faces.

Wildfires can occur at any time of the year, but are most likely to occur during the spring, summer, or fall. Thunderstorms that contain lightning frequently start wildfires. Wildfires are often also sparked by utilities and vehicles as well. According to the Wyoming State Forestry Division, the majority of wildfires in the state are started by humans.

It should be noted that fires are also an important natural component of the natural ecosystem. Wildlands need to burn periodically to naturally maintain viable environments. Fuel maintenance (controlled burns, mowing, cattle grazing, and other means) is a necessary replacement to uncontrolled wildland fires because of threats to human habitation.

Generally, there are three major factors that sustain wildfires and predict a given area's potential to burn. These factors are fuel, topography, and weather.

- Fuel—Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Also, to be considered as a fuel source are manmade structures, such as homes and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Fuel is the only factor that can be modified by humans. The main fuel types in Merced County are crops and grasses, while there are also brush and pine fuels present in some areas in the southwest of the county.
- Topography—An area's terrain and slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement and types of vegetation throughout a hillside can also contribute to increased fire activity on slopes.
- Weather—Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will more readily ignite and burn more intensely. Thus, during periods of drought, the threat of wildfire increases. Wind is the most influential weather factor of the three and its influence can increase rates of spread regardless of temperature and relative humidity.

As the population and the wildland/urban interface in Wyoming increases, the more significant the risk of wildland fire hazard. The past 100 years of wildland fire suppression has led to heavy vegetation growth and thus has greatly increased the potential fuel-load for a wildfire to burn. As the wildland/urban interface has grown into these densely packed forests, the potential for catastrophic wildland fires has increased as well. Fires have historically played a natural role on western landscapes. For example, some species of trees occupy sites following fire until replaced by more shade-tolerant species. In some cases, regeneration of vegetation can be enhanced by fire. Fires may have positive or negative effects, or both, depending upon the resources at risk in the fire area.

Geographical Area Affected

Certain areas of the counties in Region 6, because of their semi-arid climate and availability of fuel, are vulnerable to catastrophic wildland fires, and over 50% involve wildland areas. The entire Region could potentially burn from wildfires, with the exception of areas above the tree line. According to the methodology for characterizing spatial extent, a significant portion of the planning area is affected by wildfires.

Figure 4-55 shows the areas at greatest risk of wildfire, based on WYWRAP data. While the threat of wildfire is statewide and regionwide, the greatest risk to people and property is concentrated near inhabited areas. Figure 4-56 shows the risk to Wildland Urban Interface (WUI) areas, classified as wildfire threat compared against the average number of houses per acre. WYWRAP data uses Wildland Development Areas (WDA) as a surrogate for the original WUI data layer to represent where people live in the wildland.

Figure 4-57 Region 6 Wildfire Risk

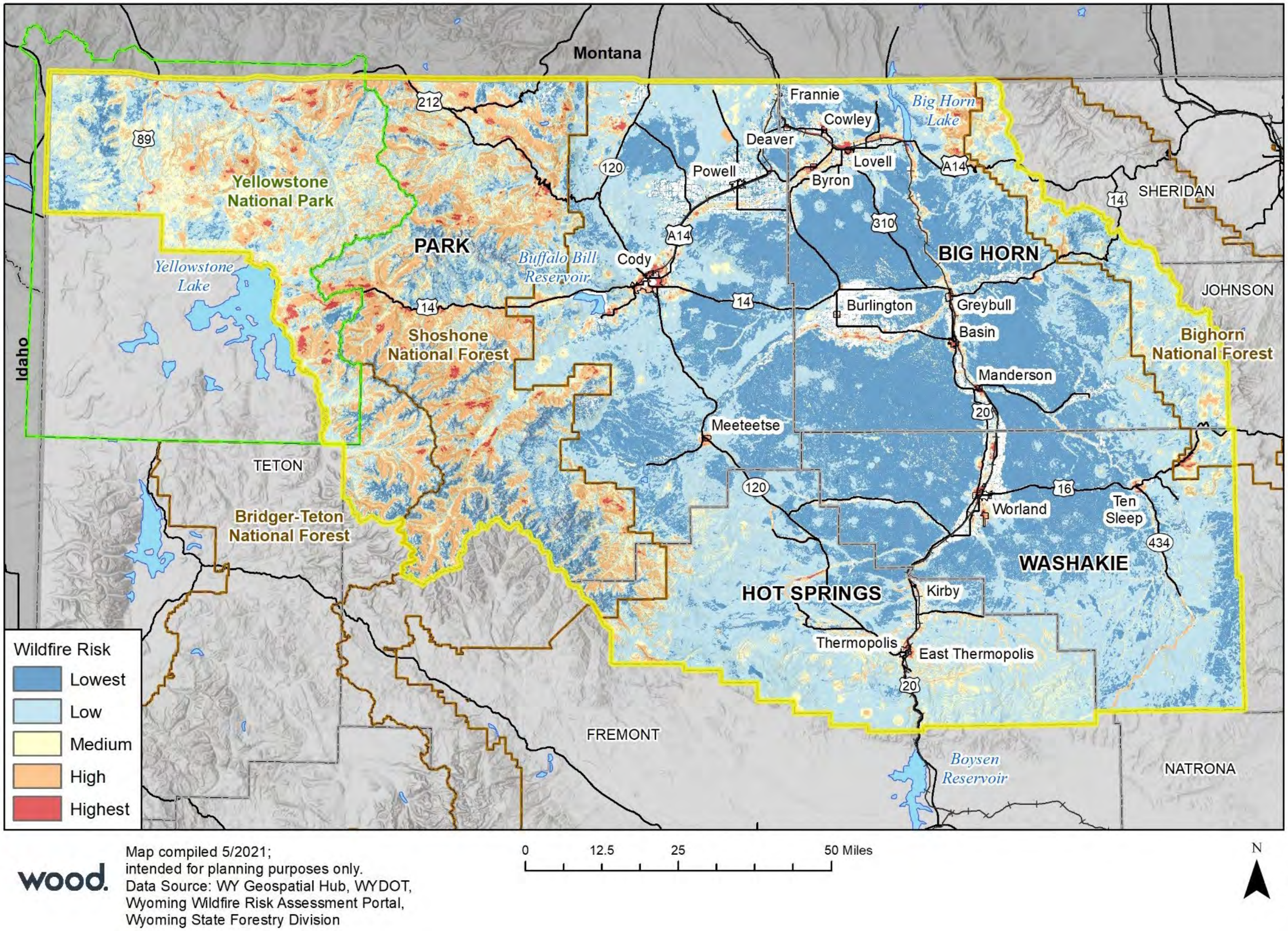
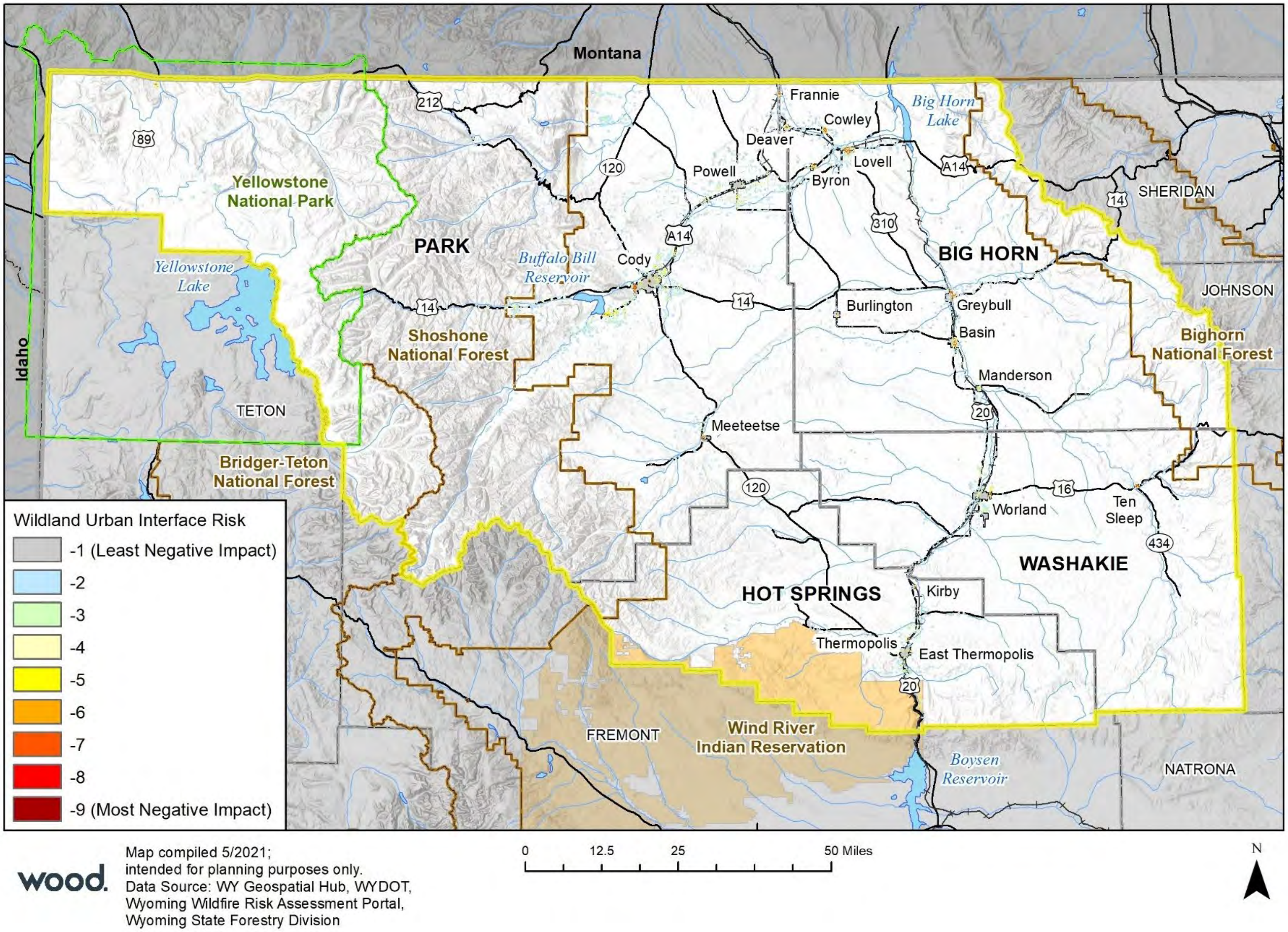


Figure 4-58 Region 6 Wildland Urban Interface (WUI) Risk



Past Occurrences

The Federal Wildland Fire Occurrence database, maintained by the USGS and other agencies, includes perimeter and point GIS layers for fires on public lands throughout the United States. The data includes fires dating back to 1980. The National Park Service, Bureau of Land Management, and US Forest Service reports include fires of 10 acres and greater. The database is limited to fires on federal lands. Some fires may be missing altogether or have missing or incorrect attribute data. Some fires may be missing because historical records were lost or damaged, fires were too small for the minimum cutoffs, documentation was inadequate, or fire perimeters have not yet been incorporated into the database. Also, agencies are at different stages of participation. For these reasons, the data should be used cautiously for statistical or analytical purposes.

Perhaps the most notable fire incident in Wyoming State history were the Yellowstone Fires in the late 1980s. The Yellowstone National Park fires of 1988 were the largest series of fires in the northern Rockies during the last 50 years. Fifty fires started in the park that year. These fires, along with other natural and human-caused fires that began outside the Park boundaries, eventually burned more than a third of the Park, nearly 800,000 acres. Another 700,000 acres outside the Park also burned. Figure 4-57 displays the extent of burned area from the fires. Approximately 25,000 firefighters worked to put out the fires. The costs exceeded $120 million. Roughly half of the national park lies within northwestern Park County.

Figure 4-59 Extent of 1988 Yellowstone Fires

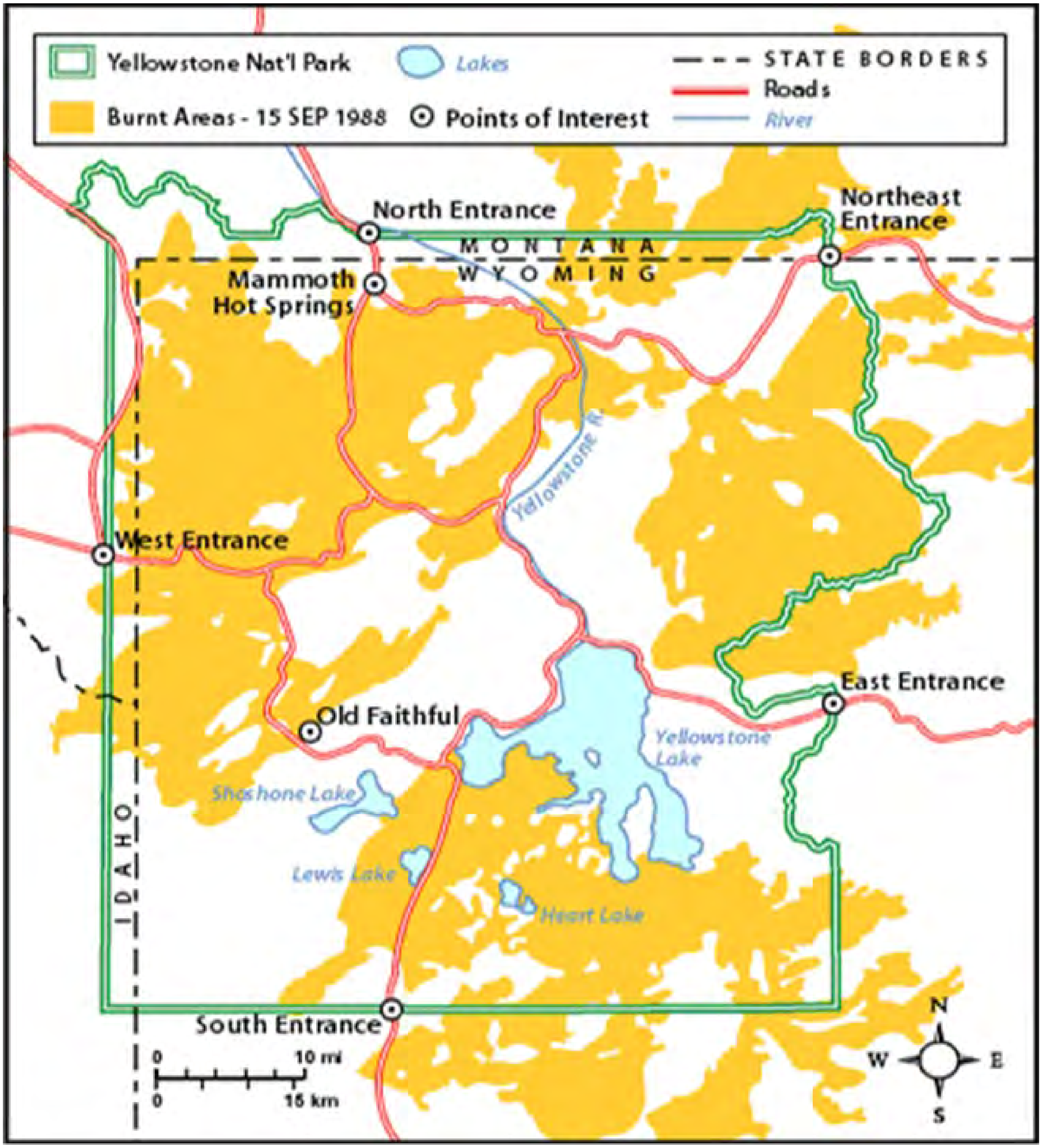
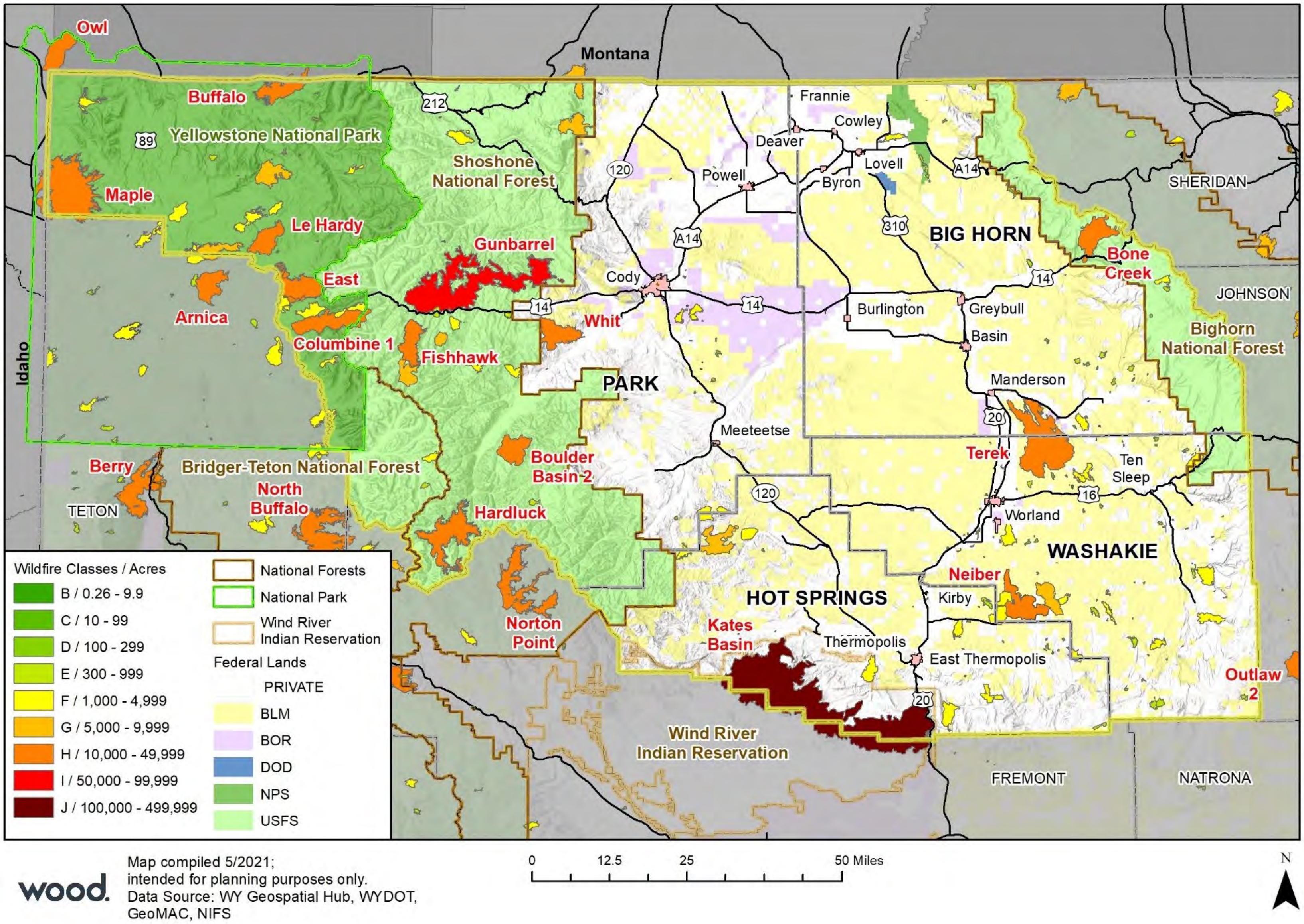


Figure 4-58 below shows a map of past wildfires that have affected Region 6 based on the Federal Wildland Occurrence Database. Some of the largest recorded fires occurred in the northwest part of the Region. Some of the more significant fires are detailed further in the county annexes.

Figure 4-60 Region 6 Past Wildfire Occurrences, 2000-2020



Frequency/Likelihood of Occurrence

Wildfires are highly likely to occur in each county in the Region each year, meaning that there is nearly a 100% chance of a fire happening in any given year. It is important to note that the risk of wildfires occurring may increase during times of drought, especially prolonged droughts such as the statewide Wyoming drought that began between 1999 and 2000 and the 1988 drought in northwestern Wyoming. Table 4-59 below summarizes the average annual number of occurrences by county in Region 6, based on analysis of data from WYWRAP conducted during the 2021 Wyoming State HMP update. This information and past record of events also suggests that each county can expect at least one fire to occur annually.

Table 4-65 Region 6 Average Number of Wildfires Per Year by County, 2000-2019

County	Annual Average
Big Horn	2
Hot Springs	3
Park	4
Washakie	5

Source: WYWRAP, 2021 Wyoming State Hazard Mitigation Plan

Changing Future Conditions

The effects of future changing conditions have the potential to impact wildfire behavior, the frequency of ignitions, fire management, and fuel loads. Increasing temperatures may intensify wildfire threat and susceptibility to more frequent wildfires in the state. Forests are also sensitive to variable precipitation events, as drought has contributed to trees being more susceptible to pests and pathogens, in turn contributing to greater amounts of standing dead fuels. The extending of the wildfire season into winter months, coinciding with seasonal high wind patterns, can also create dangerous fire behavior.

While the recent historic trend shows a general upward trend in acreage burned per year, it is noted that not all wildfires are considered destructive given that there are positive ecological benefits from periodic fires. Suppression resources have been more focused on wildfires with life and safety threats in recent decades.

Potential Magnitude (Extent)

Most of the counties ranked the potential magnitude as limited, defined as 10 to 25 percent of property is severely damaged, facilities and services are unavailable between 1 and 7 days. However, wildfire can have significant economic impacts as they often coincide with the busy tourist season in the summer months. More specific consequences are discussed by county in the next section. It is important to note that the magnitude of a wildfire can be intensified by drought.

Vulnerability Assessment

People

The most exposed population are those living in the wildland-urban interface (WUI) zones, where residential properties are directly intruding into traditional wildland areas. The exposure of the population in these zones increases with the exposure of the corresponding general property, examined in the section below. Other indirect impacts from wildfires on people are related to dense smoke from fires within the region. Wildfires in the past three years have decreased the air quality throughout the entire Western United States. Dense smoke poses a risk to both people with compromised health as well as those considered healthy. A study from the University of California San Diego found that wildfire smoke is more harmful to respiratory health in humans than pollution from cars (NPR 2021). Studies have also shown an increase in ambulance calls, hospital visits and an increase of people experiencing respiratory or cardiac emergencies (NPR 2020).

Population at-risk estimates were developed by multiplying the average household size from the U.S. Census for each county in the region by the number of residential structures within the Medium, High, and Highest wildfire risk areas based on WYWRAP data. These results are shown in Table 4-60 below. It is important to note that many of these structures may include seasonal homes that could be vacant, although the likelihood of them being occupied during fire season is higher.

Table 4-66 Region 6 Population at Risk to Wildfire Hazard

	Big Horn County	Hot Springs County	Park County	Washakie County
Medium Wildfire Risk	452	145	1,407	267
High Wildfire Risk	926	275	2,917	615
Highest Wildfire Risk	3,562	55	2,321	620
Total	**4,940**	**475**	**6,645**	**1,502**

Source: WYWRAP, Wood GIS Analysis

Property

The potential impacts of wildfire on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings located throughout the wildfire risk area, with greatest potential impact on property, buildings and infrastructure located within high and very high hazard zones including the WUI, and buildings and infrastructure located within forested lands, to include national forests and parks.

Another method of estimating vulnerability is to determine the value of structures that are located within wildfire risk areas. For this plan update, GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was overlaid on the wildfire hazard layer. For purposes of this analysis, it was assumed that every parcel with an improved value greater than zero was developed in some way, thus only improved parcels and their values were analyzed. An analysis of the value of those parcels (the improvement value plus estimated value of building contents) quantifies the potential losses from wildfires. The results of this analysis are summarized in Table 4-61. The total values shown in below include both structure value and contents and can be used as an estimate of potential losses since wildfires typically result in a total loss. An estimated $1.89 billion in property is potentially exposed to the wildfire hazard throughout Region 6. The majority of this exposure is in Park County.

Table 4-67 Wildfire Hazard Exposure – General Property Summary by County

County	Jurisdiction	Parcel Count Highest	Parcel Count High	Parcel Count Medium	Total Parcel Count	Improved Value	Estimated Content Value	Total Value
Big Horn County	Basin	257	24	-	**281**	$29,796,371	$15,680,381	**$45,476,752**
	Burlington	37	11	-	**48**	$5,966,693	$3,336,169	**$9,302,862**
	Byron	137	11	1	**149**	$12,183,849	$6,946,545	**$19,130,394**
	Cowley	194	9	-	**203**	$28,387,639	$16,050,927	**$44,438,566**
	Deaver	52	5	2	**59**	$4,108,673	$2,396,067	**$6,504,740**
	Frannie	-	43	1	**44**	$2,915,733	$1,642,362	**$4,558,095**
	Greybull	145	53	2	**200**	$17,860,883	$9,765,736	**$27,626,619**
	Lovell	450	3	-	**453**	$45,895,248	$24,057,283	**$69,952,531**

County	Jurisdiction	Parcel Count Highest	Parcel Count High	Parcel Count Medium	Total Parcel Count	Improved Value	Estimated Content Value	Total Value
	Manderson	28	-	-	**28**	$2,626,653	$1,711,144	**$4,337,797**
	Big Horn Unincorporated	195	271	196	**662**	$88,389,463	$51,785,598	**$140,175,061**
	Total	**1,495**	**430**	**202**	**2,127**	**$238,131,205**	**$133,372,209**	**$371,503,414**
Hot Springs County	East Thermopolis	2	-	-	**2**	$583,102	$291,551	**$874,653**
	Kirby	-	29	-	**29**	$1,466,304	$912,957	**$2,379,261**
	Thermopolis	8	-	-	**8**	$732,967	$511,013	**$1,243,980**
	Hot Springs Unincorporated	21	119	82	**222**	$41,651,950	$26,828,954	**$68,480,904**
	Total	**31**	**148**	**82**	**261**	**$44,434,323**	**$28,544,474**	**$72,978,797**
Park County	Cody	583	29	-	**612**	$182,925,232	$112,729,814	**$295,655,046**
	Meeteetse	102	1	-	**103**	$10,636,768	$5,527,513	**$16,164,281**
	Powell	6	1	6	**13**	$5,170,859	$4,894,445	**$10,065,304**
	Park Unincorporated	413	1,262	621	**2,296**	$594,658,518	$313,117,040	**$907,775,558**
	Total	**1,104**	**1,293**	**627**	**3,024**	**$793,391,377**	**$436,268,811**	**$1,229,660,188**
Washakie County	Ten Sleep	66	-	-	**66**	$7,885,427	$4,221,904	$12,107,331
	Worland	61	34	7	**102**	$24,617,438	$18,550,548	$43,167,986
	Washakie Unincorporated	196	254	124	**574**	$99,495,552	$54,700,320	$154,195,872
	Total	**323**	**288**	**131**	**742**	**$131,998,417**	**$77,472,771**	**$209,471,188**
	Grand Total	**2,953**	**2,159**	**1,042**	**6,154**	**$1,207,955,322**	**$675,658,264**	**$1,883,613,586**

Critical Facilities and Lifelines

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 overlay was performed with the wildfire hazard layers and the critical facility point data. Replacement values were not available with the data thus an estimate of potential monetary loss could not be performed. Impacts to any of these facilities could have wide ranging ramifications, in addition to property damage and other cascading impacts.

The total counts and types of critical facilities by FEMA Lifeline category are summarized below.

Table 4-68 Critical Facilities at Risk to Medium Wildfire Risk by Jurisdiction and FEMA Lifeline

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn	Unincorporated	8	1	-	-	1	-	2	**12**
	Total	**8**	**1**	**0**	**0**	**1**	**0**	**2**	**12**

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Hot Springs	Unincorporated	6	3	-	-	-	-	1	**10**
	Total	**6**	**3**	**0**	**0**	**0**	**0**	**1**	**10**
Park	Powell	-	-	-	-	-	1	-	**1**
	Unincorporated	58	5	-	-	-	-	12	**75**
	Total	**58**	**5**	**0**	**0**	**0**	**1**	**12**	**76**
Washakie	Unincorporated	5	2	-	-	-	-	5	**12**
	Total	**5**	**2**	**0**	**0**	**0**	**0**	**5**	**12**

Table 4-69 Critical Facilities Exposed to High Wildfire Risk by Jurisdiction and FEMA Lifeline

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn	Basin	2	1	2	-	-	-	-	**5**
	Burlington	3	-	-	-	-	-	-	**3**
	Byron	1	-	-	-	-	-	-	**1**
	Deaver	1	-	-	-	-	-	-	**1**
	Greybull	-	-	-	-	-	1	-	**1**
	Unincorporated	11	3	4	-	-	1	8	**27**
	Total	**18**	**4**	**6**	**0**	**0**	**2**	**8**	**38**
Hot Springs	Unincorporated	5	-	-	-	-	-	10	**15**
	Total	**5**	**0**	**0**	**0**	**0**	**0**	**10**	**15**
Park	Cody	3	-	-	-	-	-	-	**3**
	Meeteetse	-	1	-	-	-	-	-	**1**
	Powell	1	-	-	-	-	-	-	**1**
	Unincorporated	38	9	-	-	-	8	37	**92**
	Total	**42**	**10**	**0**	**0**	**0**	**8**	**37**	**97**
Washakie	Unincorporated	2	2	-	1	-	-	7	**12**
	Total	**2**	**2**	**0**	**1**	**0**	**0**	**7**	**12**

Table 4-70 Critical Facilities Exposed to Highest Wildfire Risk by Jurisdiction and FEMA Lifeline

County	Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Big Horn	Basin	6	-	-	-	2	2	-	**10**
	Burlington	3	-	-	-	1	3	-	**7**
	Byron	-	1	-	-	-	-	-	**1**
	Cowley	2	-	-	-	-	1	-	**3**
	Deaver	-	-	-	-	1	2	-	**3**
	Greybull	-	-	-	-	1	1	-	**2**
	Lovell	5	-	-	-	1	4	-	**10**
	Manderson	-	-	-	-	-	-	-	**0**
	Unincorporated	3	1	2	-	-	-	6	**12**
	Total	**19**	**2**	**2**	**0**	**6**	**13**	**6**	**48**
Hot Springs	Thermopolis	4	-	-	-	-	1	-	**5**
	Unincorporated	1	-	-	-	-	-	1	**2**
	Total	**5**	**0**	**0**	**0**	**0**	**1**	**1**	**7**
Park	Cody	4	-	-	-	-	1	-	**5**
	Meeteetse	-	-	2	-	-	-	-	**2**
	Unincorporated	10	1	2	-	1	1	16	**31**
	Total	**14**	**1**	**4**	**0**	**1**	**2**	**16**	**38**
Washakie	Ten Sleep	1	-	-	-	1	2	-	**4**
	Worland	2	1	-	-	-	-	1	**4**
	Unincorporated	7	2	2	-	-	-	5	**16**
	Total	**10**	**3**	**2**	**0**	**1**	**2**	**6**	**24**

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. Tourism in Region 6 plays a major economic role, with the presence of Yellowstone National Park and other outdoor recreational opportunities. Damage to these assets or disruption of access to them can have far reaching negative impacts to the local economy. 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.

Environment and Cultural Resources

According to GIS mapping, the Big Cedar Ridge Fossil Plant Area in Washakie County is vulnerable to wildfires. This area is home to fossilized prehistoric plant remains. Historic resources such as this provide insight into what Washakie County’s environment was like millions of years ago.

A large percentage of Park County includes Yellowstone National Park, which is a crown jewel in the National Park system and contains many natural and cultural resources potentially at risk. Wildfires in Yellowstone also have a regional impact on summer tourism.

The Hot Springs County CWPP notes Areas of Critical Environmental Concern and sage grouse leks on maps. While wildfire is generally beneficial to most wildlife species, negative impacts can occur where significant areas of sagebrush are burned within crucial mule deer winter range and sage-grouse breeding and winter habitats.

Other natural resources and natural areas may actually benefit from wildland fire, as at some level they must also be exposed to wildfire for a healthy ecological development of the area. Historic and cultural resources exhibit a vulnerability rating similar to those in general property, where vulnerability ratings increase the further into the WUI the property is, and the less mitigated the landscaping surrounding the property is. In addition, older buildings may be exempt from internal fire mitigation such as sprinklers and fire suppression technology, which may increase the vulnerability of the resource.

Development Trends

The wildland/urban interface (WUI) is a very popular building location, as shown by national and statewide trends. More and more homes are being built in the interface. Overall, Wyoming has less developed wildland urban interface than most western states. According to the Park CPT during the 2021 update there continues to be development pressures in the WUI. Throughout the Region there remains potential for future home construction in undeveloped, forested private lands adjacent to fire-prone public lands. Building homes in these high-risk areas would put lives and property in the path of wildfires. Regulating growth 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 set forth to include ponds, access by apparatus, pumps, and backup generators. Such standards serve to protect residents and property, as well as emergency services personnel.

Risk Summary and Overall Significance by Jurisdiction

Wildfires occur within the region on generally an annual basis. Based on GIS analysis, the Region has over $1.8 billion in building value potentially at risk to wildland fires. Though it is not likely that the areas at risk will simultaneously face a completely destructive event, this figure provides the upper end of what could be affected.

Overall, wildfire is a high significance hazard to the Region. County ratings are noted in the table below.

Table 4-71 Wildfire Hazard Risk Summary

County	Likelihood	Spatial Extent	Potential Magnitude	Significance
Big Horn	Highly Likely	Extensive	Catastrophic	High
Hot Springs	Likely	Significant	Limited	High
Park	Likely	Significant	Limited	High
Washakie	Likely	Significant	Limited	High

Municipalities most impacted: Ten Sleep, Thermopolis and E Thermopolis (direct and indirect impacts); Cody (direct and indirect impacts);

5 Mitigation Strategy

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.

5.1 Mitigation Strategy: Overview

This section describes the mitigation strategy process and mitigation action plan for the Region 6 Hazard Mitigation Plan. It describes how the counties 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 county's HMPC 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 Goals and Objectives

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

Up to this point in the planning process, each county's CPT has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals and mitigation actions were developed and updated based on these tasks. During the 2021 update of this plan each county CPT held a series of meetings designed to update and achieve a collaborative mitigation strategy as described further throughout this section.

During the first set of planning workshops held in 2021, the counties reviewed the results of the hazard identification, vulnerability assessment, capability assessment and goals from the State of Wyoming Multi-Hazard Mitigation Plan. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the counties to update planning goals and to base the development of new or updated mitigation strategies for the counties in the Region.

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;
- 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. Objectives define strategies to attain the goals and are more specific and measurable and are sometimes developed in mitigation planning as an intermediate step between goals and mitigation actions or projects.

The update of goals for each county in the region was initiated through a facilitated discussion at the second planning workshops held in 2021 (Risk Assessment and Goals workshop). The HMPC members were provided a PowerPoint presentation that explained goals, objectives and actions and listed examples of each. Existing plan goals and related plan goals were noted in the PowerPoint, including the State of Wyoming Multi-Hazard Mitigation Plan (2020). This review was to ensure that the Regional plan's mitigation goals were aligned and integrated with existing plans and policies. Based on discussion at the CPT meetings the groups decided that the mission statement from the Wyoming Multi-Hazard Mitigation Plan was applicable as an overall mission statement for the Region as well.

The mission statement of the Region 6 Mitigation Plan is to *"reduce or eliminate risk to human life and property from hazards."*

Based on this mission statement, the risk assessment review and the goals update process, each county identified or updated county-specific goals which provide the direction for reducing future hazard-related losses within the county and regional planning area. During the 2021 planning process, the Park County CPT determined their goals were still valid and did not change them. Washakie County CPT suggested minor edits to goal one, to include visitors in addition to residents as well as adding a new goal four related to lifelines. Similarly, the Hot Springs County CPT also added mention of lifelines to their goal one and added a 4th goal to emphasize life safety. The Big Horn County CPT decided to revise their goals to align generally with the State Mitigation Plan goals, with some modifications. The updated goal statements for each county in the Region are noted below.

Hot Springs County Goals

- **Goal 1:** Strengthen Public Infrastructure and Lifelines
- **Goal 2:** Improve Existing Mitigation Capabilities
- **Goal 3:** Reduce Economic Losses due to Hazard Events including costs of Response and Recovery
- **Goal 4:** Reduce life safety impacts including vulnerable populations such as those with access and functional needs

Park County Goals

- **Goal 1:** Mitigate the effect of hazards through education, ordinances, resolutions, and clear definition and implementation of mitigation projects to enhance life-safety and reduce the loss of property of residents and visitors to Park County.
- **Goal 2:** Coordinate mitigation activities with all entities of Park County to assess the hazards and take various actions to reduce or eliminate the risk factors of those hazards.
- **Goal 3:** Reduce the local economic impact caused by the effects of hazards in the communities

Washakie County Goals

- **Goal 1:** Mitigate the effect of identified hazards through education, ordinances, resolutions, and clear definition and implementation of mitigation projects to reduce the loss of property and enhance life-safety of residents and visitors

- **Goal 2:** Coordinate mitigation activities with all entities of Washakie County to assess the identified hazards and take various actions to reduce or eliminate the risk factors of those hazards.
- **Goal 3:** Reduce the economic impact on the local economy caused by the effects of identified hazards in the communities.
- **Goal 4:** Strengthen Public Infrastructure and Lifelines.

Big Horn County Goals

- **Goal 1:** Strengthen public infrastructure and lifelines and reduce property losses.
- **Goal 2:** Improve existing mitigation capabilities.
- **Goal 3:** Reduce economic losses and losses of life due to hazard events.
- **Goal 4:** Reduce costs of response and recovery.

5.3 Identification and Analysis of Mitigation Actions

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

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 2021 planning process each county's CPT analyzed viable mitigation options by hazard that supported the identified goals. The CPT considered the following categories of mitigation actions, as defined in FEMA's 2013 *Local Mitigation Planning Handbook*:

- Plans and regulations: These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
- Structure and infrastructure projects: These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- Natural systems protection: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.
- Education and awareness: These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

The CPT was also provided with the following list of categories of mitigation actions, which originate from the Community Rating System:

- **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**: 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.
- **Emergency services:** Actions that protect people and property during and immediately after a disaster or hazard event.
- **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.

In order to identify and select mitigation actions to support the mitigation goals, each hazard identified and profiled in Chapter 4 was evaluated. At the mitigation strategy workshops the counties were also provided a matrix showing examples of potential mitigation action alternatives for each of the above categories, for each of the identified hazards. The counties were also provided a handout that explains the categories and provided further examples. Finally, two documents from FEMA were suggested as reference for ideas and best practices: The Hazard Mitigation Assistance Mitigation Action Portfolio (2020) and Mitigation Ideas (2013). These documents list the common alternatives for mitigation by hazard and/or best practices and examples of successful mitigation projects funded by FEMA. The counties were asked to consider both future and existing buildings in considering possible mitigation actions. A facilitated discussion then took place to examine and analyze the options. Appendix B provides the matrix of alternatives considered. Each proposed action was written on a large sticky note and posted on flip charts in the meeting rooms underneath the hazard it addressed. The result was a number of new project ideas with the intent of reducing the impacts of the identified hazards.

The mitigation strategy is based on existing local authorities, policies, programs, and resources, as well as the ability to expand on and improve these existing tools. As part of the Regional Plan update the county planning teams reviewed existing capabilities for reducing long-term vulnerability to hazards. Those capabilities are noted by jurisdiction in the county annexes and can be assessed to identify gaps to be addressed and strengths to enhance through new mitigation actions. For instance, gaps in 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 came to 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 was identified to provide additional details on the project so they could be captured in the plan. Final action strategies are discussed in Section 5.4.

5.3.1 Prioritization Process

Once the mitigation actions were identified, the county planning teams 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 includes:

- 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 (Multiple Objective Management)?

At the mitigation strategy workshops, the counties used STAPLEE to determine which of the new identified actions were most likely to be implemented and effective. Keeping the STAPLEE criteria in mind, each member 'voted' for the new mitigation actions by sticking a colored dot on the sticky note on which the action was written. The number of dots next to each action was totaled as an indication of relative priority and translated into 'high,' 'medium' and 'low.' The results of the STAPLEE evaluation process produced prioritized mitigation actions for implementation within the planning area.

The process of identification and analysis of mitigation alternatives allowed the county planning teams to come to consensus and to 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 Disaster Mitigation Act regulations; however, this was a planning level analysis as opposed to a quantitative analysis. 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 description of the problem and proposed project, the entity with primary responsibility for implementation, any other alternatives considered, a cost estimate, expected project benefits, potential funding sources, and a schedule for implementation. Development of these project details for each action led to the determination of a high, medium, or low priority for each.

5.4 Mitigation Action Plan

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

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 Regional Plan represents a plan update for all four counties. As part of the update process each county CPT reviewed the previously identified actions 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 in the Plan or in some cases recommended for deletion.

The counties and the majority of their participating jurisdictions have been very successful in implementing actions identified in their respective plans' Mitigation Strategy, thus, working steadily towards meeting each plan's goals. Progress on mitigation actions previously identified in these planning mechanisms are detailed in the mitigation action strategy in the county 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. Reasons that some actions have not been completed include low priority, lack of funding, or lack of administrative resources. See the county annexes for more details on progress on implementation.

As of September 2021, 12 actions have been completed, 3 deleted and 97 continuing in the 2021 Region 6 Plan. During the 2021 process, 67 new actions were developed. The table below summarizes progress implementing mitigation actions by county. Further details can be found in each county annex.

Table 5-1 Mitigation Action Progress Summary by County

County	Completed	Deleted	Continuing	New Actions in 2021	Total New/Continuing Actions
Big Horn	7	1	36	27	63
Hot Springs	1	0	20	13	33
Park	2	2	21	12	33
Washakie	2	2	20	15	35
Total	**12**	**5**	**97**	**67**	**164**

5.4.2 Continued Compliance with NFIP

Given the significance of the flood hazard in the planning area and as required by DMA, an emphasis will be placed on continued compliance with the National Flood Insurance Program (NFIP). Counties and jurisdictions that participate in the NFIP, which are noted in the respective annexes, 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 updates by adopting new maps or amendments to maps;
- Utilize Digital Flood Insurance Rate maps 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 Regional Plan that support the ongoing efforts by participating counties 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 planning teams, outlining how each county 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 county are detailed in Chapter 8 of each respective county's annex. These details include the action description, hazard (s) mitigated, lead and partner agencies responsible for initiating implementation, costs, funding sources, and timeline. Many of the action items included in this plan are a collaborative effort among local, state, and federal agencies and stakeholders in the planning area.

Further, it should be clarified that 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 counties are not obligated by this document to implement any or all of these projects. Rather, this mitigation strategy represents the desires of the community to mitigate the risks and vulnerabilities from identified hazards. The counties also realize that new needs and priorities may arise as a result of a disaster or other circumstances and reserves the right to support new actions, as necessary, as long as they conform to their overall goals, as listed in this plan.

Where feasible it is recommended that mitigation be integrated and implemented through existing planning mechanisms. Specific related mechanisms such as Community Wildfire Protection Plans, are noted in the county annexes.

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.

6.1 Formal Adoption

DMA Requirements §201.6(c)(3):
[The local 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).

The purpose of formally adopting this plan is to secure buy-in from the counties of Region 6 and the 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 C Records of Adoption. This plan will be re-adopted every five years in concurrence with the required DMA local plan update requirements

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 section provides an overview of the overall strategy for plan implementation and maintenance, and outlines the method and schedule for monitoring, updating, and evaluating the plan. The section also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement

6.2 Implementation

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, each County and jurisdiction will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

Implementation will be accomplished by adhering to the schedules identified for each action (see Chapter 5 for the mitigation strategy and the annexes for county mitigation actions), and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits of each project to the communities of Region 6 and their stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. The three main components of implementation are:

- **Implement** the action plan recommendations of this plan;
- **Utilize** existing rules, regulations, policies, and procedures already in existence; and
- **Communicate** the hazard information collected and analyzed through this planning process so that the community better understands what can happen where, and what they can do themselves to be

better prepared. Also, publicize the "success stories" that are achieved through the HMPC's ongoing efforts

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. 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 a 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 Region and its counties will be in a position to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and 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 adoption of this plan, the Region and its counties will be responsible for the plan implementation and maintenance. Each county, led by their emergency management agency, will reconvene their CPT - HMPC for plan implementation and maintenance. This HMPC will be the same committee (in form and function, if not actual individuals) that developed this HMP and will also be responsible for the next formal update to the plan in five years.

Each county's HMPC 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 a 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 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.

Each HMPC will not have any powers over respective county 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, 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 Maintenance

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

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.

6.3.1 Maintenance Schedule

The emergency management coordinators are responsible for initiating plan reviews and consulting with the heads of participating departments in their own counties. In order to monitor progress and update the mitigation strategies identified in the action plan, each county and their standing HMPC will conduct an annual review of this plan and/or following a hazard event. The 2016 plan noted that an annual mitigation action progress report will be prepared by the HMPC and kept on file to assist with future updates. The annual review will be conducted by re-convening each HMPC in November of each year. This process was generally followed during the 2016-2021 timeframe, though in some cases the annual meetings and annual reports were not developed. For the 2022-2027 implementation period the Region 6 counties will follow the following schedule/process:

Big Horn County: Annual review will be concurrent with the annual THIRA review/update

Park County: Annual review will be concurrent with one of the quarterly LEPC meetings

Hot Springs County: Annual review will occur on or be concurrent with one of the quarterly LEPC meetings

Washakie County: Annual review will occur on or be concurrent with one of the quarterly LEPC meetings

This plan will be updated, approved, and adopted within a five-year cycle as per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. The Region and its counties will inquire with WYOHS and FEMA for funds to assist with the update. It is recommended to begin seeking funds in 2023 as most applicable grants have multiple years to expend the funds. Funding sources may include the Emergency Management Performance Grants or Hazard Mitigation Assistance (HMA) grant funds. The next plan update should be completed and reapproved by WYOHS 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.

6.3.2 Maintenance and 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.

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.

In order to best evaluate any changes in vulnerability as a result of plan implementation, each County will adhere to the following process:

- A representative from the responsible office identified in each mitigation measure 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 action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.

Changes will be made to the plan to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be by written changes and submissions, as 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.

6.3.3 Incorporation into Existing Planning Mechanisms

Another important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other County plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. As described in each county annex capability assessment, the Counties 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 or community comprehensive plans
- County or community land development codes
- County or community emergency operations plans
- Threat and Hazard Identification and Risk Assessments (THIRA)
- Community Wildfire Protection Plans (CWPP)
- Transportation plans
- Capital improvement plans and budgets
- Recovery planning efforts
- Watershed planning efforts
- Wildfire planning efforts on adjacent public lands
- Master planning efforts
- Greenway or river corridor planning efforts
- Other plans, regulations, and practices with a mitigation aspect

The county annexes note, where applicable, how the previous versions of the hazard mitigation plan have been incorporated into existing planning mechanisms in the past 5 years. Each annex notes specific opportunities to integrate the mitigation plan into other mechanisms in the future.

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 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 hazard mitigation plan.

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 to 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, press releases to local media, and through public hearings.

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. The next five-year update process also provides an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. A public hearing(s) or survey to receive public comment on the plan will be held during the plan update period. 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, or through public surveys. As part of this effort, at least one public meeting will be held, and public comments will be solicited on the plan update draft.

1 Mitigation Planning and County Planning Team

Big Horn County developed this annex during the development of the 2021 Region 6 Hazard Mitigation Plan. This County Annex builds upon the 2015 Big Horn County Hazard Mitigation Plan. Due to the coinciding of adoption of an updated plan during the 2016 Regional Plan development the 2015 Big Horn County Hazard Mitigation Plan was included as an annex in its entirety to the Regional Plan. During the 2021 update this annex has been revised to be more consistent with the other county annexes. 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 jurisdictions participated in the DMA planning process for the County.

- Big Horn County
- Town of Basin
- Town of Burlington
- Town of Byron
- Town of Cowley
- Town of Deaver
- Town of Frannie
- Town of Greybull
- Town of Lovell
- Town of Manderson

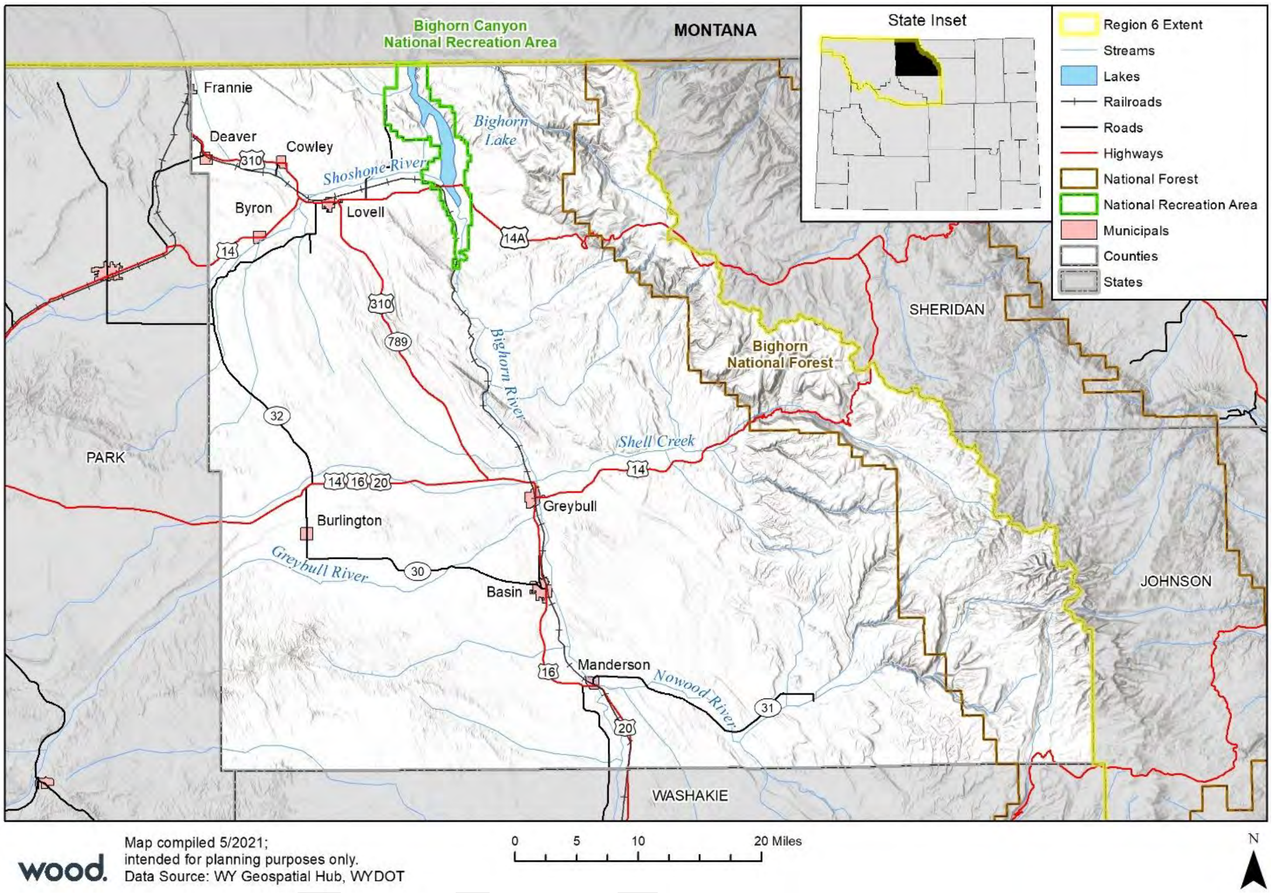
More details on the planning process followed and how the counties, municipalities and stakeholders participated can be referenced in Chapter 3 of the base plan. Additional details on which local government departments participated and who represented them are listed in Appendix A.

2 Geography and Climate

Big Horn County was created from parcels taken from Johnson, Fremont, and Sheridan counties, and was officially organized in 1897. Big Horn County is located in the northern part of Wyoming's Big Horn Basin and has a total area of 3,159 square miles. Counties adjacent to Big Horn include Park, Hot Springs, Sheridan, and Johnson Counties in Wyoming and Carbon and Big Horn Counties in Montana to the north. Towns include Basin, Burlington, Byron, Cowley, Deaver, Frannie, Greybull, Lovell, and Manderson.

The County experiences an arid climate with long, cold, dry winters and hot, dry summers. The average winter temperature is 25°F and the average summer temperature is around 66°F with the average annual precipitation around 6.4 inches per year.

Figure 1 Big Horn County Base Map



3 Population Trends

According to the 2019 United States Census Bureau American Community Survey (ACS), there were a total of 11,882 people living in Big Horn County. With a population of 11,461 people recorded in the 2000 US Census; the county's population has increased by 3.67% in that timeframe. Table 1 provides a summary of the population change in the county and municipalities from 2014 to 2019.

The Town of Basin serves as the county seat, while the Town of Lovell is the County's principal population center.

Table 1 Population Estimates for Communities 2014-2019

	2014	2015	2016	2017	2018	2019
Basin	1,243	1,392	1,551	1,574	1,596	1,388
Burlington	244	257	253	268	247	257
Byron	691	620	586	560	523	519
Cowley	789	831	858	790	769	623
Deaver	174	172	177	173	175	140
Frannie	153	134	109	113	137	149
Greybull	2,116	2,089	1,969	1,876	1,864	1,981
Lovell	2,409	2,361	2,347	2,662	2,252	2,237

	2014	2015	2016	2017	2018	2019
Manderson	98	110	125	102	75	74
County Total	11,827	11,895	11,931	11,920	11,901	11,882

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Select Census demographic and social characteristics for Big Horn County are shown in Table 2. The table indicates the proportion of the population that may have special needs, such as the elderly or children under 5 years of age.

Table 2 Big Horn County Demographic Profile

People	Big Horn County
Gender/Age (% of Total Population)	
Male	51.1
Female	48.9
Under 5 Years	6.2
65 Years and Over	21
Race/Ethnicity (% of Total Population)	
White	92.8
American Indian/Alaska Native	0.8
Asian	0.5
Black or African American	0.4
More than One Race	1.6
Hispanic or Latino (of any race)[1]	9.0
Education (% of Total Population, 25+ years)	
High school graduate or higher	89.7
Bachelor's degree or higher	19.0

Source: U.S. Census Bureau, 2015-2019 5-Year American Community Survey, https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2019/
1The U.S. Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race. The population self-identified as "Hispanic/Latino" is also represented within the categories in the "Race" demographic.

4 Development Trends

During the 2021 Regional Plan development the CPT discussed growth and development trends in the County including:

The growth trend in Big Horn County is largely driven by residential development on five to ten acre lots, interspersed within the general location of larger agricultural landowners. Overall, the growth rates in the county and the municipality are not consistent with one another; the county and several towns have held steady or increased slightly in population, while the two largest towns have decreased in population.

There have been three riverine flooding mitigation projects completed by private stakeholders in Big Horn County which have benefited the county. The identified projects were bank stabilization projects to reduce risk to pipelines owned and operated by the identified companies and also as a result reduced flood potential with the work done. American Colloid also completed an emergency bank stabilization project to protect their infrastructure from flooding and keep the mined bentonite from being discharged into river during an ice jam event.

5 Economy

Big Horn County's economic base includes farming, ranching, tourism, retail, healthcare, and oil and gas industry. Economic statistics are noted below.

Table 3 Big Horn County Economic Profile

	Big Horn County
Families Below Poverty Level	8.8%
Individuals Below Poverty Level	12.7%
Median Home Value	$163,400
Median Household Income	$52,804
Per Capita Income	$24,693
Population >16 Years Old in Labor Force	59.5%
Population Employed	55%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Table 4 shows the breakdown of employment in Big Horn County by the industry sector. According to data from the U.S. Census Bureau ACS, the leading employment sectors in the county are the educational services, and health care and social assistance, agriculture, forestry, fishing and hunting, and mining, retail trades, and construction sectors.

Table 4 Big Horn County Occupations and Industries

Industry	Number Employed	Percent of Labor Force
Educational services, and health care and social assistance	1,105	21.70%
Agriculture, forestry, fishing and hunting, and mining	795	15.60%
Retail trade	587	11.60%
Construction	526	10.40%
Manufacturing	513	10.10%
Arts, entertainment, and recreation, and accommodation and food services	422	8.30%
Transportation and warehousing, and utilities	218	4.30%
Professional, scientific, and management, and administrative and waste management services	214	4.20%
Other services, except public administration	206	4.10%
Public administration	192	3.80%
Finance and insurance, and real estate and rental and leasing	127	2.50%
Information	100	2.00%
Wholesale trade	76	1.50%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

6 Hazard Identification and Risk Assessment

6.1 Identified Hazards

The CPT reviewed significant hazards for inclusion in the hazard mitigation plan. For the sake of consistency, the list of hazards for consideration began with the list of hazards found in the State of

Wyoming's Hazard Mitigation Plan, updated in 2020. In the 2021 update the CPT decided to add the following hazards: pandemic/epidemic and volcano. In addition, the CPT also considered the following human caused hazards, potable water threat, power outages, cyber security breach, and violent extremism. Ultimately, the CPT decided to keep them separate from this plan because they are already covered in other County plans.

Table 5 Overall Hazard Significance* Summary Table provides a summary of the overall hazard significance for the hazards evaluated in this plan, showing variability by jurisdiction.

Table 5 Overall Hazard Significance* Summary Table

Hazard	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Avalanche	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Dam Failure	High	Low	Medium	Medium	Low	Low	Low	High	Low	High
Drought	High	Medium	High	Medium	Medium	Low	Low	Medium	Low	Medium
Earthquake	Medium	Medium	Medium	Low	Low	Low	Medium	Low	Low	High
Expansive Soils	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Extreme Cold	High	High	High	Medium	High	Low	Medium	High	Low	Medium
Flood	Medium	High	Low	Medium	Low	Low	Low	High	Low	High
Hail	High	High	Medium	Medium	Low	Low	Medium	High	Medium	Low
High Winds and Downbursts	Low	Low	Low	Medium	Medium	Low	Medium	High	Low	Medium
Landslide	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Lightning	Low	High	Low	Low	Low	Low	Low	High	Low	High
Mine Subsidence	Medium	Medium	Low	Medium	Medium	Low	Low	Low	Low	High
Tornado	Medium	High	Medium	Medium	Medium	Low	Low	High	Medium	High
Severe Winter Weather	Medium	Medium	High	Medium	Medium	Low	Medium	High	Medium	Low
Wildfire	High	Medium	Low	Low	Low	Low	Low	Medium	Low	Medium
Hazardous Materials	High	High	Medium	Low	Medium	Low	Medium	Medium	Medium	Medium
Pandemic/ Epidemic	Low	Low	Medium	Low	Low	Low	Medium-High	Low	Low	Low
Volcano	High	Low	Low	Low	Low	Low	High	Low	Low	Low

*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 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.

6.2 Building Inventory and Assets

In addition to people, structures, critical facilities and infrastructure, and other important assets in Big Horn County are potentially exposed to hazards identified in this plan. Table 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 as an assessment of the overall property exposed within the County and by jurisdiction.

The 2020 parcel and Assessor data was obtained through the Wyoming Cama website which is maintained by the Wyoming Department of Revenue. This information provided the basis for building exposure and property types. The available data is annually updated on the site and contains all counties within Wyoming. Data current as of 2020 was downloaded for all the counties within the Region and joined by Parcel Number in a separate database for analysis using GIS.

Table 6 Big Horn County's Building Inventory and Value by Jurisdiction

Jurisdiction	Property Type	Improved Parcel	Improved Value	Est. Content Value	Total Exposure
Basin	Commercial	53	$7,894,543	$7,894,543	$15,789,086
	Improved Vacant Land	9	$742,803	$742,803	$1,485,606
	Residential	499	$48,917,160	$24,458,580	$73,375,740
	Total	**561**	**$57,554,506**	**$33,095,926**	**$90,650,432**
Burlington	Commercial	8	$782,622	$782,622	$1,565,244
	Improved Vacant Land	6	$780,108	$780,108	$1,560,216
	Residential	108	$12,291,378	$6,145,689	$18,437,067
	Total	**122**	**$13,854,108**	**$7,708,419**	**$21,562,527**
Byron	Commercial	11	$1,286,037	$1,286,037	$2,572,074
	Improved Vacant Land	18	$1,670,866	$1,670,866	$3,341,732
	Residential	196	$16,996,189	$8,498,095	$25,494,284
	Total	**225**	**$19,953,092**	**$11,454,998**	**$31,408,090**
Cowley	Commercial	9	$1,517,995	$1,517,995	$3,035,990
	Improved Vacant Land	16	$2,398,806	$2,398,806	$4,797,612
	Residential	220	$30,827,323	$15,413,662	$46,240,985
	Total	**245**	**$34,744,124**	**$19,330,463**	**$54,074,587**
Deaver	Commercial	4	$700,269	$700,269	$1,400,538
	Improved Vacant Land	11	$574,086	$574,086	$1,148,172
	Residential	71	$4,993,035	$2,496,518	$7,489,553
	Total	**86**	**$6,267,390**	**$3,770,873**	**$10,038,263**
Frannie	Commercial	3	$342,471	$342,471	$684,942
	Improved Vacant Land	5	$96,785	$96,785	$193,570
	Residential	55	$3,504,884	$1,752,442	$5,257,326
	Total	**63**	**$3,944,140**	**$2,191,698**	**$6,135,838**

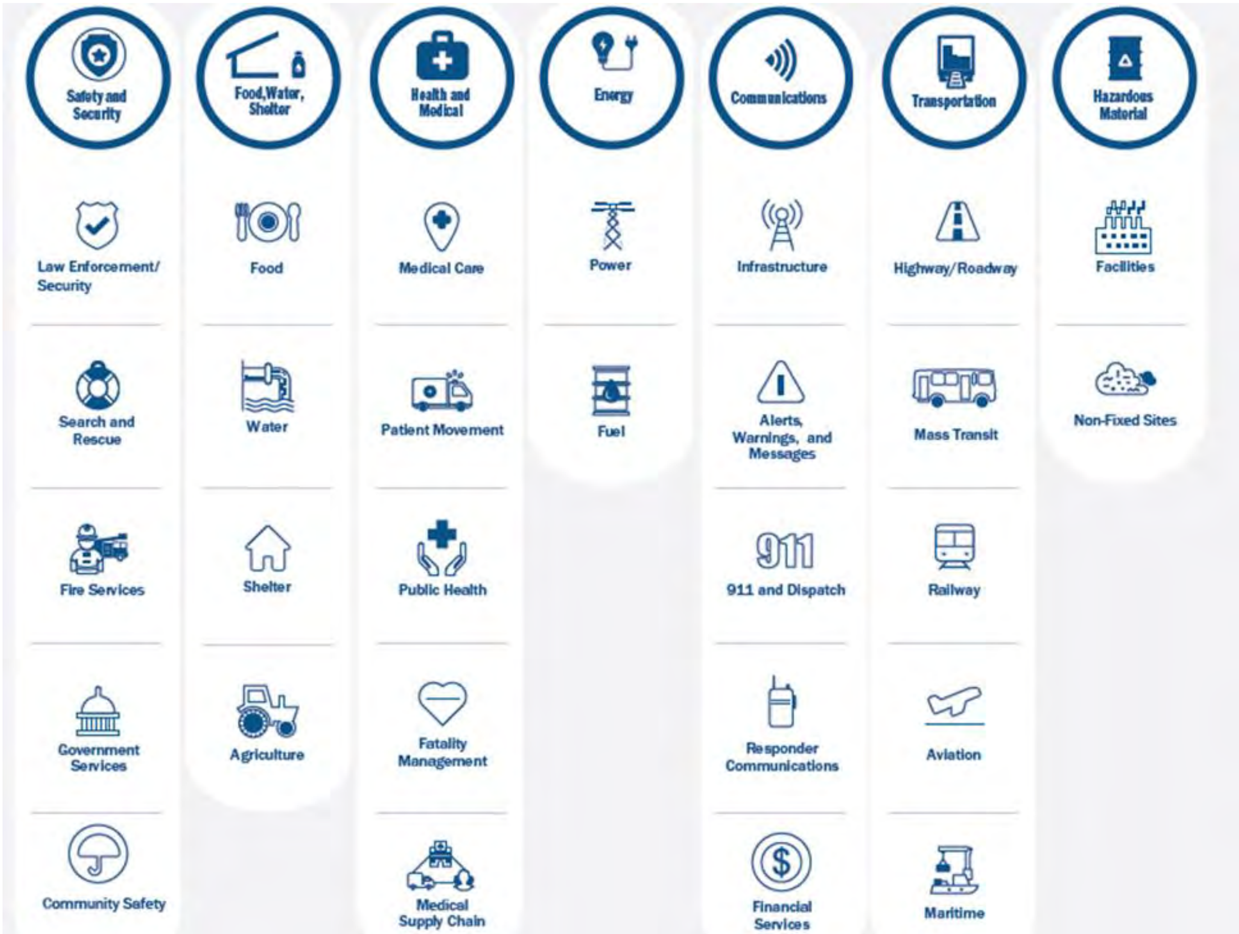
Jurisdiction	Property Type	Improved Parcel	Improved Value	Est. Content Value	Total Exposure
Greybull	Commercial	109	$14,561,448	$14,561,448	$29,122,896
	Exempt	1	$0	$0	$0
	Improved Vacant Land	11	$297,138	$297,138	$594,276
	Residential	746	$67,533,300	$33,766,650	$101,299,950
	Total	**867**	**$82,391,886**	**$48,625,236**	**$131,017,122**
Lovell	Commercial	113	$14,837,537	$14,837,537	$29,675,074
	Improved Vacant Land	13	$789,041	$789,041	$1,578,082
	Residential	812	$83,845,927	$41,922,964	$125,768,891
	Total	**938**	**$99,472,505**	**$57,549,542**	**$157,022,047**
Manderson	Commercial	3	$907,914	$907,914	$1,815,828
	Residential	46	$2,804,408	$1,402,204	$4,206,612
	Total	**49**	**$3,712,322**	**$2,310,118**	**$6,022,440**
Unincorporated	Agricultural	139	$14,136,742	$14,136,742	$28,273,484
	Commercial	198	$31,358,109	$31,358,109	$62,716,218
	Exempt	23	$0	$0	$0
	Improved Vacant Land	74	$8,673,092	$8,673,092	$17,346,184
	Industrial	4	$5,026,688	$7,540,032	$12,566,720
	Residential	1,820	$240,999,484	$120,499,742	$361,499,226
	Total	**2,258**	**$300,194,115**	**$182,207,717**	**$482,401,832**
	Grand Total	**5,414**	**$622,088,188**	**$368,244,988**	**$990,333,176**

Source: (http://cama.state.wy.us/)

6.2.1 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. FEMA organizes critical facilities into seven lifeline categories as shown in Figure 2.

Figure 2 FEMA Lifeline Categories



A summary of the critical facilities exposure analysis can be found in Table 7 and Figure 4-2 in the Base Plan illustrates the location of critical facilities in Region 6.

Table 7 Summary of Big Horn County Critical Facilities by Jurisdiction

Jurisdiction	Communications	Energy	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Basin	21	3	2	-	3	7	1
Burlington	6	-	-	-	1	4	-
Byron	1	1	-	-	-	1	-
Cowley	2	-	-	-	-	3	-
Deaver	4	-	2	-	1	2	1
Frannie	-	-	2	-	-	1	-
Greybull	15	1	-	-	2	7	1
Lovell	12	1	1	-	4	7	-
Manderson	1	-	-	-	-	4	2
Unincorporated	181	28	10	1	2	4	88
Total	**243**	**34**	**17**	**1**	**13**	**40**	**93**

6.2.2 Natural, Historic, and Cultural Assets

Assessing the vulnerability of Big Horn County to disasters 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 a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
If these resources are impacted by a disaster, knowing 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 Resources

By definition, a historic property not only includes buildings of other types of structures, such as bridges and dams, but also includes prehistoric of Native American sites, roads, byways, historic landscapes, and many other features. Given the history of the County, these types of historic properties exist in the planning area.

Information about historic assets in Big Horn County came from the following sources:

The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.

Table 8 lists the properties and districts in Big Horn County that are on the National Register of Historic Places.

Table 8 Big Horn County Historic Properties

Site	Date Listed	Jurisdiction	Address
Medicine Wheel-Medicine Mountain	4/16/1969	Kane	Address Restricted
Medicine Lodge Creek Site	7/5/1973	Hyattville	Address Restricted
Basin Republican-Rustler Printing Building	7/19/1976	Basin	409 W. C St.
Hanson Site	12/15/1978	Shell	Address Restricted
Lower Shell School House	2/7/1985	Greybull	U.S. 14
EJE Bridge over Shell Creek	2/22/1985	Shell	Cty. Rd. CN9-57
EJP County Line Bridge	2/22/1985	Hyattville	Rd. CN9-60
EJZ Bridge over Shoshone River	2/22/1985	Lovell	Cty. Rd. CN9-111
Rairden Bridge	2/22/1985	Manderson	S of Big Horn Cty. Rd. CN9-30
Bear Creek Ranch Medicine Wheel (48BH48)	5/4/1987	Greybull	Address Restricted
US Post Office--Basin Main	5/19/1987	Basin	402 W. C St.
US Post Office--Greybull Main	5/22/1987	Greybull	401 Greybull Ave.

Site	Date Listed	Jurisdiction	Address
Black Mountain Archeological District (48BH900/902/1064/1067/1126/1127/1128/1129)	7/2/1987	Shell	Address Restricted
Black Mountain Archeological District (Boundary Increase)	4/16/1990	Shell	Address Restricted
Paint Rock Canyon Archeological Landscape District	7/12/1990	Hyattville	Address Restricted
Big Horn Academy Historic District	3/26/1992	Cowley	25 and 35 E. First South
M L Ranch	7/15/1992	Lovell	Off Alt. US 14 near E shore of Bighorn Lake, 13 mi. E of Lovell, Bighorn Canyon National Recreation Area
Hyart Theater, The	1/8/2009	Lovell	251 E. Main St.
Carey Block	12/18/2009	Greybull	602 Greybull Ave.
Southsider Shelter	8/1/2012	Tensleep	Address Restricted
Schunk Lodge	1/4/2018	Big Horn	Approx. 1 mi. N of Red Grade Rd. & Big Goose RS, Bighorn NF

Sources: National Register Information System, www.nr.nps.gov/

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 areas protects sensitive habitat as well as attenuates and stores floodwaters.

A number of natural resources exist in Big Horn County, including wetlands, endangered species, and imperiled plant communities. Also, the scenery itself, and access to the scenic backcountry, are economic drivers for the County and its communities.

Wetlands

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. Wetlands reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. They also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital.

Endangered Species

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. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

As of June 2021, there are six federally recognized endangered, threatened, or candidate species in Big Horn County according to the U.S. Fish and Wildlife Service. These species are listed in Table 9 along with state listed species.

Table 9 Endangered and Threatened Species in Big Horn County

Common Name	Scientific Name	Type of Species	Status
Bald eagle	*Haliaeetus Leucocephalus*	Bird	Recovery
Greater Sage-grouse	*Centrocercus urophasianus*	Bird	Resolved Taxon
Ute ladies'-tresses	*Spiranthes diluvialis*	Flowering Plant	Threatened
Monarch Butterfly	*Danaus plexippus*	Insect	Candidate
Gray wolf	*Canis lupus*	Mammal	Recovery
Canada Lynx	*Lynx Canadensis*	Mammal	Threatened

Source: http://www.fws.gov/endangered/

6.3 Vulnerability to Specific Hazards

This section details vulnerability to specific hazards, where quantifiable, only where it differs from that of the Region. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas and 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.

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Extreme Cold
- Expansive Soils
- Flood
- Hail
- Hazards Materials
- High Winds and Downbursts
- Landslide, Debris Flow and Rockfall
- Lightning
- Mine Subsidence
- Pandemic/Epidemic
- Tornado
- Volcano
- Wildfire
- Winter Weather

6.3.1 Avalanche

Avalanche prone areas are limited to the far eastern parts of the County but have had negligible impact. Refer to Chapter 4 in the base plan for a discussion of general avalanche risk in the Region.

6.3.2 Dam Failure

Due to the presences of several high hazard dams both within and upstream of the County and the presence of several towns along the Bighorn and Shoshone rivers, there is considerable risk to dam failure. A table and map in Chapter 4 indicates the High and Significant Hazard dams throughout all of Region 6, including those upstream of the County. Table 10 below shows dams located within Big Horn County.

Table 10 High and Significant Hazard Dams in Big Horn County

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Big Horn County						
Shell Creek	Shell Valley Watershed Imp. District	Shell Creek	H	Shell	6.0	Y
Adelaide	Shell Valley Watershed Improvement Dist.	Adelaide Creek	H	Shell	8.0	Y
Leavitt	Frank Schmidt	Davis Draw, Trib. Beaver Creek	H	Shell	15.0	N
Garnett	Gene and Louise Powers	Shell Creek Trib Bighorn River	S	Greybull	1.0	N
Fairview Extension	Fairview Extension Reservoir Co.	Wardell Draw	S	Greybull	16.0	N
Harrington	Kohn's Ranch	Manny Draw	S	Greybull	17	N
Crosby	Tim Woods & Samantha Wright	Gypsum Creek	S	N/A	N/A	N

High Hazard dams in the County include the Leavitt, Adelaide, and Shell Creek dams. The Buffalo Bill dam outside of the County (located within Park County) is also a high hazard dam that poses a concern to the HMPC. Many dam sites whose failure could have potentially the biggest impact on Big Horn County and its towns and cities actually lie outside the County boundaries. Those sites are listed below:

Boysen Dam and Reservoir is an earthen dam located on the Wind River, approximately 20 miles south of Thermopolis in Fremont County. The Wind River becomes known as the Big Horn River downstream from the reservoir; eventually, the river flows into Manderson in southern Big Horn County.

The first dam in the Boysen area was constructed of concrete in 1908 and was replaced by a second structure which became operational in December 1952. The current dam is operated by the U.S. Federal Bureau of Reclamation and is an earth-filled dam with a structural height of 220 feet.

Hydroelectric power is tied into the transmission lines to Alcova, Thermopolis, and Pilot Butte-Thermopolis, and provides irrigation water through storage for lands below and above the reservoir. Total flood damages reduced by the reservoir since construction totaled about $75.0 million by the end of 1998.

Shell Reservoir and Adelaide Lake are located in eastern Big Horn County, high above the unincorporated town of Shell, collecting water from snow melt and small streams located in the Big Horn

Mountains. Waters from the lake and reservoir contribute to Shell Creek, which flows west approximately 15 miles after leaving the town of Shell, eventually joining the Big Horn River several miles north of the town of Greybull.

Inundation mapping has been developed for privately owned high hazard dams in the county by the Wyoming State Engineer's Office. Utilizing this inundation data, GIS analysis has revealed population, property, and critical facilities within the county that are at risk from dam inundation. Refer to Chapter 4 in the Base Plan for additional discussion of dam incident risk related to the Region and the County.

6.3.3 Drought

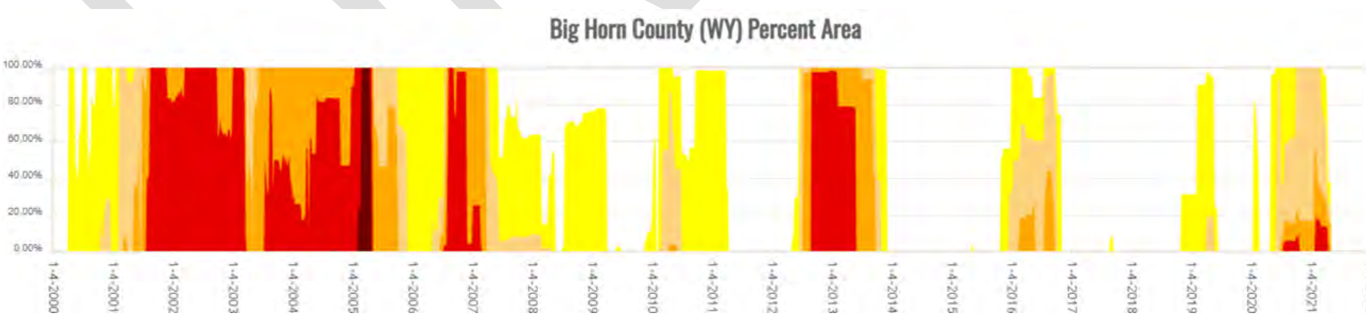
Similar to the rest of the Region drought is a high significance hazard for the County. Drought is a regular and widespread occurrence in the State of Wyoming. Since 2012 there have been 12 USDA Disaster Designations in Big Horn County for drought. According to the U.S. Drought Monitor records for Big Horn County, in the 1,095-week period from 2000 through 2020, the county spent 772 weeks (71% of the time) in Abnormally Dry (D0) conditions. Approximately 51% of the time, or 557 weeks, was spent in Moderate Drought (D1) or worse conditions. Weeks in drought between 2000 and 2020 are summarized in Table 11 and shown in time series from January 2000 and January 4, 2021 in Figure 3.

Table 11 Big Horn County Weeks in Drought by Intensity, 2000-2020

Category	Description	Palmer Drought Severity Index (PDSI)	Standardized Precipitation Index (SPI)	Big Horn County Weeks in Drought, 2000-2020
D0	Abnormally Dry	-1.0 to -1.9	-0.5 to -0.7	772
D1	Moderate Drought	-2.0 to -2.9	-0.8 to -1.2	557
D2	Severe Drought	-3.0 to -3.9	-1.3 to -1.5	391
D3	Extreme Drought	-4.0 to -4.9	-1.6 to -1.9	227
D4	Exceptional Drought	-5.0 or less	-2.0 or less	13

Source: U.S. Drought Monitor

Figure 3 Big Horn County Drought Intensity, 2000- January 4, 2021



Source: U.S. Drought Monitor

Refer to the Chapter 4 in the Base Plan for additional discussion of drought risk related to the Region and the County.

6.3.4 Extreme Cold

Since 2012, Big Horn County has received 4 USDA Disaster Designations for freeze or frost. Extreme cold has caused crop damages and losses. Between 2007 and 2020 freeze and frost has caused 13,631 acres to be lost resulting in $4,814,145 indemnity payments countywide. Average annual losses due to extreme cold is estimated to be $370,319. Vulnerability to extreme cold is not noticeably different from the rest of the region and is considered a medium significance hazard. Refer to Chapter 4 for a discussion of this hazard's risk related to Big Horn County and the Region.

6.3.5 Earthquake

Big Horn County has the lowest potential for earthquakes amongst the counties in Region 6. However, being located in close proximity to Yellowstone National Park, all of Region 6 including Big Horn County have the potential to experience shaking from earthquakes. One such earthquake occurred on November 17, 1925, centered in the southeastern portion of Big Horn County. This intensity V event was located approximately 23 miles north of Ten Sleep. People in Ten Sleep, Sheridan, Fort McKenzie, and at Dome Lake Resort in the Big Horn Mountains reported feeling the earthquake tremors. The tremors shook cabins, pictures, and furniture. A "distinct roar" heard at Dome Lake was attributed to a possible earthquake-induced landslide (Casper Daily Tribune, November 18, 1925). No damage was reported.

According to a Hazus analysis conducted, a 2,500-year probabilistic earthquake ground shaking could result in $26 million in economic losses in the county. Refer to Chapter 4 for a discussion of the earthquake risk relative to Big Horn County and the wider Region.

6.3.6 Expansive Soils

Expansive soils cause occasional problems in the County. During the Regional Plan development. The CPT noted the following consequences of expansive soils in Big Horn County:

- Issues on Highways; and
- Added costs to building middle school to mitigate impacts.

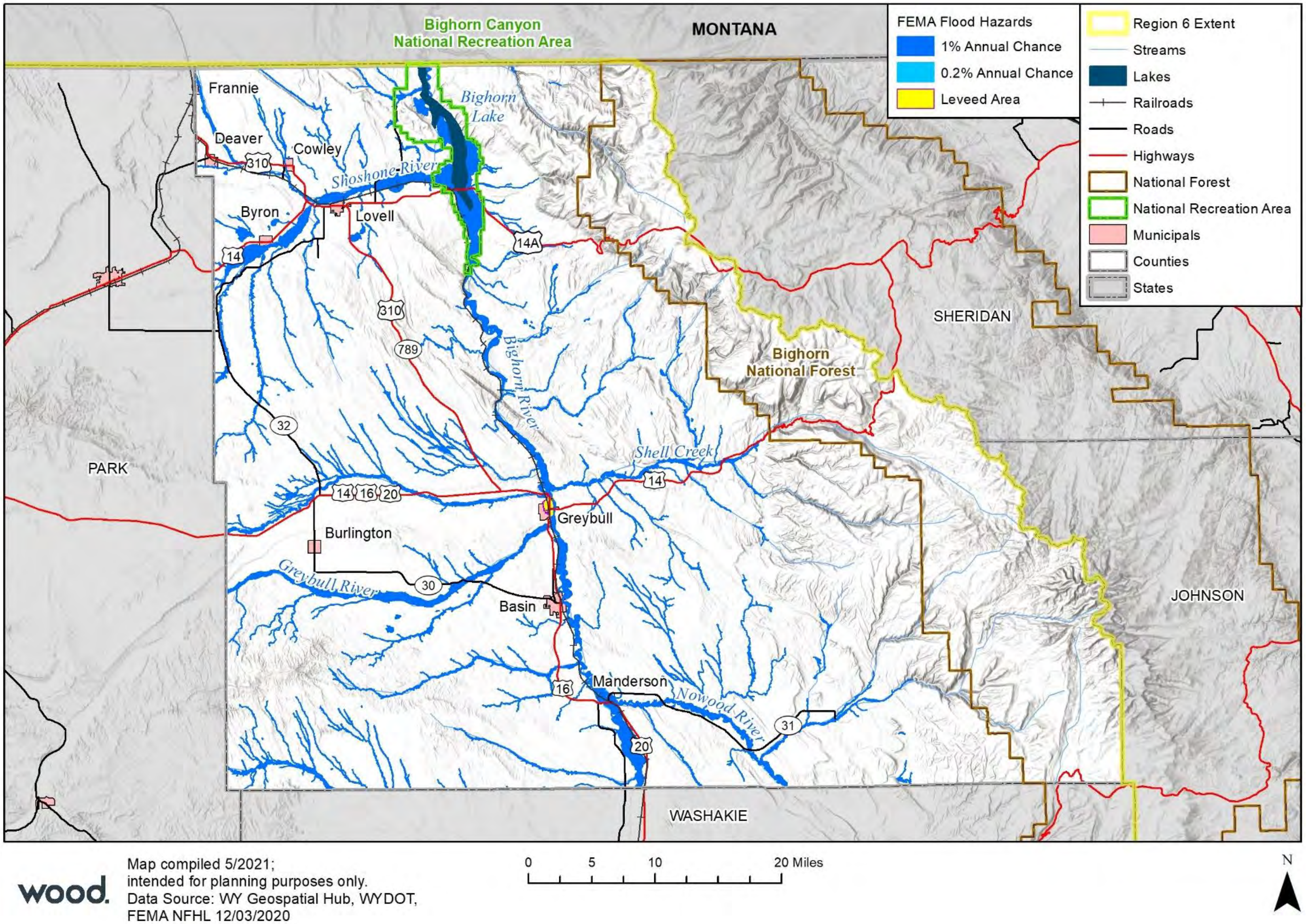
Data did not exist to provide a more quantitative loss estimate. See Chapter 4 for more description on the expansive soils hazard.

6.3.7 Flood

A flood, as defined by the National Flood Insurance Program (NFIP), is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from overflow of waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days. During the development of the 2021 State of Wyoming Hazard Mitigation Plan, 29 flood events and $3.2 million in property damage were noted specific to Big Horn County. Flooding events occurring within the boundaries of Big Horn County are generally attributed to three factors (1) winter thaws and spring break up on the Big Horn River (sometimes with associated ice jams), (2) rapid snow melt and or heavy rains in higher elevations, and (3) spring or summer deluges that result in flash flooding. The most damaging flood occurred in July of 1962 in northern Big Horn Basin when severe thunderstorms and heavy rains of 4 to 6 inches with 6 to 9 inches of hail and high gusty winds caused widespread damage and flash flooding in the Cowley, Byron, Penrose, and Lovell areas. Figure 4 below shows the extent of the 1% annual chance and 0.2% annual chance floodplains in Big Horn County

Table 12 and Table 13 below provide some detail specific to Big Horn County on the county's potential flood losses and participation in the NFIP. Refer to Chapter 4 of the base plan for a discussion of the flood risk relative to Big Horn County, with details on property and critical facility risk from flood for the County and the wider Region.

Figure 4 Big Horn County FEMA Flood Hazards



Parcel Level Analyses

The following results show potential impacts from flooding in Big Horn County, including total number of buildings exposed and associated costs related to a general flooding incident based on a parcel level analysis. Detailed maps of the FEMA floodplain in each jurisdiction are shown below in Figure 5 through Figure 11, including exposed properties.

Table 12 Exposure and Potential Loss in 1% Annual Chance Floodplain by Jurisdiction

Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
Basin	1	$6,353	$3,177	$9,530	$2,382
Cowley	1	$70,555	$70,555	$141,110	$35,278
Greybull	1	$8,153	$4,077	$12,230	$3,057
Lovell	4	$535,819	$300,781	$836,600	$209,150
Manderson	49	$3,712,322	$2,310,118	$6,022,440	$1,505,610
Unincorporated	180	$21,934,696	$16,822,830	$38,757,526	$9,689,382
Total	**236**	**$26,267,898**	**$19,511,537**	**$45,779,435**	**$11,444,859**

Table 13 Exposure and Potential Loss to Area Protected by Levee Flood Hazard (FEMA)

Jurisdiction	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss
Greybull	781	$70,894,911	$41,625,341	$112,520,252	$28,130,063
Total	**781**	**$70,894,911**	**$41,625,341**	**$112,520,252**	**$28,130,063**

Figure 5 Greybull FEMA Flood Hazards

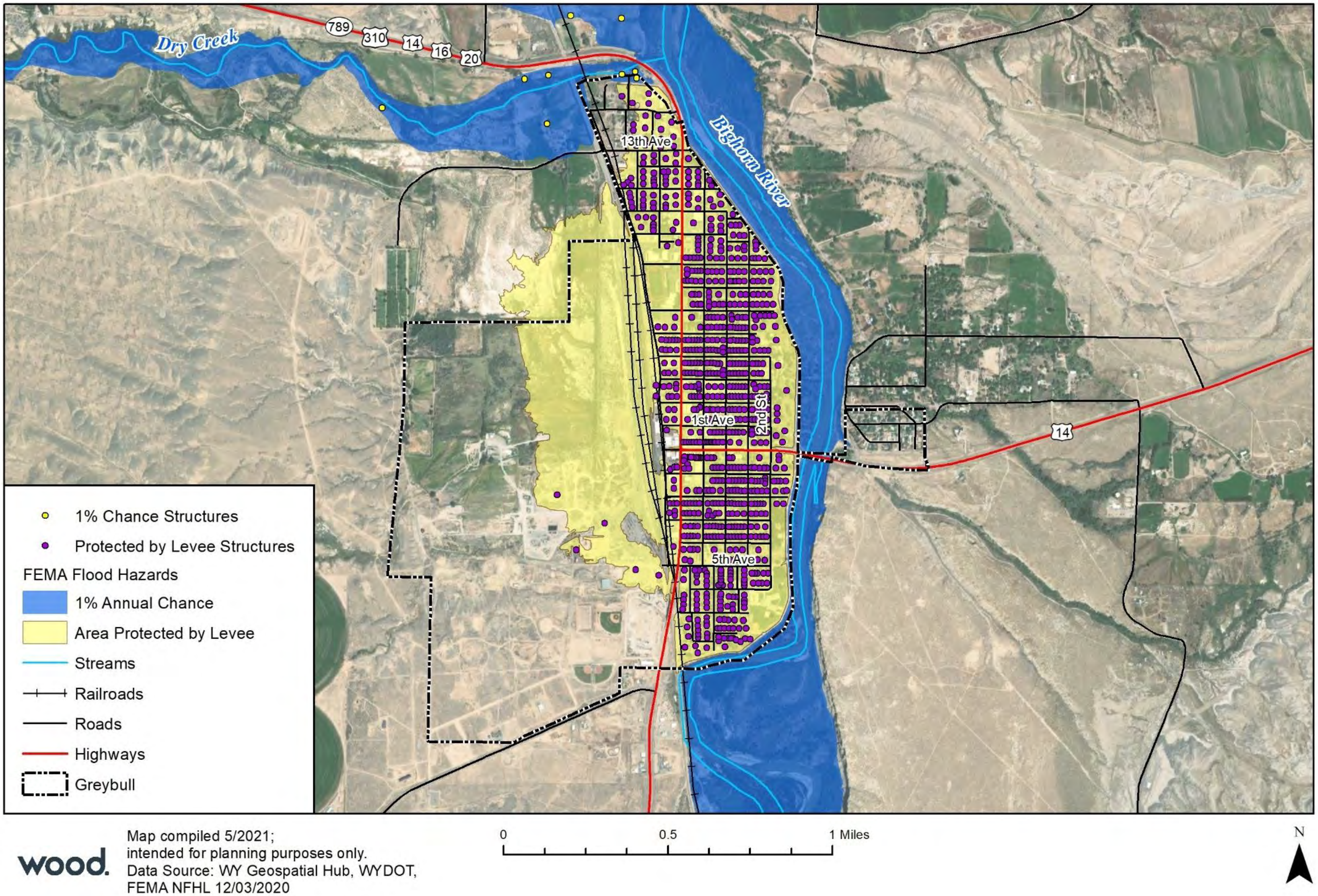


Figure 6 **Basin FEMA Flood Hazards**

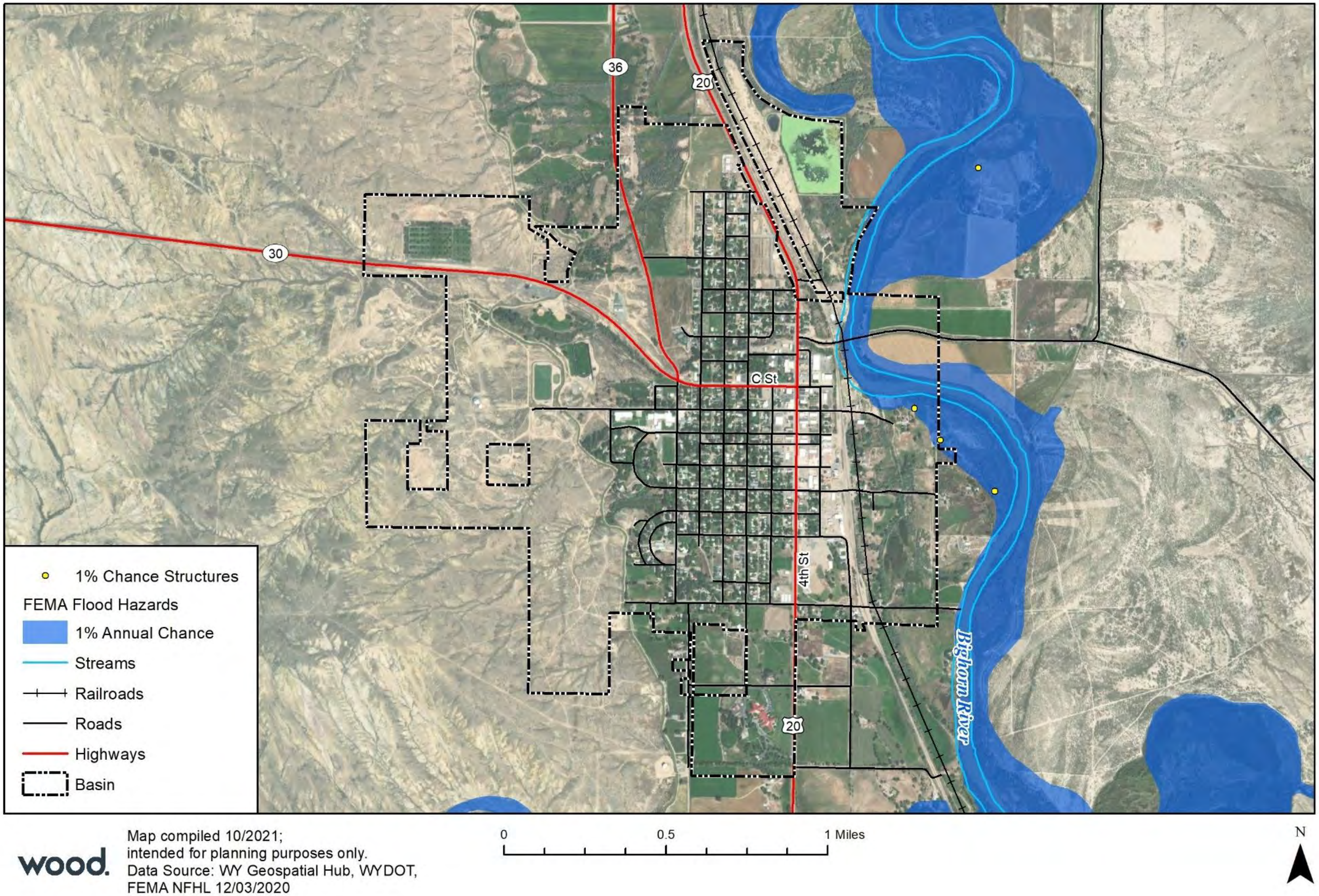


Figure 7 Cowley FEMA Flood Hazards

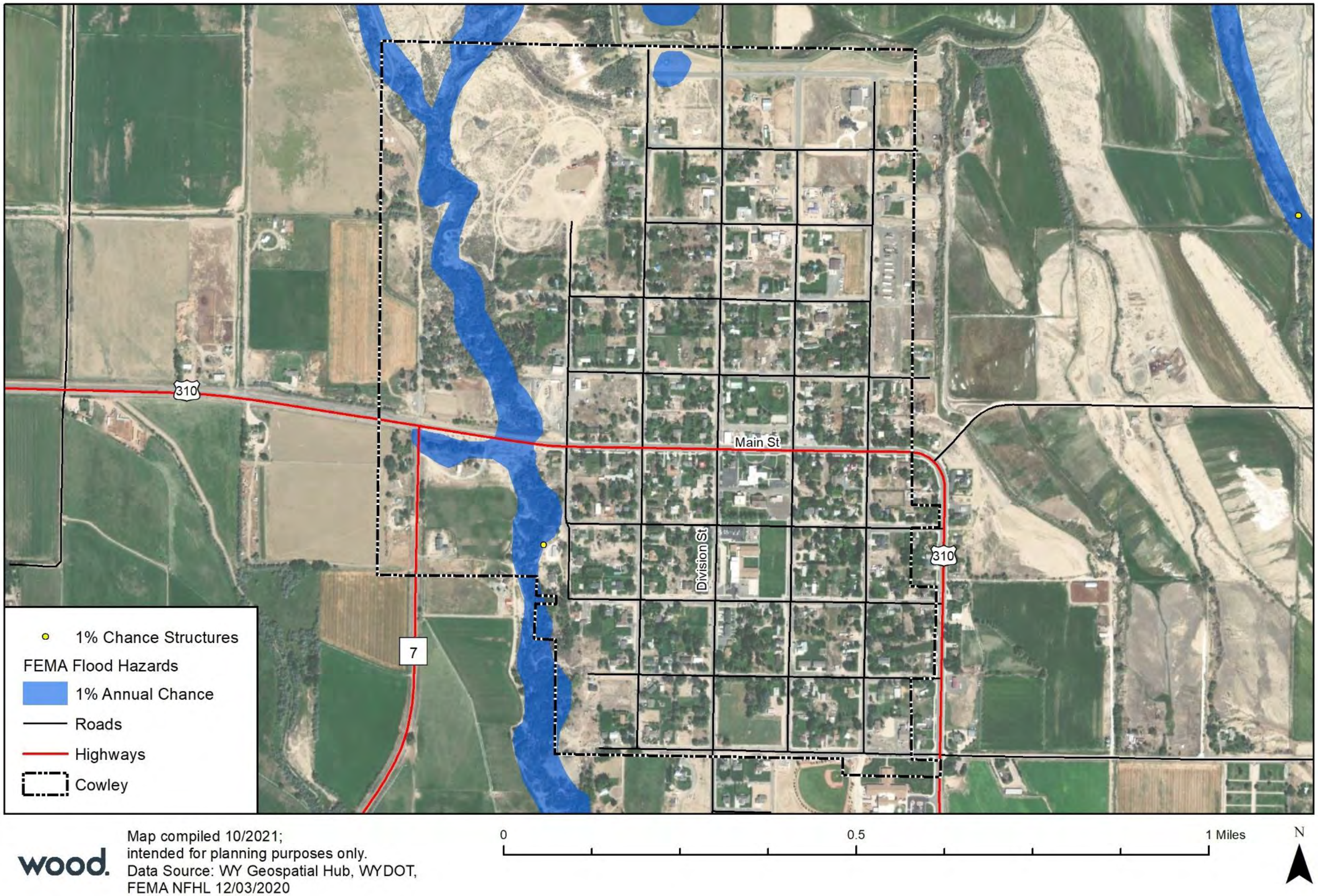


Figure 8 Deaver FEMA Flood Hazards

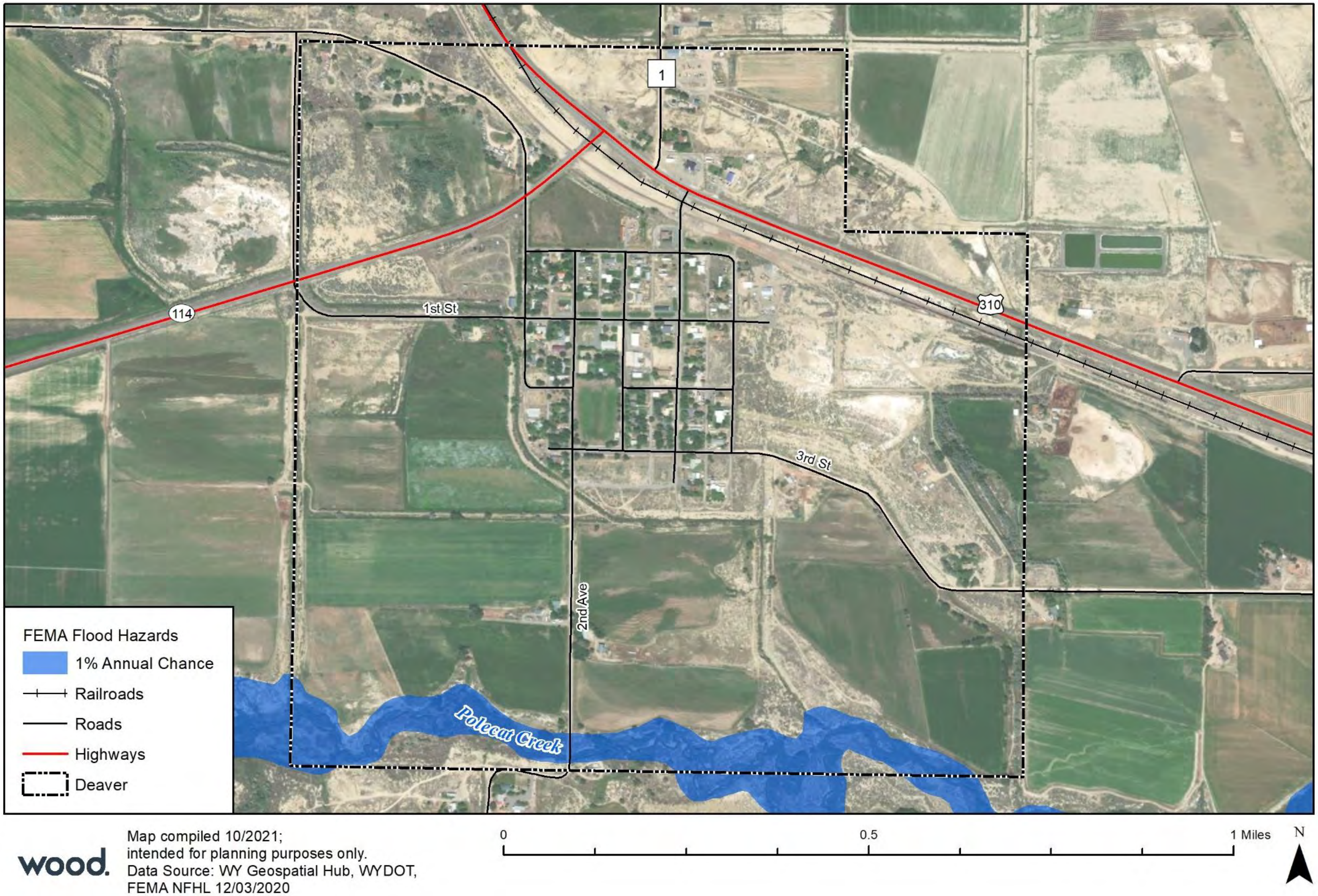


Figure 9 Lovell FEMA Flood Hazards

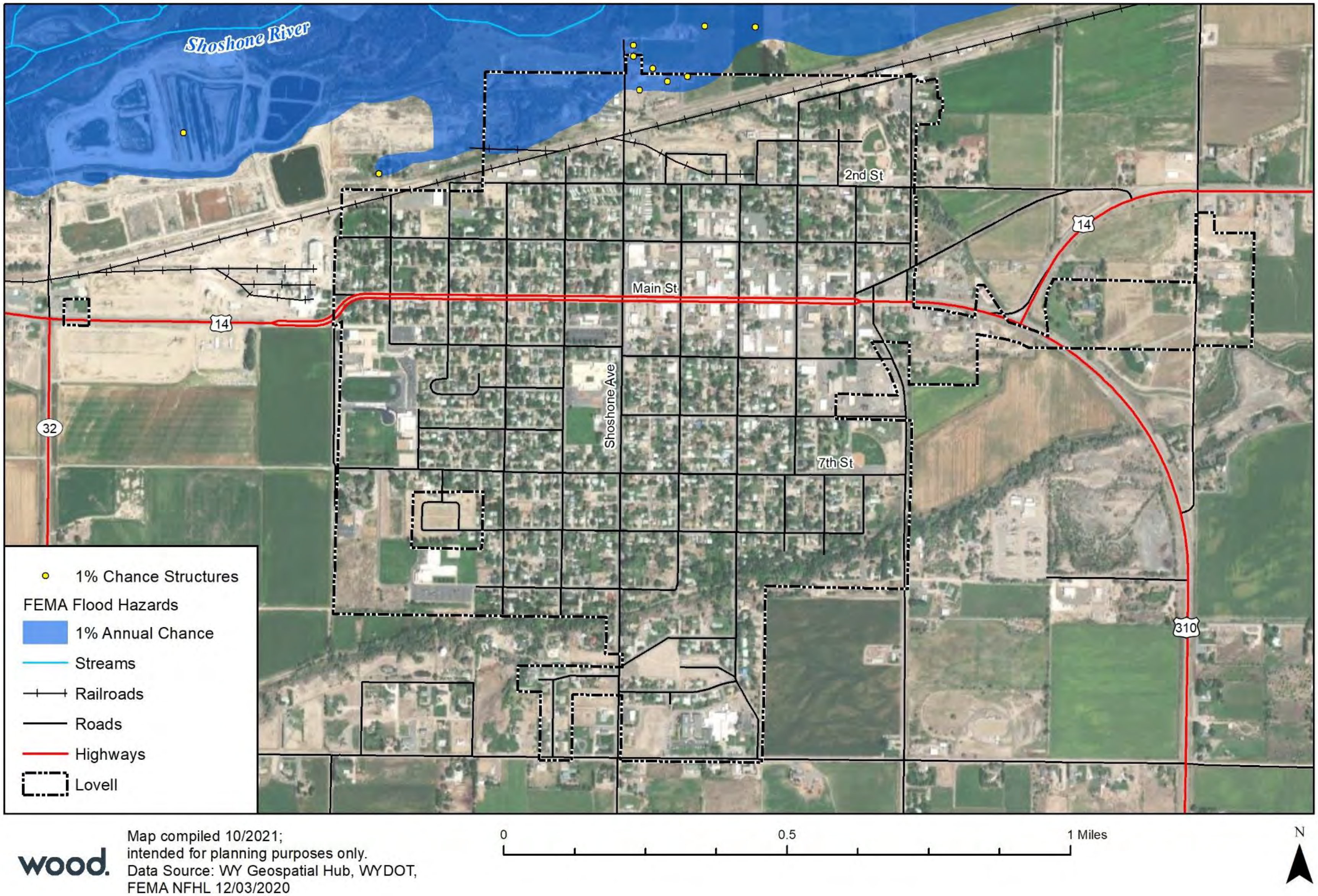


Figure 10 Frannie FEMA Flood Hazards

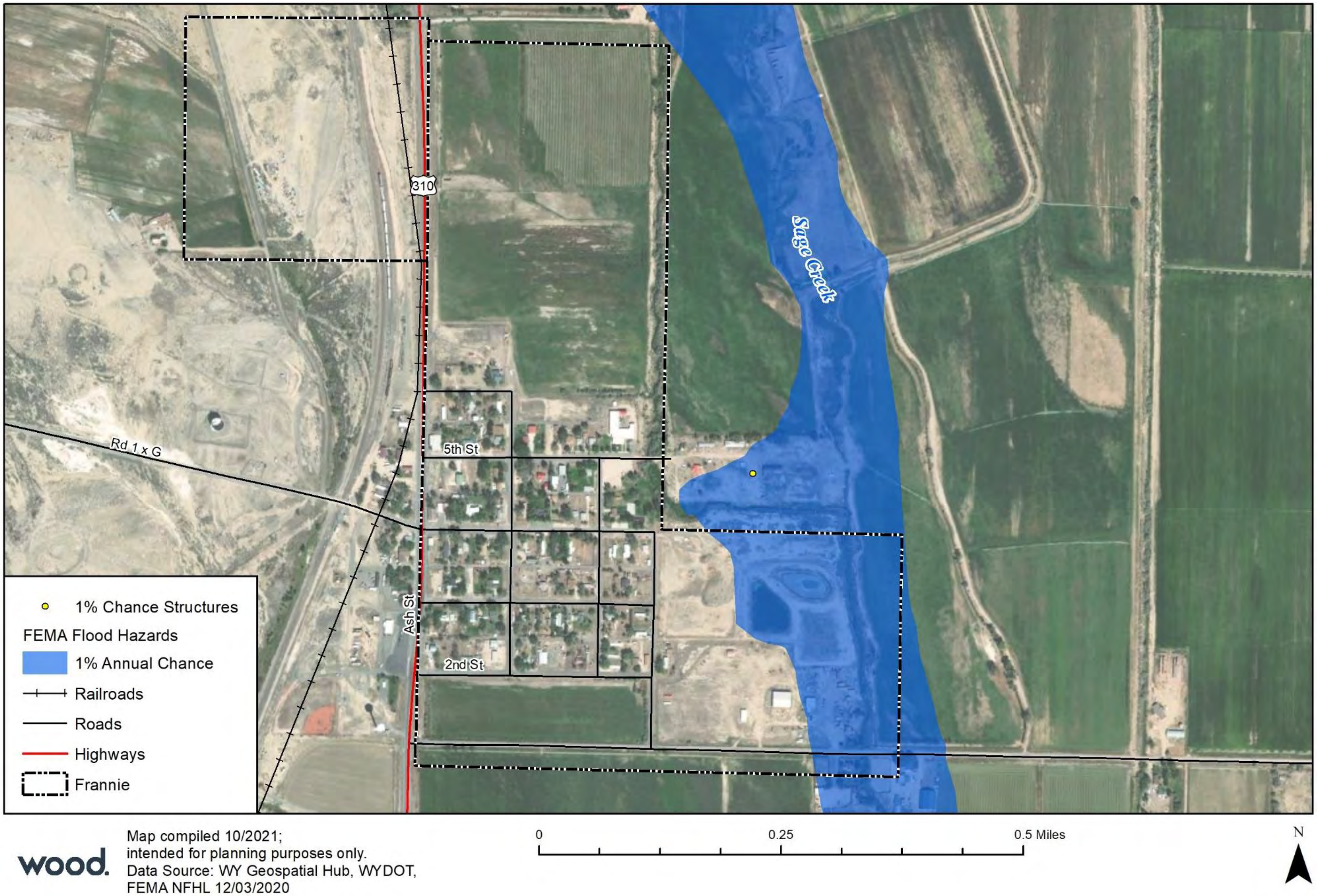
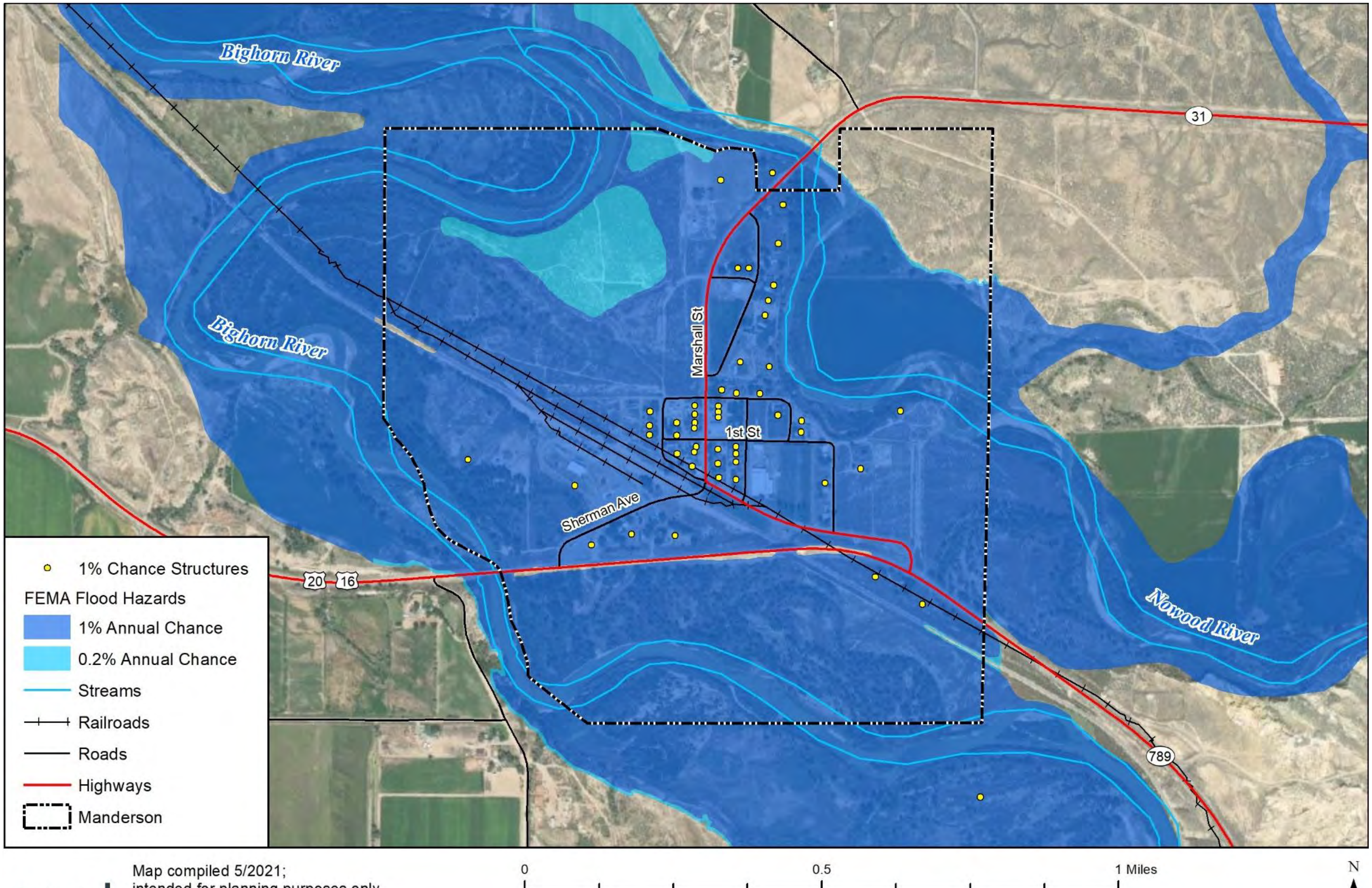


Figure 11 Manderson FEMA Flood Hazards



wood.

Map compiled 5/2021;
intended for planning purposes only.
Data Source: WY Geospatial Hub, WYDOT,
FEMA NFHL 12/03/2020

Flood Insurance Claims Analysis

The table below lists details regarding the flood insurance policies in the County.

Table 14 NFIP Insurance Policies and Claims Analysis (as of May 17, 2021)

Community	Date Joined	Current Map Date	Policies in Force	Insurance in Force	Number of Paid Losses	Total Losses Paid	Repetitive Loss Buildings/ Losses
County	4/4/1997	2/19/2014	13	$2,441,800	5	$47,439	0/0
Greybull	2/19/1980	2/19/2014	6	$1,575,000	1	$12,212	0/0
Lovell	10/01/1986	2/19/2014	N/A	N/A	N/A	N/A	N/A
Manderson	4/16/1979	2/19/2014	4	$435,100	2	$47,348	0/0

Source: http://www.fema.gov/policy-claim-statistics-flood-insurance and Wyoming Office of Homeland Security, State NFIP Coordinator

Repetitive Loss Properties: There are no reported Repetitive Loss properties in the County.

Community Rating System: Neither the County nor any of the communities participate in the CRS program.

6.3.8 Hail

According to records from the National Center for Environmental Information (NCEI) Storm Events Database, in the past 58 years there have been 30 events and only one resulted in 1 injury (8/7/2009) in in Big Horn County. A majority of the events took place in Unincorporated Big Horn County (17), followed by the Towns of Burlington (9) and Greybull (9). The largest hailstone recorded in Big Horn County was 2.5 inches on August 7, 2009, in Greybull. Past hail events have resulted in a total of $89,000 in property damages.

In 2018 the County received a USDA Disaster Designation (S4396) for hailstorms, which in some cases caused total crop loss. According to the CPT, the 2018 hailstorm caused power outages in Lovell and Cowley. Ping pong hail was reported causing extensive property damages including down trees onto powerlines, houses, and cars as well as road closures. Multiple county buildings experienced roof and window damages. Emergency Response Teams were activated during the storm to check on homes with power lines down and electricity dependent citizens in Lovell. The American Red Cross and the Wyoming Office of Homeland Security bother responded to conduct a quick response damage assessment after the event.

In terms of insured crop losses, according to the U.S. Department of Agriculture (USDA) Risk Management Agency (RMA) between 2007 and 2020 65,627,999 acres were lost to hail and $4,560,827 indemnity payments made to farmers in Big Horn County. Average annualized crop losses in the County due to hail is estimated to be $350,833.

Vulnerability to hail is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of hail risk related to Big Horn County and the Region.

6.3.9 Hazardous Materials

Hazardous materials vulnerability is significant in the County for transportation accidents due to the highways and railroad that passes through the County and all municipalities. Hazardous Materials facilities are listed along with the county's critical facilities in Table 7 in the Building Inventory and Assets section of this annex. According to the Wyoming State Hazard Mitigation Plan, there have been 43 hazardous materials incidents in Big Horn County from 1990 to 2019. According to the Right-to-Know network database, there is one facility in Big Horn County required to generate a Risk Management Plan. There are also multiple pipelines transporting hazardous materials across the county.

Refer to Chapter 4 for a discussion of hazardous materials risk in the Region and County.

6.3.10 High Wind

According to NCEI records between 1975 and 2020 there were 51 high wind events in Big Horn County. A majority of the events took place in Unincorporated Big Horn County (28), followed by the Towns of Greybull (22), Basin (6), and Cowley (4). The highest recorded event in Big Horn County was 78 miles per hours on June 29, 2018, as part of a severe thunderstorm event that produced a microburst that downed several hundred trees in the Bighorn National Forest. The most damaging event recorded in the NCEI database also took place in 2018 on May 27th. The event took place along a line from Manderson to Basin to Greybull and resulted in download trees and powerlines. Trees were also reported to fall on several houses in Bain and Greybull as well as roof damages for commercial properties in Basin. In total the event resulted in $75,000 in property damages.

In terms of insured crop losses, according to the USDA Risk Management Agency between 2007 and 2020 1,357 acres were lost to wind and $184,772 indemnity payments made to farmers in Big Horn County. Average annualized crop losses in the County due to wind is estimated to be $14,213.

Refer to Chapter 4 for a discussion of wind vulnerabilities related to Big Horn County and the Region.

6.3.11 Landslide, Debris Flow and Rockfall

The CPT noted the following related to landslide events:

Sloughing at Hwy 14A had gotten worse and that Sheep Canyon was affected in winter 2021; the Shell Canyon Road landslide issues took several months to fix.

While the risk is primarily in the unincorporated areas the municipalities are all vulnerable to indirect impacts of landslides when the highway or railroad is impacted.

Critical Facility Analysis

A GIS analysis of critical facilities identified 24 communication assets located within landslide hazard areas with the highest susceptibility. All 24 are located in unincorporated Big Horn County. Refer to Chapter 4 for further details on the critical facility analysis.

6.3.12 Lightning

Vulnerability to lightning is not noticeably different from the rest of the region. The follow lightning events were recorded in the NCEI database and/or noted by the CPT:

On August 18, 1996 a lightning strike in Burlington killed 11 heads of cattle (NCEI).
The Lovell sewer lagoon was out of service for a period of time from a lightning strike in 2019 (CPT).

6.3.13 Mine Subsidence

During the Big Horn County Risk Assessment and Goals Meeting, members of the CPT commented that there are some areas of mine and natural subsidence in Big Horn County.

The Gebo mine area has been reclaimed per the Wyoming Geological Survey. Natural sinkholes in limestone exist at Legend Rock, the golf course, and Anchor Dam. While not a subsidence hazard per se, a potential public safety hazards exist with cisterns in certain areas. These are typically 20' deep by 5' wide.

6.3.14 Pandemic/Epidemic

Vulnerability to pandemic/epidemic is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of pandemic/epidemic risk related to the Region.

6.3.15 Tornado

The NCEI database shows 20 records of events between 1958 and 2017 (note: the database was searched from 1950-2020 but no events were recorded before after 2017). These recorded events resulted in a total of $350,000 in property damages and 3 causalities (1 death and 2 injuries). The greatest magnitude recorded was an F3 on August 2, 1985. Unincorporated County has the most recorded events followed by Basin and Greybull.

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Mobile homes are more vulnerable to the impacts of a tornado event compared to housing types due to methods of construction. Statewide, mobile homes represent about 13% of total housing compared to 6.1% Nationwide. Big Horn County has a higher percentage of mobile homes as total housing compared to the statewide and national averages. Table 15 shows the breakdown of mobile for each jurisdiction.

Table 15 Percent of Mobiles Homes as Total Housing, by Jurisdiction

Jurisdiction	Total Housing	% Mobile Homes
Unincorporated County	5,474	15.2%
Basin	554	14.8%
Burlington	85	15.3%
Byron	208	22.1%
Cowley	243	19.3%
Deaver	85	23.5%
Frannie	76	28.9%
Greybull	862	11.7%
Lovell	1,040	7.1%
Manderson	49	44.9%

Source: U.S. Census, American Community Survey (ACS) 5-Year Estimates, 2015-2019

Refer to Chapter 4 for a discussion of tornado risk related to the Region.

6.3.16 Volcano

Vulnerability to volcano is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of volcano risk related to the Region.

6.3.17 Wildfire

Wildfire is a high significance hazard for the County, consistent with other counties in the Region. Furthermore, the past 100 years of wildland fire suppression have led to heavy vegetation growth, greatly increasing the potential fuel-load for a wildfire to burn.

Big Horn County has a long history of wildfire, as a significant portion of the county is located in the Big Horn Mountains. One of the earliest recorded large fires was in the summer of 1876 when the Sioux Indians retreated into the Big Horn Mountains, setting fire to the land, burning an estimated 500,000 acres to keep the United States Army, under the command of General Crook, from pursuing them. Historically, most significant fires in Big Horn County have occurred in the eastern county, in and around the foothills and higher elevations of the Bighorn Mountains. More recently there have been several fires affecting over 1,000 acres, and many smaller fires throughout the county (see Figure 4.45). Lightning starts many wildfires, but a number of structures in Big Horn County have burned as a result of out-of-control irrigation ditch burning to clear vegetation and debris for agricultural field operations (Source: Wyoming Multi-Hazard Mitigation Plan 2014). Additional details on fire history in Big Horn County can be referenced in their County Annex to this plan.

According to the Federal Wildland Occurrence data, there have been hundreds of wildfires throughout Big Horn County. Many of these fires were relatively small, burning only a few acres. The largest fire fully within Big Horn County, the Bone Creek Fire, occurred in 2007 and burned 13,450 acres. The larger Weintz fire in 2018 burned more than 42,000 acres across Big Horn and Washakie counties. Table 16 describes Big Horn County wildfires that burned 1,000 or more acres between 1980 and 2020.

Table 16 Wildfires over 1,000 acres in Big Horn County, 1980-2020

Name	Year	Acres Burned
Terek	2018	42,264
Weintz	2018	1,243
Big Fork	2013	1,509
Reservoir	2011	2,200
Bone Creek	2007	13,450
Copper	2003	2,500
Little Mt 2	1997	1,093
Intermission	1988	1,800
Dorn 2	1988	1,514

Big Horn County contains locations that are popular for seasonal homes. One is Meadow Lark Lake area in the Big Horn Mountains. The second location is the unincorporated town of Hyattville.

6.3.18 Winter Weather

Vulnerability to winter weather is not noticeably different from the rest of the region. Refer to Chapter 4 HIRA for a discussion of winter weather risk related to Big Horn County and the Region.

7 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 through the use of 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.

7.1.1 Big Horn County Regulatory Mitigation Capabilities

Table 17 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Big Horn County and each participating jurisdiction. Excerpts from applicable policies, regulations, plans and programs descriptions follow to provide more detail on existing mitigation capabilities.

Table 17 Big Horn County and Jurisdictions Regulatory Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Comprehensive, Master, or General Plan	Yes 1/6/2010	Yes 2014	Yes	No	Yes	Yes	No	No	Yes Adopted County's plan	No
Capital Improvement Program or Plan (CIP)	Yes	No	No	No	No	No	No	Yes	No	No
Floodplain Management Plan	Yes	No	No	No	No	No	No	Yes	Yes	No
Stormwater Program / Plan	No Not at county level. Commercial regulated by DEQ at state level	No	No	No	No	No	No	No	Yes	No
Community Wildfire Protection Plan (CWPP)	Yes 2018	No	No	No	No	No	No	No	No	No
Erosion / Sediment Control Program	Yes Residential subdivision review process	No	No	No	No	No	No	No	Yes	No
Economic Development Plan	Yes	No	No	Yes	No	Yes	No	No	Yes	No
Building Codes (Year)	No	Yes	Yes	Yes	Yes 2014	Yes IBC	No	Yes 2009	Yes 2018 IBC	No

Regulatory Tool (ordinances, codes, plans)	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
	County is required to follow State Fire Marshall codes: 2018 IBC, IFC, IM, IFGC, IEBC								2006 IRC	
Site Plan Review Requirements	Yes Required to be evaluated prior to building permit issued	Yes Title 10	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Zoning Ordinance (Land Use)	Yes Airport zoning ordinance	Yes Title 11	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Subdivision Ordinance	Yes Commissioner subdivision regulation and resolution	Yes Title 10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
National Flood Insurance Program (NFIP) Participant	Yes Joined 4/4/1997	Yes 2/19/2014	Not Required	No; sanctioned 2-19-2015	No; sanctioned 9-19-1976	No; sanctioned 2-19-2015	No; sanctioned 2-19-2015	Yes Joined 2/19/1980	Yes Joined 10/1/1986	Yes Joined 4/16/1979
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes municipal studies overlap into county and are applicable	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Regulatory Tool (ordinances, codes, plans)	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
	to floodplain regs.									
Floodplain Ordinance	Yes	Yes	No	No	No	No	No	Yes Adopted County's	Yes	Yes
Elevation Certificates for Floodplain Development	Yes	No	No	No	No	No	No	Yes Required if developing in a floodplain	Yes	No
Community Rating System (CRS) Participant	No	No	No	No	No	No	No	No	No	No
Open Space / Conservation Program	Yes Conservation District is required to review all building and use permits	Yes	No	No	No	No	No	No	Yes	No
Growth Management Ordinance	Yes Subdivision regulations and conservation district review fill the role of growth management ordinances in County	No	No	No	No	No	No	No	No	No
Stormwater Ordinance	No	No	No	No	No	No	No	No	Yes	No

Regulatory Tool (ordinances, codes, plans)	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	No	No	No	No	No	No	No	Yes	No
Other	Yes EOP, Natural Resources Management Plan (applies to Fed. Lands only), Public Health Pandemic Plan									

7.1.2 Big Horn County Administrative and Technical Mitigation Capabilities

Table 18 identifies the County and Town personnel responsible for activities related to mitigation and loss prevention in Big Horn County.

Table 18 Big Horn County and Jurisdictions Administrative/Technical Mitigation Capabilities

Administrative/Technical Resources	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Planning Board / Commission	Yes	Yes	No	No	Yes	No	No	Yes	Yes Mayor appointed board	No
Mitigation Planning Committee	Yes Consists of all elected officials and department heads in County Building and grounds checklists are reviewed quarterly.	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team	Yes Multiple agencies and employees; Participation on County CPT	Participation on County Mitigation Planning Team
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes Conducted yearly by County Maintenance Supervisor	Yes	Yes	No	Yes	No	No	Yes Public Works	Yes Public Works/Parks	Yes Maintenance
Emergency Manager	Yes County Emergency Management Coordinator	No	Yes Public Works Director	No	Yes	No	No	Yes Town Administrator	Yes Administration EMC	No
Building Official	Yes County Maintenance Supervisor	No	Yes Public Works Director	No	Yes	No	No	Yes Building Inspector	Yes Administration	No
Floodplain Administrator	Yes County Land Planner	Yes	No	No	No	No	No	Yes Town Administrator	Yes Building Inspector	Yes

Administrative/Technical Resources	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Planner/ engineer with knowledge of land development/ land management practices	Yes County Land Planner	No	No	No	No	No	No	No	Yes Council/ Administration	No
Personnel Skilled in GIS	Yes County Land Planner	Yes Through County	No	No	Yes	No	No	Yes Contractor	No	No
Transportation Planner	No	No	Yes	No	No	No	No	No	No	No
Civil Engineer	Yes Contractor	Yes	Yes	No	Yes	No	No	Yes Contractor	Yes Contractor	No
GIS Data Resources (Hazard areas, critical facilities, land use, building footprints, etc.)	Yes	Yes Through County	No	No	Yes	No	No	No	No	No
Warning Systems / Services (flood)	Yes Warning Sirens, CodeRED	Yes Sirens	Yes	Yes Public Alert System	Yes	No	No	Yes Blackboard/ community siren	Yes Dispatch	Yes Emergency Signal
Warning Systems / Services (other/ multi hazard)	Yes Warning Sirens, CodeRED	Yes Sirens	Yes	Yes Public Alert System	Yes	Yes CodeRED	Yes	Yes Blackboard/ community siren	Yes Dispatch	Yes Emergency Signal
Grant Writing / Management	Yes County Clerk	Yes Contracted	Yes	No	Yes	No	Yes	Yes Town Administrator	Yes Town Administrator	No

Administrative/Technical Resources	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Other:	County Commissioners, Natural Resource Land Use Committee									

7.1.3 Big Horn County Financial Capabilities

Table 19 identifies the County and Town 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 19 Big Horn County and Jurisdictions Financial Capabilities

Financial Resources	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
	Accessible/ Eligible to Use?									
Levy for Specific Purposes with Voter Approval	Yes	Yes	No	No	No	No	No	No	Yes	No
Utilities Fees	No	No	Yes	No	No	No	No	Yes	Yes	No
System Development / Impact Development Fee	No	No	No	No	No	No	No	No	No	No
General Obligation Bonds to Incur Debt	Yes	No	No	No	No	No	No	No	Yes	No
Special Tax Bonds to Incur Debt	Yes	No	No	No	No	No	No	No	Yes	No
Open Space / Conservation Fund	No	No	No	No	No	No	No	No	No	No
Stormwater Utility Fees	No	No	No	No	No	No	No	No	No	No
Capital Improvement Project Funding	Yes	Yes	No	No	No	No	No	Yes	Yes	No

Financial Resources	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
	Accessible/ Eligible to Use?									
Community Development Block Grants (CDBG)	Yes	Yes	No	No	No	No	No	Yes	Yes	No
Other	General Funds from County 12 mil. Levy									

FEMA Funding Leveraged for Hazard Mitigation

The County and certain jurisdictions within have received FEMA HMA funding for the following projects in the past, as summarized in the following table.

Table 20 Mitigation Actions Funded by FEMA in Big Horn County 2010 to mid-2020

Year	Funding Source	Jurisdiction	Description
2012	HMGP: DR-1923	County	Big Horn County Sheriff CAD System & Enhanced 911
	HMGP: DR-4007	County	Big Horn County-wide Warning & Notification System
2018	HMGP: DR 4327	Big Horn County	Public Health Generator Project
	HMGP	Big Horn County/Town of Greybull	Town of Greybull South-end Levee Project

Source: OpenFEMA Data Resources accessed February 2021

7.1.4 Big Horn County Education and Outreach Capabilities

Table 21 shows the mitigation education and outreach capabilities the County and jurisdictions have in place now. Additional information shared by the CPT is listed after the table.

Table 21 Big Horn County and Jurisdictions Mitigation Education and Outreach Capabilities

Education and Outreach Capabilities	Big Horn	Basin	Burlington	Byron	Cowley	Deaver	Frannie	Greybull	Lovell	Manderson
Public Education /Outreach Program	Yes	Yes	Yes	No	Yes	No	No	No	No	No
Local Citizen Groups That Communicate Hazard Risks	Yes	No	No	Yes	Yes	No	No	No	Yes	No
Firewise	West Ten Sleep Creek Cabin Owners Association	No	No	No	No	No	No	Yes	No	No
StormReady	Yes	No	No	No	No	No	No	Yes	Yes	No
Other?	Yes	No	No	Yes	No	No	No	Yes	No	No

As noted above, in addition to the capabilities listed above some of the jurisdictions listed other ongoing outreach efforts.

Big Horn County

- Emergency Management conducts educational outreach on household personal preparedness. Presentations have occurred for faith-based partners and community meetings at the public libraries, and multiple health fairs.
- Fire safety outreach conducted in the schools by individual fire districts/departments, as well as at community health fairs.

Town of Byron

- Neighborhood Watch helps to inform and educated citizens

Town of Greybull

- Blackboard emergency communications system is set up so we can communicate with all served customers with a text/call/email regarding hazards or emergency operations

Town of Lovell

- Church groups and the Local Emergency Planning Committee (LEPC) help communicate risks
- Participated in previous Firewise remediation standards

7.1.5 Opportunities for Enhancement

Based on the capabilities assessment, Big Horn County has several existing mechanisms in place that already help to mitigate hazards. There are also opportunities for the County to expand or improve on their policies, programs and fiscal capabilities and further protect the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County, Towns and WOHS. Additional training opportunities will help to inform County and Town staff members on how best to integrate hazard information and mitigation projects into their departments. The follow are specific opportunities the CPT provided or are recommended as an outcome of the 2021 capabilities assessment update.

Big Horn County

- Integrate risk information in future CWPP updates.

Town of Basin

- Update building codes.
- Obtain 3+backup generators

Town of Byron

- Create public outreach programs to educate residents on hazards.
- Revisit with the State NFIP Coordinator the potential of joining the National Flood Insurance Program to allow residents access to flood insurance.

Town of Burlington

- Explore opportunities to participate in Firewise.
- Become a StormReady certified community.

Town of Frannie

- Create public outreach programs to educate residents on hazards.
- Revisit with the State NFIP Coordinator the potential of joining the National Flood Insurance Program to allow residents access to flood insurance.

Town of Cowley

- Better understand the existing warning siren capabilities.
- Create public outreach programs to educate our residents on what to do in an emergency.
- Revisit with the State NFIP Coordinator the potential of joining the National Flood Insurance Program to allow residents access to flood insurance.

Town of Deaver

- Integrate risk information into future comprehensive plan updates.
- Revisit with the State NFIP Coordinator the potential of joining the National Flood Insurance Program to allow residents access to flood insurance.

Town of Greybull

- Establish regular communication with the network of emergency planners in the basin so that we can be ready for the next emergency.

Town of Lovell

- Training and education with elected officials on emergency management, preparedness and mitigation.

Town of Manderson

- Create public outreach programs to educate our residents on fire and flood preparedness.
- Improve existing warning systems.
- Improve existing building code and land use ordinances for better structure protection.

8 Mitigation Strategy

This section describes the mitigation strategy and mitigation action plan for Big Horn County. See Chapter 5 of the base plan for more details on the process used to develop the mitigation strategy.

8.1.1 Mitigation Goals

During the 2021 planning process the Big Horn County CPT decided to revise their goals to align generally with the State Mitigation Plan goals, with some modifications.

Goal 1: Strengthen public infrastructure and lifelines and reduce property losses.
Goal 2: Improve existing mitigation capabilities.
Goal 3: Reduce economic losses and losses of life due to hazard events.
Goal 4: Reduce costs of response and recovery.

8.1.2 Progress of 2016 Actions

During the 2021 planning process the Big Horn County Planning Team reviewed all the mitigation actions from the 2016 plan. Of their 44 mitigation actions from 2016, 30 of the actions are continuing and are implemented annually, demonstrating ongoing progress and building the community's resiliency to disasters. Six (6) were noted as being continuing not started, 7 actions were completed and 1 deleted (Table 22).

Table 22 Completed and Deleted Actions

2016 ID	Mitigation Action	Hazards Mitigated	Jurisdiction	Priority	Status/Implementation Notes
1.2	Upgrade communications system in Sheriff's Office	All hazards	Big Horn County	High	Completed
1.6	Work with state to refill County prevention position	Wildland Fire	Big Horn County	High	Completed

2016 ID	Mitigation Action	Hazards Mitigated	Jurisdiction	Priority	Status/Implementation Notes
1.3	Purchase enterprise GIS system	All hazards	Big Horn County	Medium	Deleted. Updated GIS system to free version. No purchase needed
5.1	Complete North drain install project	Flood	Town of Cowley	High	Completed
6.1	Identify supply shelter	All hazards	Town of Deaver	High	Completed
9.1	Address Road 12 drain issue	Flood	Town of Lovell	Medium	Completed. Copper Sulfate treatments every other month fixed the issue.
9.2	Research and implement warning/notification system	All hazards	Town of Lovell	Low	Completed. RIMS to Text incorporated. Siren warning system
9.3	Continue effort to shore up sewer lagoon	Flood	Town of Lovell	Medium	Completed. Added a backup generator for the sewer lagoon.

In addition to the complete actions listed above, the CPT noted the following mitigation success stories.

Big Horn County

Three riverine flood mitigation projects in Big Horn County were completed by private stakeholders, (Merit Energy and Enbridge Pipeline) that benefitted the county. The identified projects were bank stabilization projects to reduce risk to pipelines owned and operated by the identified companies. They did also reduce flood potential with the work done. American Colloid also completed an emergency bank stabilization project to protect their infrastructure from flooding and keep the mined bentonite from being discharged into river during an ice jam event. Clearing of excess vegetation on the Big Horn River, a recommendation from the County CWPP, has decreased fire hazard for wildland fire urban interface as well as helping to mitigate ice jam hazards.

Town of Greybull

The town Fire Department and Police Department have upgraded over 90% of their radios to WYLINK-compatible models so that we can better communicate with other agencies in an emergency

Town of Lovell

In 2017 the Town experienced a massive snowstorm and noted the ability to mitigate many of the problems due to a well-thought-out snow removal plan.

8.1.3 Mitigation Actions

As a part of the 2021 regional planning process, the CPT developed a list of hazard mitigation actions or projects specific to Big Horn County and its jurisdictions. The process used to identify, develop and prioritize these actions is described in Chapter 5 of the base plan.

The County Planning Team identified and prioritized the following mitigation actions based on risk assessments, goals, and objectives. 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.

Those that reduce losses to future development are indicated by an asterisk (*) in the Action Identification (ID) column in Table 23.

Continued Compliance with NFIP. Also, important to reducing losses to future development, and required by DMA 2000 planning requirements, is continued compliance with the NFIP. The jurisdictions that participate in the NFIP (County, Greybull, Lovell and Manderson) 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. Related to this is the need for improved floodplain mapping to support floodplain management which is noted in a specific action in the following table. Byron, Cowley, Deaver, and Frannie do not participate and are communities that have a mapped Special Flood Hazard Area based on updated Flood Insurance Rate Maps that became effective 2/19/2014. According to NFIP Community Status Book these communities are sanctioned by the NFIP, which means flood insurance through the NFIP is not available to residents, and FEMA mitigation grant opportunities are restricted. Communities including Deaver will revisit the potential of joining the National Flood Insurance Program in the future, as noted in a related mitigation strategy in the table below. In general, the parcel-based risk assessment performed during this update indicated little to no risk to existing structures in these communities. These communities are not currently anticipating annexation of areas at high risk on the FIRM map and flood insurance has not been identified as a priority of concern for residents of these communities.

Table 23 is grouped by jurisdiction and shows how each action connects to the County's mitigation goals as described in section 6.2.1 and FEMA Lifeline (refer to Figure 2).

The Status/Implementation Notes column describes the progress made on the actions so far, using the following categories:

Continuing-Ongoing: work has begun on the project and is ongoing.
Continue - Not completed: little or no work has been done on the project to date and the CPT agreed to carry over the action into the updated plan.
New in 2021: The action is new to this plan update; little to no work has been completed.

The Timeline column describes the estimated time of completion for each project. The following are the timeline categories:

Short Term: 1-4 years
Long Term: 5+
Annual Implementation: action is implemented every year

The Cost Estimate column describes the estimated project costs. The following are the cost estimate 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

Table 23 Big Horn County Mitigation Actions

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
BH-1	2,3,4 Safety & Security	Conduct public education to increase cell phone registration in notification system.	All Hazards	Big Horn County	Emergency Management	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing-Ongoing. Submitted SHSP Grant in 2016. Information booths at health fairs.
BH-2	2,3,4 Safety & Security	Conduct an exercise focused on evacuation of people unable to self-evacuate.	Flood, Wildfire, Volcano, HazMat	Big Horn County	Emergency Management	Biennial Implementation	Low Staff Budget	Medium	Continuing-Ongoing. Held first exercise in March 2016. Functional Exercise planning in progress.
BH-3	1,2,3,4 Safety & Security	Continue program to reduce non-native vegetation in the Big Horn River floodplain.	Flood, Wildfire, Drought	Big Horn County	Emergency Management Sheriff,	Annual Implementation	Moderate FEMA HMA Grants	High	Continuing-Ongoing. New CWPP plan completed in 2017-2018. Specific fuels reduction plans a remaining need.
BH-4	1 Safety & Security	Identify/construct facilities to house response equipment across the county.	All Hazards	Big Horn County	Emergency Management, Sheriff	Long Term	Moderate Staff Budget	High	Continuing-Ongoing.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
BH-5	2,3 Food, Water, Shelter	Coordinate with churches to establish shelters.	All Hazards	Big Horn County	Emergency Management, Red Cross	Short Term	Low Red Cross	Medium	Continuing-Ongoing. Meetings with Church and Red Cross have started.
BH-6	2 Safety & Security	Develop briefing paper for elected officials on natural hazards in the county.	All Hazards	Big Horn County	Emergency Management	Annual Implementation	Little to no cost Staff Budget	Low	Continuing-Ongoing.
BH-7	1,2,3,4 Safety & Security	Identify, plan and execute wildfire fuel mitigation projects in conjunction with an update of the countywide CWPP.	Wildfire	Big Horn County	CWPP Operating Group, contract services	Short Term	High Forest Service	High	New in 2021.
BH-8	1,2,4 Communications	Increase radio capabilities, repeater towers to expand communication and warning capabilities.	All Hazards	Big Horn County	Sheriff	Long Term	High	High	New in 2021
BH-9	2,4 Safety & Security, Communications	Software support/updates for computer aided dispatching: mapping, Big Horn County Sheriff's Office upgrades.	All Hazards	Big Horn County	Sheriff	Short Term	Moderate Grants	Medium	New in 2021
BH-10	2 Health & Medical	Update the Public Health Pandemic Plan incorporating lessons learned from three After Action Report's	Pandemic/Epidemic	Big Horn County	Public Health	Short Term	Moderate	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		written in the wake of COVID-19 pandemic.							
BH-11	1,3 Transportation	Culvert projects in repetitive flood areas including Rd 16 "Big Coulee Drainage" and Rd 32 ½ "Red Gulch Drainage".	Flood, Dam Incident	Big Horn County	Engineering, Road and Bridge	Long Term	High FEMA HMA Grants	Medium	New in 2021
BH-12	2,4 Safety & Security	Develop county-wide evacuation plan and educate public on evacuation preparation and procedures.	Volcano, Flood, Wildfire, Dam Incident	Big Horn County	Emergency Management, Sheriff's Office	Short Term	Moderate Staff Budget	Low	New in 2021
BH-13	2 Food, Water, Shelter, Safety Security	Identify location and construct safe room shelter to double as public facility such as restroom or equipment shelter.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Big Horn County	Emergency Management	Long Term	Moderate Staff Budget, FEMA HMA Grants	Low	New in 2021
BA-1	1 N/A	Clear gulches of dead vegetation to reduce flood and wildfire potential	Wildfire, Flood	Town of Basin	Town Administration	Short Term	Low Staff Budget, volunteers	Low	Continuing-Ongoing.
BA-2	1,3 N/A	Remove dead and dying tree limbs to reduce impacts on power lines and structures	Wind, Winter Storm, Wildfire, Flood	Town of Basin	Town Administration	Short Term	Low Staff Budget, volunteers	Low	Continuing-Ongoing
BA-3	2,4 N/A	Equip and train response Agencies for identified Threats and Hazards in Big Horn County.	All Hazards	Town of Basin	Town Administration	Short Term	Moderate Staff Budget	Low	Continuing-Ongoing

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
BA-4	1,2,3 Food, Water, Shelter	Enhance water source security by developing a plan to secure water supply from infrastructure threats as well as natural disaster issues.	Drought, Wildfire, Landslide	Town of Basin	Town Administration	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
BA-5	1,2,3 Energy	Transfer switch and generator with for a generator at town hall.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Basin	Town Administration	Short Term	Moderate FEMA HMA Grants	Low	New in 2021
BA-6	1,2,3 Energy, Food, Water, Shelter	Transfer switch and generator with quick connects for community center/gym.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Basin	Town Administration	Short Term	Moderate FEMA HMA Grants	Low	New in 2021
BU-1	2 Safety & Security	Work with County to fund shared GIS position.	All Hazards	Town of Burlington	Town Administration	Short Term	Moderate Staff Budget	High	Continuing-Ongoing. Worked with County on mapping.
BU-2	2,3 Safety & Security	Clean-up of debris around town.	Wind, Wildfire	Town of Burlington	Town Administration	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing. Community debris pickups.
BU-3	1,2,3 Safety & Security	Mow/treat weeds within community.	Wildfire	Town of Burlington	Town Administration	Annual Implementation	Moderate Staff Budget	High	Continuing-Ongoing.
BU-4	2 Safety & Security	Educate population on tornado shelter locations.	Tornado, Wind	Town of Burlington	Town Administration	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing. Subscribed to automated notification

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
									system; Educated public on County systems, town has a system also. Exploring tornado shelters in parks.
BU-5	2,3 Food, Water, Shelter	Construct tornado shelters in Centennial and Orlando/Aagard park bathrooms to provide a safe refuge for community and visitors.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Burlington	Town Administration	Short Term	Moderate	Medium	New in 2021
BY-1*	2 Safety & Security	Investigate feasibility of joining NFIP.	Flood	Town of Byron	Town Administration	Short Term	Low Staff Budget	Medium	Continuing-Ongoing
BY-2	2 Communications	Investigate and install emergency alert system.	All Hazards	Town of Byron	Town Administration	Short Term	Moderate FEMA HMA Grants	High	Continuing-Ongoing
BY-3	2,3 Safety & Security	Send fall letter to prepare for cold weather travel.	Winter Weather	Town of Byron	Town Administration	Annual Implementation	Low Staff Budget	Medium	Continuing-Ongoing
BY-4	2,3 Food, Water, Shelter	Identify or build shelter location and shore up to tornado standards if necessary.	All Hazards	Town of Byron	Town Administration	Short Term	Moderate Staff Budget FEMA HMA Grants	High	Continuing-Ongoing
BY-5	1,3 Food, Water, Shelter	Identify/address potential lagoon discharge to river.	Flood	Town of Byron	Town Administration	Long Term	Moderate Staff Budget	High	Continuing-Ongoing

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
BY-6	1,3 Energy	Install transfer switches and generators at the sewer lagoon.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Byron	Town Administration	Short Term	Moderate	Medium	New in 2021
BY-7	1,3 Energy	Install transfer switches for and generators at the townhall.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Byron	Town Administration	Short Term	Moderate	Medium	New in 2021
C-1	1,3 Food, Water, Shelter	Reclaim and refurbish three drains from old drainage district to mitigate stormwater flooding	Flood	Town of Cowley	Town Administration	Long Term	Moderate FEMA HMA Grants	Medium	Continuing Not Completed
C-2	2 Safety & Security	Strengthen emergency response—recruit, update	All Hazards	Town of Cowley	Town Administration	Annual Implementation	Moderate Staff Budget	Medium	Continuing-Ongoing
C-3	2,3 Food, Water, Shelter	Enhance shelter facility with emergency backup power and better kitchen.	All Hazards	Town of Cowley	Town Administration	Short Term	Moderate Staff Budget, Red Cross Grants	Low	Continuing Not Completed
C-4	Safety & Security, Food, Water, Shelter	Water security system to shore up security at the well site and air vacs on transmission lines to reduce/eliminate contamination due to earthquake or terrorist attacks.	Earthquake	Town of Cowley	Town Administration and Crew	Long Term	Moderate Staff Budget, Grants	Medium	New in 2021
D-1	1,2,3,4 Energy	Work with power company to ensure prompt response as	Lightning	Town of Deaver	Town Administration	Short Term	Low Staff Budget	High	Continuing-Ongoing

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		well as mitigation measures.							
D-2	2,3,4 Safety & Security	Educate the public on travel during severe weather.	Tornado, Wind, Winter Storm, Extreme Cold	Town of Deaver	Town Administration	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing
D-3*	2 Safety & Security	Update floodplain mapping.	Flood	Town of Deaver	Town Administration	Short Term	Moderate, FEMA RiskMAP	Low	Continuing-Ongoing
D-4	2 Safety & Security	Revisit participation in NFIP.	Flood	Town of Deaver	Town Administration	Short Term	Low Staff Budget	Low	Continuing-Ongoing
D-5	1,2,3 Energy	Install transfer switch and generator at the town hall for power outages to provide a resource for elderly people on oxygen, and a climate-controlled refuge during hot and cold temperatures.	Extreme Cold, Hail, Lightning, Tornado, Wind, Winter Storm	Town of Deaver	Town Administration	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
D-6	2 Safety & Security	Provide public information and awareness on wildfires, storms, etc. to allow people to take measures to protect themselves and their property.	All Hazards	Town of Deaver	Town Administration	Short Term	Low Staff Budget	Medium	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
F-1	2,3 Safety & Security, Communications	Do a mailing explaining the different siren tones.	Tornado	Town of Frannie	Town Administration	Annual Implementation	Low Staff Budget	Medium	Continuing-Ongoing
F-2	2,3 Safety & Security	Use water bill to educate people about seasonal weather hazards.	Extreme Cold, Hail, Lightning, Tornado, Wind, Winter Storm	Town of Frannie	Town Administration	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing
F-3	2,3,4 Safety & Security	Keep weeds and grasses sprayed and mowed to reduce wildfire risk.	Wildfire	Town of Frannie	Town Administration	Annual Implementation	Low Staff Budget	Medium	Continuing-Ongoing. Seasonal Issue.
F-4	2,3,4 Safety & Security	Address abandoned property that could contribute to fire hazards and wind-borne debris.	Wind, Wildfire	Town of Frannie	Town Administration	Short Term	Low Staff Budget	High	Continuing – Not Completed
F-5	1,3 Transportation	Implement improved stormwater drainage at 2nd and Ash intersection.	Flood	Town of Frannie	Public Works	Short Term	High FEMA HMA Grants	Medium	New in 2021
F-6	1,2,4 Energy, Safety & Security	Critical facilities protection: Install transfer switch and generator at town hall to continue operations during hazardous events.	Earthquake, Extreme Cold, Flood, Hail, Lightning, Tornado, Wildfire, High Wind, Winter Storm, Volcano	Town of Frannie	Public Works	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
G-1	1,2,3 Transportation	Upgrade drainage infrastructure on 6th Street to prevent ponding.	Flood	Town of Greybull	Public Works	Long Term	Moderate FEMA HMA Grants	High	Continuing-ongoing, have not identified a funding source to allow

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
									completion of this project.
G-2	2,3,4 Safety & Security	Work with county to remove non-native vegetation in/along Big Horn River.	Flood, Wildfire	Town of Greybull, County	Town Administration, County Weed & Pest	Annual Implementation	Moderate Staff Budget	Medium	Continuing-ongoing. This is a perpetual project, with help from Weed & Pest we are getting the area sprayed.
G-3	2 Food, Water, Shelter	Promote domestic water conservation (per land plan).	Drought	Town of Greybull	Town Administration, Public Works	Annual Implementation	Low Staff Budget	Medium	Continuing-ongoing. This is a perpetual project to continue to educate consumers about the need to protect our water source
G-4	1,3 Safety & Security, Transportation	Recertify Greybull levee.	Flood	Town of Greybull	Public Works	Short Term	Moderate FEMA HMA Grants	High	Continuing-ongoing. During the ice jam event in 2014 the lagoon area was breached. The project is in the review stage by FEMA. All field work has been completed as of 2021.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
G-5	1,3,4 Energy	Install a transfer switch and generator at town hall to provide continuity of services during hazard events.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Greybull	Town Administration	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
G-6	2,3,4 Safety & Security	Continue removal of invasive Russian Olive in the Greybull River floodplain to mitigate ice jam flooding, reduce wildfire potential, and enhance in-stream flow.	Flood, Drought, Wildfire	Town of Greybull	Town Administration	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
L-1	1,3,4 Energy	Install transfer switch and generator(s) at Community center.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Lovell	Town Administration	Short Term	Moderate FEMA HMA Grants	High	New in 2021
L-2	1,3,4 Energy	Install transfer switch and quick connects for generator(s) at sewer lagoon.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Lovell	Town Administration	Short Term	Moderate FEMA HMA Grants	High	New in 2021
L-3	2,3,4 Communications	Improve citizen communication systems related to hazards and warning to include mass text and updated siren system.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Lovell	Town Administration	Short Term	Low Staff Budget	High	New in 2021
L-4	1 Safety & Security	Implement a sewer lagoon expansion and dredging program to mitigate hazards	Flood	Town of Lovell	Town Administration	Long Term	High	High	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		associated flooding and sediment.							
M-1	2,3 Safety & Security	Educate residents about benefits of flood insurance.	Flood	Town of Manderson	Floodplain Administrator, Town Administration	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing
M-2	1,2,3 Transportation	Evaluate and address town drainage issues.	Flood	Town of Manderson	Public Works	Short Term	Moderate Staff Budget FEMA HMA Grants	High	Continuing-Not Completed
M-3	2,3,4 Safety & Security, Communications	Use water bills to remind people to prepare for severe weather.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather	Town of Manderson	Town Administration	Annual Implementation	Low Staff Budget	Medium	Continuing-Ongoing
M-4	2,3,4 Communications	Check into obtaining warning/notification software.	All Hazards	Town of Manderson	Town Administration	Short Term	Medium Grants, Staff Budget	Medium	Continuing – Not Completed.
M-5	2,3,4 Communications	Provide public education regarding information on flooding and hazards, including siren alerts and anticipated responses.	All Hazards	Town of Manderson	Town Administration	Short Term	Low Staff Budget	Low	New in 2021
M-6	2,3,4 Safety & Security	Create an evacuation, disaster and COOP plan to include assigned duties, directions on how to protect assets (water, sewer), and how to	All Hazards	Town of Manderson	Town Administration	Short Term	Moderate	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		communicate to residents.							
M-7	1,2,3,4 Safety & Security	Assess the level of flood protection provided by the existing berm/levee along the Nowood River. enhancements for 100-year flood protection.	Flood, Dam Incident	Town of Manderson	Town Administration	Long Term	Moderate FEMA HMA Grants	Low	New in 2021

*Addresses avoiding losses to future development

9 Implementation

Moving forward the Big Horn County CPT will use the mitigation action table in the previous section to track progress on implementation of each project. Implementation of the plan overall is discussed in Chapter 6 of the base plan.

9.1 Incorporation into Existing Planning Mechanisms

Also discussed in Chapter 6 is the importance of implementation and incorporation of the principles of this plan into other planning mechanisms.

As described in the capability assessment, the County already implements 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 or community comprehensive plans
- County or community development codes
- County or community Emergency Operations Plans
- Threat and Hazard Identification and Risk Assessments (THIRA)
- Community Wildfire Protection Plan (CWPP)
- County Continuity of Operations Planning (COOP)
- 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
- Other plans, regulations, and practices with a mitigation aspect

The process for incorporation of the Regional Hazard Mitigation Plan into other planning mechanisms can be as simple as cross-referencing the Hazard Mitigation Plan where applicable. Integrated planning is a key to building community resiliency.

In terms of the prior Big Horn County Hazard Mitigation Plan being incorporated into or referenced in other documents, Big Horn County developed a countywide CWPP in 2018, which referenced the HMP for continuity of planning and cross-over implementation. Another is the County's Threat Hazard Identification and Risk Assessment (THIRA), which is regularly updated and references the HMP; during the 2021 planning process a joint meeting was held to update the THIRA following a meeting to update the HMP's mitigation strategy. In addition, the Town of Greybull noted that in the Town's new residential subdivision the required property line offsets between structures was increased based on risk assessment information related to wildfire. While the other Town's did not specially incorporate or reference the 2015 HMP in municipal plans or planning mechanisms, a process to do so with the 2022-2027 plan is outlined in Chapter 6 of the base plan.

1 Mitigation Planning and County Planning Team

Hot Springs County updated this annex during the development of the 2022-2027 Region 6 Hazard Mitigation Plan. This County Annex builds upon previous version of the Hot Springs County Annex and Region 6 Hazard Mitigation Plan completed in 2016. 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 jurisdictions participated in the DMA planning process for the County.

- Hot Springs County
- Town of Thermopolis
- Town of East Thermopolis
- Town of Kirby

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. Additional details on which local government departments participated and who represented them are listed in Appendix A.

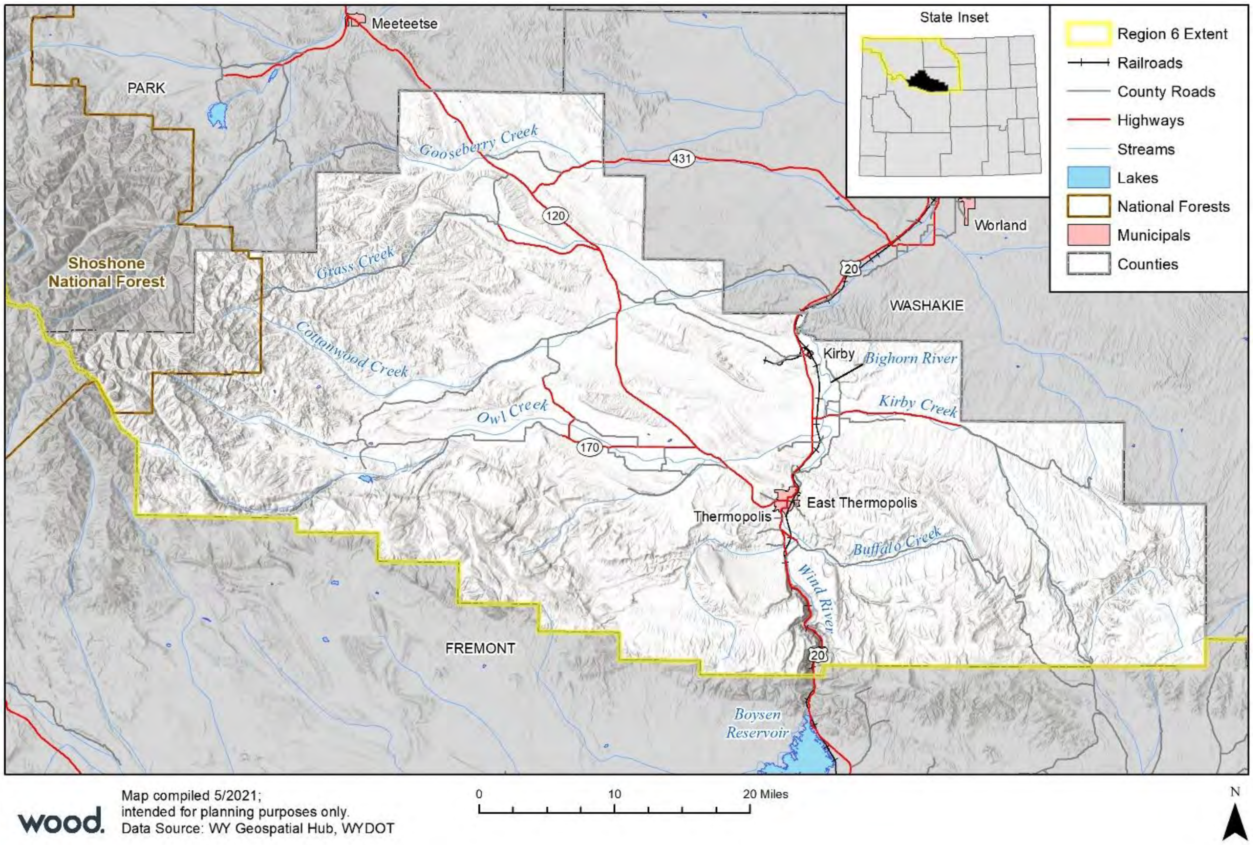
2 Geography and Climate

Hot Springs County was created on February 21, 1911. The county has a total area of 2,006 square miles, making it the smallest county by area in Wyoming. The Absaroka Mountain Range lies on the west side of the county, while the Bridger Mountains surround the east side. Hot Springs County also includes the southern portion of Bighorn Basin.

Counties adjacent to Hot Springs include Washakie, Fremont, and Park County. Towns include Thermopolis, East Thermopolis, and Kirby.

The County experiences a semi-arid climate with long, cold, dry winters and hot, dry summers. The average high temperature is 63 degrees and the average low temperature is around 33 degrees, with the average annual precipitation around 10.86 inches per year.

Figure 1 Hot Springs County Base Map



3 Population Trends

According to the 2019 United States Census Bureau American Community Survey (ACS), there were a total of 4,607 people living in Hot Springs County. With a population of 4,882 people recorded in the 2000 US Census, the county's population decreased by 6% in that timeframe. Table 1 provides a summary of the population change in the county and municipalities from 2014 to 2019.

The Town of Thermopolis is the County's principal population center and the county seat.

Table 1 Population Estimates for Communities 2014-2019

	2014	2015	2016	2017	2018	2019
Thermopolis	3,005	2,974	2,918	2,935	2,884	2,703
East Thermopolis	251	248	307	294	254	238
Kirby	93	92	114	110	85	69
County Total	4,826	4,809	4,781	4,741	4,680	4,607

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Select Census demographic and social characteristics for Hot Springs County are shown in Table 2. The table indicates the proportion of the population that may have special needs, such as the elderly or children under 5 years of age. Hot Springs County has a higher median age as well as a higher percentage individuals 65 years and older compared to both the Statewide average (37 years and 16%) and across the Counties in Region 6.

Table 2 Hot Springs County Demographic Profile

People	Hot Springs County
Gender/Age (% of Total Population)	
Male	50.2
Female	49.8
Under 5 Years	6.3
65 Years and Over	24
Race/Ethnicity (% of Total Population)	
White	95.9
American Indian/Alaska Native	2.6
Asian	0.0
Black or African American	0.6
More than One Race	1.0
Hispanic or Latino (of any race)[1]	3.8
Education (% of Total Population, 25+ years)	
High school graduate or higher	94.7
Bachelor's degree or higher	23.7
Source: U.S. Census Bureau, 2015-2019 5-Year American Community Survey, https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2019/ 1The U.S. Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race. The population self-identified as "Hispanic/Latino" is also represented within the categories in the "Race" demographic.	

4 Development Trends

During the 2021 Regional Plan development the CPT discussed growth and development trends in the County including:

- The countywide population is steadily decreasing and expected to decline to approximately 4,665 residents by 2025 according to a study done by Woods & Poole Economics.
- The CPT noted that desirability for newcomers to the County trends toward areas along the Bighorn River, which are likely to experience flooding.
- Hot Springs County and the local chamber of commerce have been promoting the outdoor recreation potential of the area, including construction of mountain biking and hiking trails. The area could see increased visitor and tourism growth in the future.
- East Thermopolis has had a large-scale renovation and modernization project at the Hot Springs County Memorial Hospital. That project is nearing completion at the time this document is being written.
- The Wyoming Dinosaur Center currently located in East Thermopolis has purchased land south of Thermopolis for development. Plans for eventual move remain in place.
- Though there is no growth into timbered areas at this time, the potential exists for range/grassland fires and smoke to threaten housing in all areas of Hot Springs County.
- Building in the rural areas south and west of Thermopolis continues at a steady pace. There are a few small subdivisions, but main development is on small acreage parcels-5 acres or less.
- In 2021, interest has increased in larger parcels. There are plans for 3 or more multi-space commercial campgrounds/RV Parks.

- Interest in fishing the Big Horn River has spiked to new highs in 2021. Out of state fishermen and drift boats are seen in numbers, daily, fishing the river.

5 Economy

Hot Springs County's economic base includes farming, ranching, tourism, retail, healthcare, and oil and gas industry. Economic statistics are noted below.

Table 3 Hot Springs County Economic Profile

	Hot Springs County
Families Below Poverty Level	10.2%
Individuals Below Poverty Level	15.2%
Median Home Value	$147,300
Median Household Income	$66,157
Per Capita Income	$30,643
Population >16 Years Old in Labor Force	60.8%
Population Employed	59%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Table 4 shows the breakdown of employment in Hot Springs County by the industry sector. According to data from the U.S. Census Bureau ACS, the leading employment sectors in the county are the educational services, and health care and social assistance, agriculture, forestry, fishing and hunting, and mining, and arts, entertainment, and recreation, and accommodation and food services sectors.

Table 4 Hot Springs County Occupations and Industries

Industry	Number Employed	Percent of Labor Force
Educational services, and health care and social assistance	645	29.1%
Agriculture, forestry, fishing and hunting, and mining	378	17.1%
Arts, entertainment, and recreation, and accommodation and food services	253	11.4%
Retail trade	158	7.1%
Construction	148	6.7%
Transportation and warehousing, and utilities	135	6.1%
Finance and insurance, and real estate and rental and leasing	132	6.0%
Public administration	109	4.9%
Other services, except public administration	83	3.7%
Professional, scientific, and management, and administrative and waste management services	78	3.5%
Manufacturing	50	2.3%
Wholesale trade	31	1.4%
Information	17	0.8%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

6 Hazard Identification and Risk Assessment

6.1 Identified Hazards

The CPT reviewed significant hazards for inclusion in the hazard mitigation plan. For the sake of consistency, the list of hazards for consideration began with the list of hazards found in the State of Wyoming's Hazard Mitigation Plan, updated in 2020. In the 2021 update the CPT decided to add the following hazards: pandemic/epidemic and volcano.

Table 5 Overall Hazard Significance* Summary Table provides a summary of the overall hazard significance for the hazards evaluated in this plan.

Table 5 Overall Hazard Significance* Summary Table

Hazard	Hot Springs County	Thermopolis	East Thermopolis	Kirby
Avalanche	Low	Low	Low	Low
Dam Failure	High	High	High	High
Drought	High	High	High	High
Earthquake	Medium	Medium	Medium	Medium
Expansive Soils	Low	Low	Low	Low
Extreme Cold	Medium	Medium	Medium	Medium
Flood	Medium	Medium	Medium	Low
Hail	High	Low	Low	Low
Hazardous Materials	Low	Low	Low	Low
High Winds and Downbursts	Medium	Medium	Medium	Medium
Landslide	High	High	High	Low
Lightning	Medium	Low	Low	Low
Mine Subsidence	Low	Low	Low	Low
Tornado	Medium	Low	Low	Low
Severe Winter Weather	Medium	Medium	Medium	Medium
Wildfire	High	High	High	Medium
Pandemic/Epidemic	Medium	Medium	Medium	Medium
Volcano	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 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.

6.2 Building Inventory and Assets

In addition to people, structures, critical facilities and infrastructure, and other important assets in Hot Springs County are potentially exposed to hazards identified in this plan. Table 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 as an assessment of the overall property exposed within the County and by jurisdiction.

The 2020 Parcel and Assessor Data was obtained through the Wyoming Cama website which is maintained by the Wyoming Department of Revenue. This information provided the basis for building exposure and property types. The available data is annually updated on the site and contains all counties within Wyoming. Data current as of 2020 was downloaded for all the counties within the Region and joined by Parcel Number in a separate database for analysis using GIS.

Table 6 Hot Springs County's Building Inventory and Value by Jurisdiction

Jurisdiction	Property Type	Building Count	Improved Value	Est. Content Value	Total Exposure
East Thermopolis	Commercial	2	$87,108	$87,108	$174,216
	Improved Vacant Land	2	$18,442	$18,442	$36,884
	Residential	89	$5,345,701	$2,672,851	$8,018,552
	Total	**93**	**$5,451,251**	**$2,778,401**	**$8,229,652**
Kirby	Commercial	3	$368,647	$368,647	$737,294
	Improved Vacant Land	1	$27,341	$27,341	$54,682

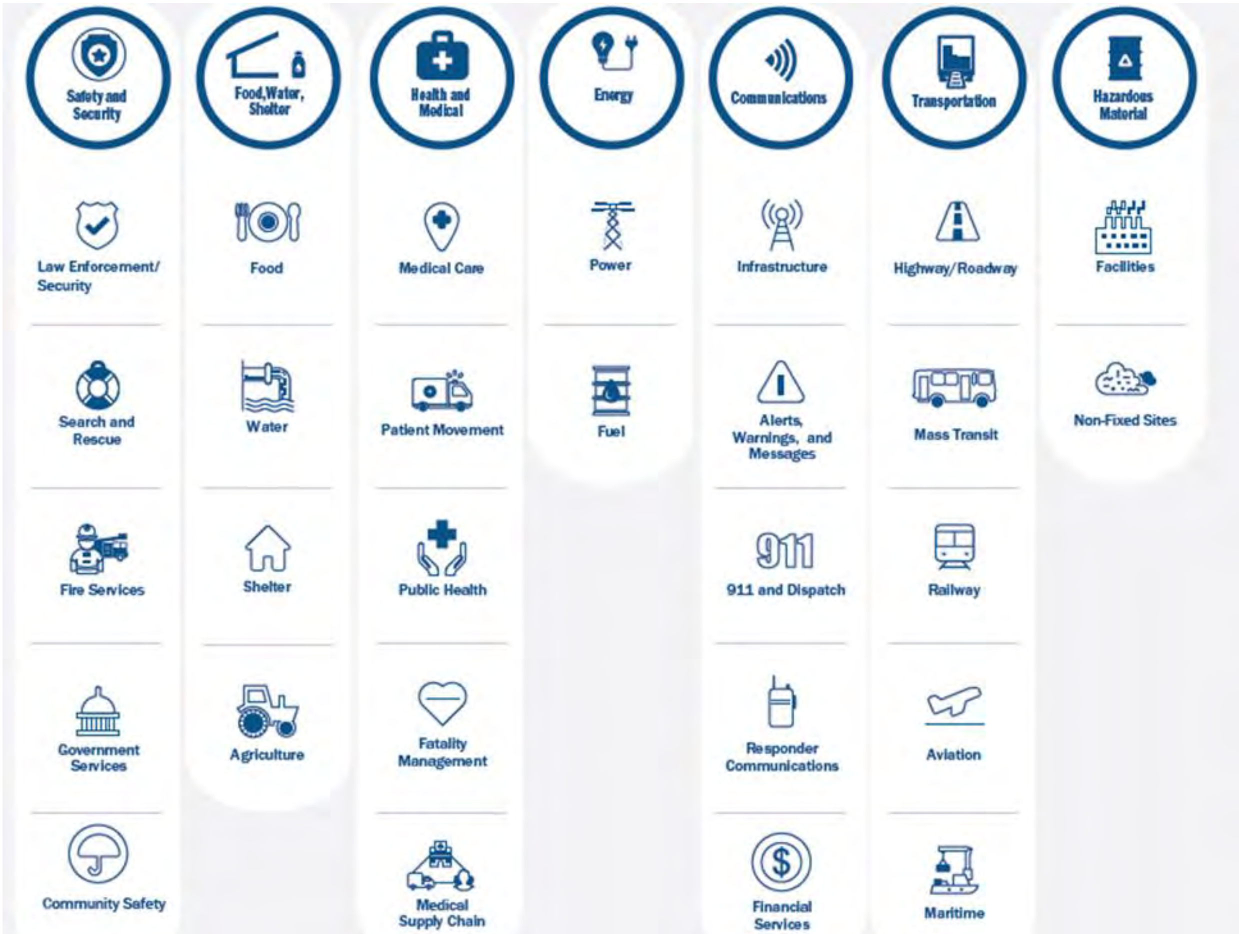
Jurisdiction	Property Type	Building Count	Improved Value	Est. Content Value	Total Exposure
	Residential	34	$1,727,852	$863,926	$2,591,778
	Total	**38**	**$2,123,840**	**$1,259,914**	**$3,383,754**
Thermopolis	Commercial	157	$29,199,610	$29,199,610	$58,399,220
	Improved Vacant Land	10	$412,906	$412,906	$825,812
	Industrial	4	$654,462	$981,693	$1,636,155
	Residential	944	$90,102,361	$45,051,181	$135,153,542
	Total	**1,115**	**$120,369,339**	**$75,645,390**	**$196,014,729**
Hot Springs Unincorporated	Agricultural	15	$1,882,728	$1,882,728	$3,765,456
	Commercial	67	$11,450,853	$11,450,853	$22,901,706
	Improved Vacant Land	3	$13,215	$13,215	$26,430
	Industrial	6	$4,960,968	$7,441,452	$12,402,420
	Residential	405	$70,298,964	$35,149,482	$105,448,446
	Total	**496**	**$88,606,728**	**$55,937,730**	**$144,544,458**
	Grand Total	**1,742**	**$216,551,158**	**$135,621,434**	**$352,172,592**

Source: (http://cama.state.wy.us/)

6.2.1 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. FEMA organizes critical facilities into seven lifeline categories as shown in Figure 2.

Figure 2 FEMA Lifeline Categories



A summary of the critical facilities exposure analysis can be found in Table 7 and Figure 4-2 in the Base Plan illustrates the location of critical facilities in Region 6.

Table 7 Summary of Hot Springs County Critical Facilities by Jurisdiction

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
East Thermopolis	-	-	-	-	-	1	1	**2**
Thermopolis	23	1	-	-	7	9	2	**42**
Unincorporated	50	19	-	-	-	2	35	**106**
Total	**73**	**20**	**0**	**0**	**7**	**12**	**38**	**150**

Source: Hot Springs CPT, HIFLD

6.2.2 Natural, Historic, and Cultural Assets

Assessing the vulnerability of Hot Springs County to disasters 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 a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.

- If these resources are impacted by a disaster, knowing 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 Resources

By definition, a historic property not only includes buildings of other types of structures, such as bridges and dams, but also includes prehistoric of Native American sites, roads, byways, historic landscapes, and many other features. Given the history of the County, these types of historic properties exist in the planning area.

Information about historic assets in Hot Springs County came from the following sources:

- The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.

Table 8 lists the properties and districts in Hot Springs County that are on the National Register of Historic Places.

Table 8 Hot Springs County Historic Properties

Site	Jurisdiction	Address
Legend Rock Petroglyph Site	Grass Creek	Address Restricted
Kirby Jail and Town Hall	Kirby	120 E. 4th St.
Downtown Thermopolis Historic District	Thermopolis	Broadway, 5th and 6th Sts.
CQA Four Mile Bridge	Thermopolis	WY 173
EFP Bridge over Owl Creek	Thermopolis	Cty. Rd. CN15-28
Woodruff Cabin Site	Thermopolis	26 mi. NW of Thermopolis
US Post Office--Thermopolis Main	Thermopolis	440 Arapahoe St.
Callaghan Apartments	Thermopolis	116 E. Park St.
Halone, Alex, House	Thermopolis	204 Amoretti St.
Bates Battlefield	Unknown	Bates Creek

Sources: National Register Information System, www.nr.nps.gov/

Another site of importance in terms of historic, cultural, and natural resources is Hot Springs State Park adjacent to Thermopolis and East Thermopolis. The State Park is a major economic driver for the County and surrounding communities and due to its location along the Bighorn River can be prone to flooding.

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 areas protects sensitive habitat as well as attenuates and stores floodwaters.

A number of natural resources exist in Hot Springs County, including wetlands, endangered species, and imperiled plant communities. Also, the scenery itself, and access to the scenic backcountry, are economic drivers for the County and its communities.

Wetlands

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. Wetlands reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. They also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital.

Endangered Species

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. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

As of July 2021, there are seven federally recognized endangered, threatened, or candidate species in Hot Springs County according to the U.S. Fish and Wildlife Service. These species are listed in Table 9 along with state listed species.

Table 9 Endangered and Threatened Species in Hot Springs County

Common Name	Scientific Name	Type of Species	Status
Bald eagle	*Haliaeetus Leucocephalus*	Bird	State Threatened (recovery)
Greater Sage-Grouse	*Centrocerus urophasianus*		Resolved Taxon
Whitebark pine	*Pinus albicaulis*	Conifers and Cycads	Candidate
Ute ladies'-tresses	*Spiranthes diluvialis*	Flowering Plant	Threatened
Monarch Butterfly	*Danaus plexippus*	Insects	Candidate
Grizzly bear	*Ursus arctos horribilis*	Mammal	Threatened
Black-footed ferret	*Mustela Nigripes*		Endangered
Gray wolf	*Canis lupus*		Experimental Population, Non-Essential
Canada Lynx	*Lynx Canadensis*		Threatened
North American Wolverine	*Gulo luscus*		Resolved Taxon

Source: http://www.fws.gov/endangered/

6.3 Vulnerability to Specific Hazards

This section details vulnerability to specific hazards, where quantifiable, only where it differs from that of the Region. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas and 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.

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Extreme Cold
- Expansive Soils
- Flood
- Hail
- Hazards Materials
- High Winds and Downbursts
- Landslide, Debris Flow and Rockfall
- Lightning
- Mine Subsidence
- Pandemic/Epidemic
- Tornado
- Volcano
- Wildfire
- Winter Weather

6.3.1 Avalanche

Avalanche prone areas are limited to the far west part of the County but have had negligible impact. Refer to Chapter 4 in the base plan for a discussion of general avalanche risk in the Region.

6.3.2 Dam Failure

Due to the presences of Boysen dam upstream of the County and major population centers including Thermopolis and East Thermopolis there is considerable risk to dam failure. There are also many dams upstream above Boysen in Fremont County. A table and map in Chapter 4 indicates the High and Significant Hazard dams upstream of the County.

Boysen Dam and Reservoir is an earthen dam located on the Wind River, approximately 20 miles south of Thermopolis in Fremont County. The current dam is operated by the U.S. Federal Bureau of Reclamation and is an earth-filled dam with a structural height of 220 feet. Total flood damages reduced by the reservoir since construction totaled about $75.0 million by the end of 1998. If Boysen Dam fails, impacts could be significant to Thermopolis, East Thermopolis, the unincorporated areas along the Bighorn River, and Kirby, including loss of life.

The Anchor Dam is the only High Hazard dam in the County. It has a dike built to keep water from going into sinkholes nearby. Failure of the dam would impact Owl Creek and homes along stream. It has some flood control but is mostly intended for irrigation purposes. It has an Emergency Action Plan and warning system. Summary information of the dam is provided in Table 10Table 10 below.

Table 10 High and Significant Hazard Dams in Hot Springs County

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Hot Springs County						
Anchor	Bureau of Reclamation	South Fork Owl Creek	H	Embar	8.0	Y

Refer to Chapter 4 in the Base Plan for additional discussion of dam incident risk related to the Region and the County.

6.3.3 Drought

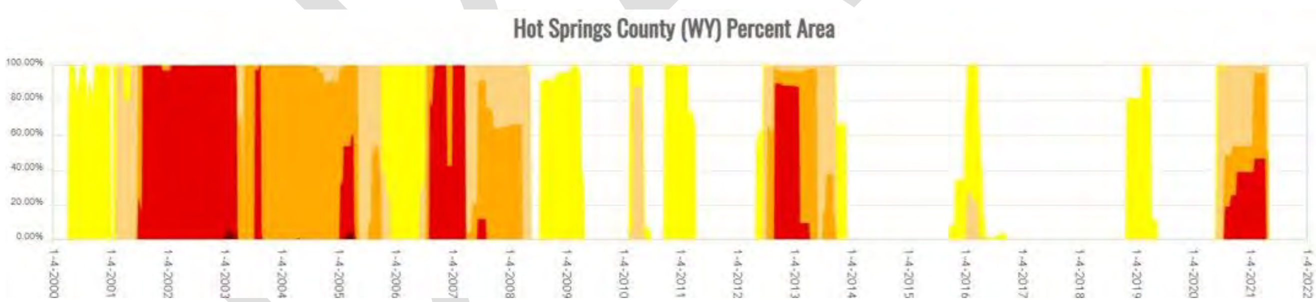
Similar to the rest of the Region drought is a high significance hazard for the County. Drought is a regular and widespread occurrence in the State of Wyoming. Since 2012 there have been 8 USDA Disaster Designations in Hot Springs County for drought. According to the U.S. Drought Monitor records for Hot Springs County, in the 1,095-week period from 2000 through 2020, the county spent 772 weeks (93% of the time) in Abnormally Dry (D0) conditions. Approximately 63% of the time, or 483 weeks, was spent in Moderate Drought (D1) conditions. Weeks in drought between 2000 and 2020 are summarized in Table 11 and shown in time series from January 2000 and January 4, 2021, in Figure 3.

Table 11 Hot Springs County Weeks in Drought by Intensity, 2000 – 2020

Category	Description	Palmer Drought Severity Index (PDSI)	Standardized Precipitation Index (SPI)	Hot Springs County Weeks in Drought, 2000-2020
D0	Abnormally Dry	-1.0 to -1.9	-0.5 to -0.7	715
D1	Moderate Drought	-2.0 to -2.9	-0.8 to -1.2	483
D2	Severe Drought	-3.0 to -3.9	-1.3 to -1.5	388
D3	Extreme Drought	-4.0 to -4.9	-1.6 to -1.9	214
D4	Exceptional Drought	-5.0 or less	-2.0 or less	18

Source: U.S. Drought Monitor

Figure 3 Hot Springs County Drought Intensity, 2000 – January 4, 2021



Source: U.S. Drought Monitor

Members of the CPT noted the following regarding water supply and impacts from drought in Hot Springs County:

- Water supply in Hot Springs County comes from rivers, wells, and groundwater recovery;
- Senior Water Right calls on the Bighorn River during times of drought can result in lower flows. The Hot Springs flows can be impacted by low river flows. The State has the option to buy water from Boysen Reservoir during drought;
- Grazing cattle are impacted the most during intense drought;
- Owl Creek has a cyclical flow depending on drought; and
- 1996-1998 fire season occurred during a drought. Emergency services could not use County water for firefighting.

Refer to the Chapter 4 in the Base Plan for additional discussion of drought risk related to the Region and the County.

6.3.4 Extreme Cold

Members of the CPT noted that extreme cold contributed to an ice jam on the Bighorn River in January of 2016 and sometimes results in burst pipes, power outages, and impacts to trees. Vulnerability to extreme cold is not noticeably different from the rest of the region and is considered a medium significance hazard. Refer to Chapter 4 for a discussion of this hazard's risk related to Hot Springs County and the Region.

6.3.5 Earthquake

According to the USGS, 1,500 to 2,500 earthquakes typically occur in and around Yellowstone each year, leaving Wyoming Region 6 as generally higher earthquake exposure relative to the rest of the state. Several notable earthquake events have occurred in Hot Springs County, which are summarized below.

The first earthquake that was reported in Hot Springs County occurred on February 13, 1928, approximately 10 miles south of Thermopolis. The intensity IV earthquake was felt as three shocks in Thermopolis, and was "felt sharply" in Worland, Owl Creek, Gebo, Crosby, and Kirby. It was also strongly felt at a mine in the Copper Mountain mining district near Bonneville. Reports indicate that two men entered their mine when aftershocks were occurring and found that many of the mine props were so loose that they could be moved by hand (Heck and Bodle, 1930).

On June 19, 1928, another intensity IV earthquake was reported in the area, with the epicenter located approximately 6 miles northwest of Thermopolis (Heck and Bodle, 1930). A single shock from this event was felt in Thermopolis, with sounds slightly preceding the earthquake.

Two earthquakes occurred in Hot Springs County in the 1940s. On October 11, 1944, an intensity IV earthquake was reported approximately 3 miles south of Thermopolis. Several landslides occurred as a result of the earthquake, and rocks fell onto the highway in Wind River Canyon. At Hot Springs State Park, there was a "caving of earth on the south rim of the large hot spring in the park" (Casper Tribune-Herald, October 13, 1944). Yet another intensity IV earthquake occurred in the same area on January 26, 1946. This event, which was felt for approximately ten seconds, rattled windows and dishes and clouded the water in Hot Springs State Park for a few days (Laramie Republican-Boomerang, January 29, 1946).

On January 23, 1950, an intensity V earthquake was felt near Hamilton Dome, approximately 22 miles northwest of Thermopolis. Houses shook and dishes rattled in the Hamilton Dome area, and the earthquake was felt in Thermopolis (Murphy and Ulrich, 1952). Another intensity V earthquake occurred approximately 3 miles south of Thermopolis on January 31, 1954 (Casper Tribune-Herald, February 2, 1954). No damage was reported from this event.

One of the largest earthquakes recorded in the Thermopolis area occurred on December 8, 1972. The magnitude 4.1, intensity V earthquake was centered approximately eight miles west of Thermopolis. It caused two cracks in the ceiling of a new addition to a Thermopolis rest home (Laramie Daily Boomerang, December 9, 1972), and the floor in a local lumberyard sank a few inches (Casper Star-Tribune, December 9, 1972). The earthquake was felt in Kinnear, Pavilion, and the Riverton area, and was reportedly felt as far away as Craig, Colorado.

On June 6, 1978, a magnitude 4.0 earthquake was recorded approximately 20 miles east of Thermopolis (Reagor, Stover, and Algermissen, 1985). No damage was associated with that earthquake.

On April 5, 2002 an earthquake of undetermined magnitude occurred in western Hot Springs County. The earthquake's epicenter was located approximately 11 miles northeast of Kirby. Although the Hot Springs

County Emergency Management agency reported ground shaking, the earthquake did not cause any damage.

As discussed in Chapter 4 of the base plan, earthquakes are low probability but could have considerable impacts in Hot Springs County. During the 2021 Regional Plan development the CPT noted the following potential consequences of earthquake in Hot Springs County:

- Earthquakes pose a risk to Boysen dam and railroad tunnels;
- The age of buildings is an issue as older and historic buildings in the County and Thermopolis are more vulnerable to earthquake shaking; and
- A concern was raised that if earthquakes affected the flow of the Hot Springs, which is a natural and cultural resource, it would affect the local economy.

According to Hazus analysis conducted, a 2,500-year earthquake event could result in $24 million in economic losses in the county. Refer to Chapter 4 for a discussion of the earthquake risk relative to Hot Springs County and the wider Region.

6.3.6 Expansive Soils

Expansive soils can lead to occasional problems in the County. During the 2016 and 2021 Regional Plan development the CPT noted the following consequences of expansive soils in Hot Springs County:

- Some houses were made inhabitable south of Thermopolis by this hazard;
- Issues on Highways; and
- Added costs to building middle school to mitigate impacts.

See Chapter 4 for more description on the expansive soils hazard.

6.3.7 Flood

A flood, as defined by the National Flood Insurance Program (NFIP), is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from overflow of waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days. The documented flood history for the Region extends back to 1917, when a 1% annual chance flood occurred in Hot Springs County along the Big Horn River and impacted Thermopolis. Cool weather preserving the heavy snowfall in the mountains until hot weather melted the snow quickly caused flooding according to FEMA Flood Insurance Study (March 23, 1999). The flood caused washed out bridges, destroyed irrigation flumes, and flooded low lying ground.

During the development of the 2021 State of Wyoming Hazard Mitigation Plan, 8 flood events and $2.1 million in property damage were noted specific to Hot Springs County. Figure 4 below shows the extent of the 1% annual chance and 0.2% annual chance floodplains in Hot Springs County, and Figure 5 shows a focused look at the flood hazard in the Town of Thermopolis.

Table 12 through Table 14 below provide some detail specific to Hot Springs County on the county's potential flood losses and participation in the NFIP. Refer to Chapter 4 of the base plan for a discussion of the flood risk relative to Hot Springs County, with details on property and critical facility risk from flood for the County and the wider Region.

Figure 4 Hot Springs County FEMA Flood Hazards

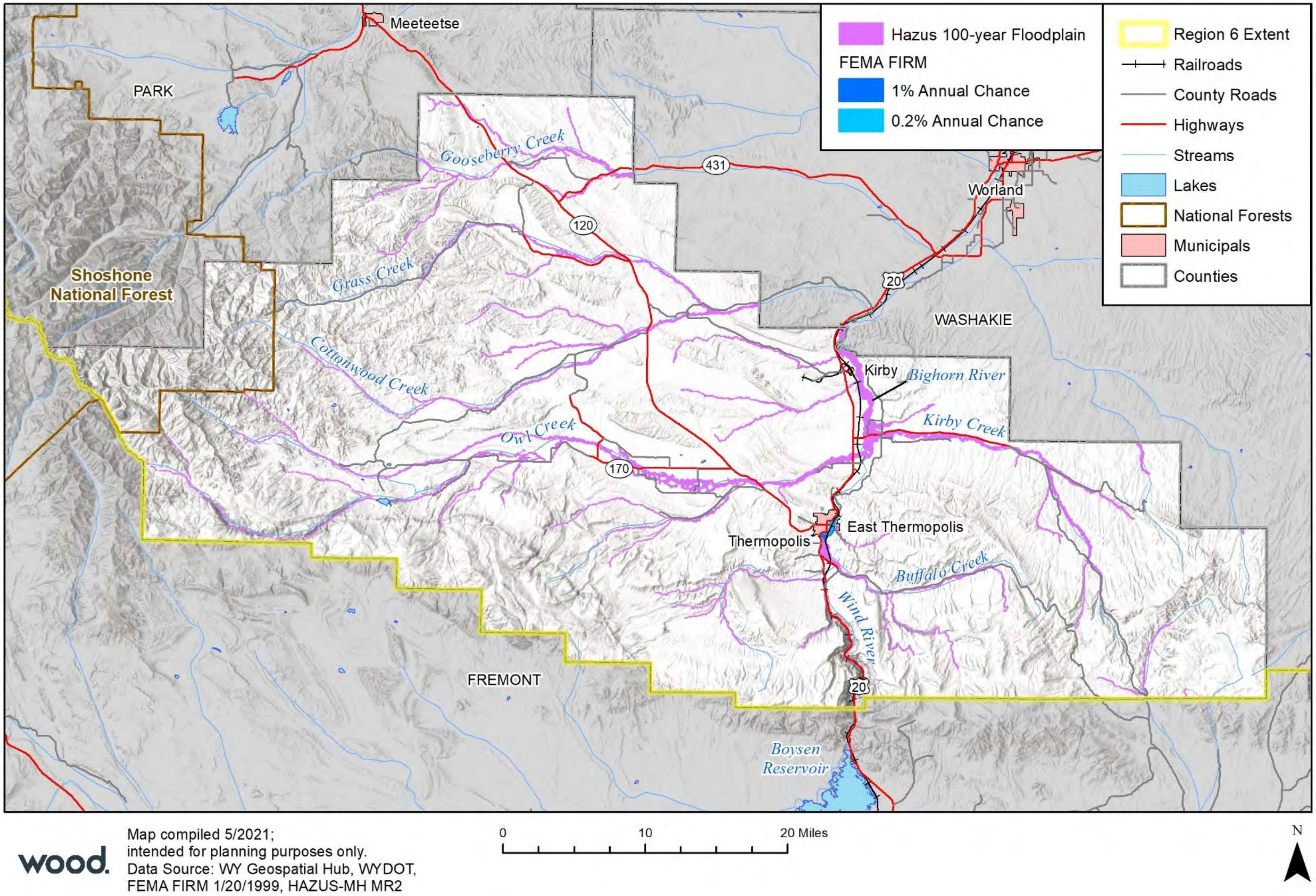


Figure 5 Towns of Thermopolis and East Thermopolis FEMA Flood Hazards

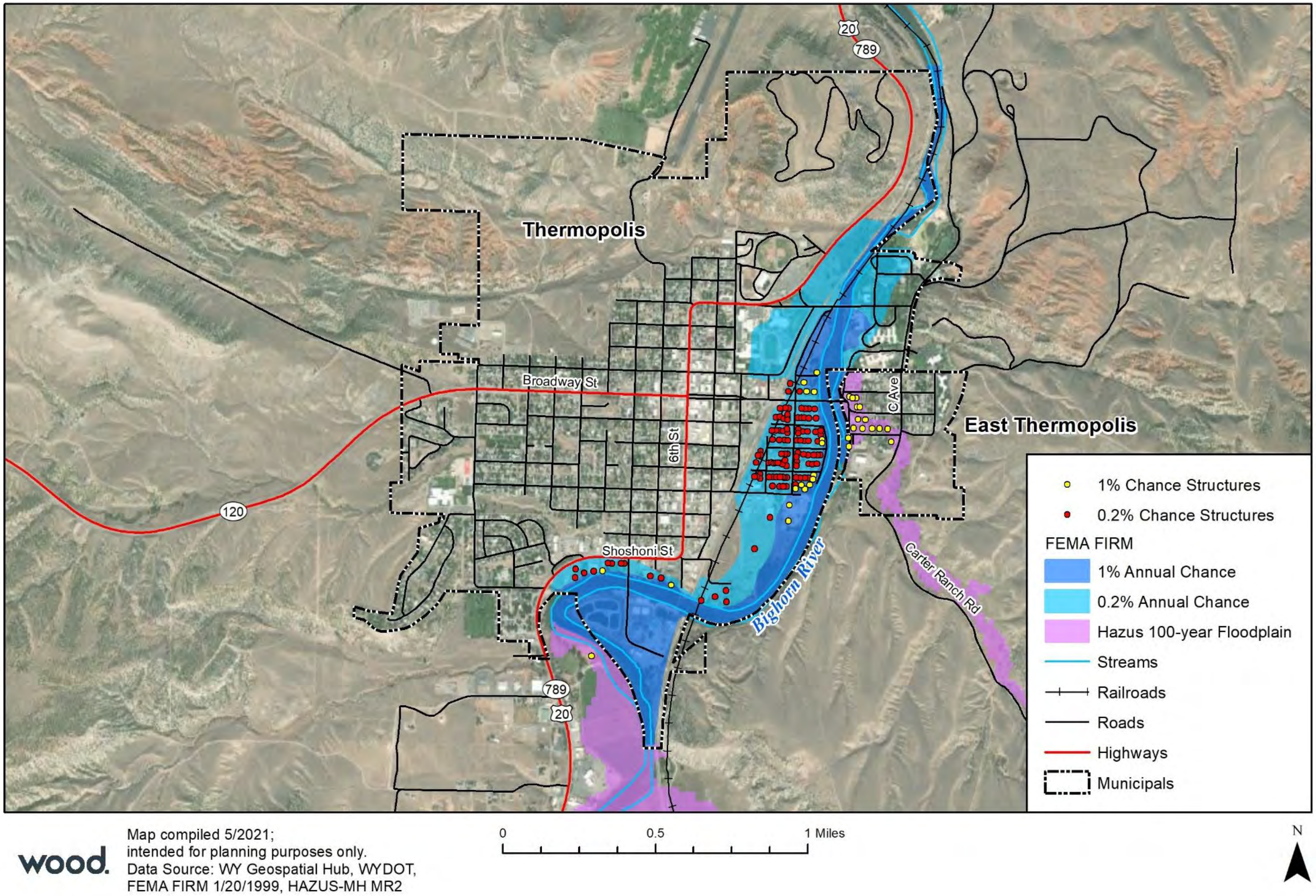
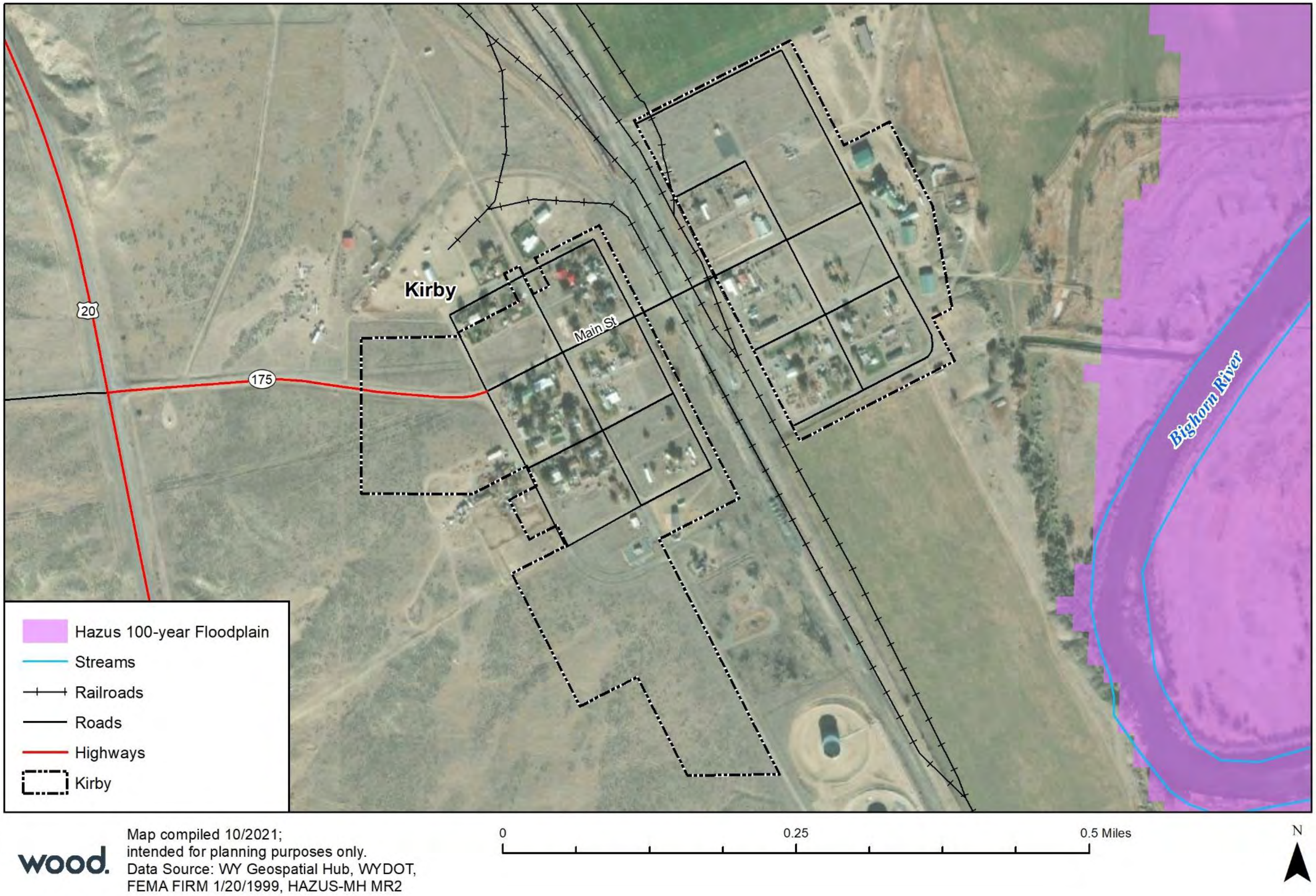


Figure 6 **Town of Kirby FEMA Flood Hazards**



Parcel Level Analyses

The following results show potential impacts from flooding, including the number or people vulnerable, total building exposure, and associated costs related to a general flooding incident based on a parcel level analysis.

Table 12 Exposure and Potential Loss in 1% Annual Chance Floodplain by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss	Population
East Thermopolis	Commercial	1	$59,085	$59,085	$118,170	$29,543	
	Residential	13	$1,073,395	$536,698	$1,610,093	$402,523	28
	Total	**14**	**$1,132,480**	**$595,783**	**$1,728,263**	**$432,066**	**28**
Thermopolis	Commercial	2	$250,466	$250,466	$500,932	$125,233	
	Improved Vacant Land	1	$3,660	$3,660	$7,320	$1,830	
	Industrial	2	$364,094	$546,141	$910,235	$227,559	
	Residential	11	$1,143,910	$571,955	$1,715,865	$428,966	23
	Total	**16**	**$1,762,130**	**$1,372,222**	**$3,134,352**	**$783,588**	**23**
Unincorporated	Agricultural	1	$73,902	$73,902	$147,804	$36,951	
	Commercial	8	$909,556	$909,556	$1,819,112	$454,778	
	Residential	65	$11,943,612	$5,971,806	$17,915,418	$4,478,855	138
	Total	**74**	**$12,927,070**	**$6,955,264**	**$19,882,334**	**$4,970,584**	**138**
	Grand Total	**104**	**$15,821,680**	**$8,923,269**	**$24,744,949**	**$6,186,237**	**190**

Table 13 Exposure and Potential Loss in 0.2% Annual Chance Floodplain by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss	Population
Thermopolis	Commercial	8	$1,221,928	$1,221,928	$2,443,856	$610,964	
	Improved Vacant Land	3	$39,277	$39,277	$78,554	$19,639	
	Industrial	1	$242,187	$363,281	$605,468	$151,367	
	Residential	95	$5,631,050	$2,815,525	$8,446,575	$2,111,644	202
	Total	**107**	**$7,134,442**	**$4,440,011**	**$11,574,453**	**$2,893,613**	**202**

Flood Insurance Claims Analysis

The table below lists details regarding the flood insurance policies in the County.

Table 14 NFIP Insurance Policies and Claims Analysis

Community	Date Joined	Current Map Date	Policies in Force	Insurance in Force	Number of Paid Losses	Total Losses Paid	Repetitive Loss Buildings/ Losses
County	5/3/1993	Study Underway	4	$1,400,000	0	$0	0/0
East Thermopolis	5/23/1986	3/23/1999	N/A	N/A	N/A	N/A	N/A
Thermopolis	7/17/1978	1/20/1999	4	$811,000	1	$0	0/0

Source: FEMA NFIP Community Information System

Repetitive Loss Properties: There are no reported Repetitive Loss properties in the County.

Community Rating System: Neither the County nor any of the communities participate in the CRS program.

6.3.8 Hail

According to records from the National Center for Environmental Information (NCEI) Storm Events Database, in the past 54 years there have been 55 hail events none of which resulted in casualties. Most of the events took place in Thermopolis (22) and Unincorporated Hot Springs (22) followed by the towns of Kirby (9) and East Thermopolis (2). The largest hailstone recorded in Hot Springs County was 2.25 inches on July 1, 2019, in Thermopolis and resulted in $1,000,000 in property damages including damages to homes and cars. Past hail events have resulted in a total of $1,020,000 in property damages. Members of the CPT noted that the 1982 hailstorm had significant impacts which also impacted the Hot Springs State Park.

In terms of insured crop losses, according to the U.S. Department of Agriculture (USDA) Risk Management Agency (RMA) there have only been insured crop losses in 2009 and 2018 (records were searched between 2007 and 2020). Between those two events, 105 acres were lost to hail and $1,208 indemnity payments made to farmers in Hot Springs County.

Vulnerability to hail is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of hail risk related to Hot Springs County and the Region.

6.3.9 Hazardous Materials

Hazardous materials vulnerability is significant in the County for transportation accidents due to the highways and railroad that passes through the County and all municipalities. According to the Wyoming State Hazard Mitigation Plan, there have been 84 hazardous materials incidents in Hot Springs County from 1990 to 2019. According to the Right-to-Know network database, there is one facility in Hot Springs County required to generate a Risk Management Plan. There are also multiple oil and gas pipelines across the county.

Refer to Chapter 4 for a discussion of hazardous materials risk in the Region and County.

6.3.10 High Wind

According to NCEI records between 1975 and 2020 there were 27 high wind events in Hot Springs County. A majority of the events took place in Thermopolis (16), followed by unincorporated Hot Springs County

(9), and Kirby (2). The highest recorded event in the county was 70 miles per hours on July 21, 2014 as a result of a thunderstorm event. The most damaging event recorded in the NCEI database also took place in 2009 on July 19th. The microburst event took place in Thermopolis and resulted in download trees, including uprooting a 50-foot Cottonwood. The wind event moved a metal shed across a street near the Hot Springs County fairgrounds. In total the event resulted in $3,000 in property damages. The CPT noted that a wind event also damaged cottonwood trees in the Hot Springs State Park.

Refer to Chapter 4 for a discussion of wind risk related to Hot Springs County and the Region.

6.3.11 Landslide, Debris Flow and Rockfall

Hot Springs County has a higher hazard significance rating for landslides than most counties in the region reflecting high risk to transportation (highway and rail) and travelling public in Wind River Canyon and economic impacts of highway and rail closures due to landslides. During the Hot Springs County Risk Assessment and Goals Meeting, members of the CPT noted the following consequences of landslides:

- Closures of Highway 120 in the Wind River Canyon due to landslides and rockfall. Event created large and costly detours.
- GIS analysis did indicate 280 parcels with a total value of $64,514,940 are within moderate to highest susceptibility landslide areas in the county. Refer to Chapter 4 for future detail on landslide exposure.
- The CPT noted that slumps are near six or more houses in Wind River Canyon, near Wolf Creek;
- Regional economic impacts from landslides can be substantial. The highway in the Wind River Canyon was closed for 3 days in May 2015 during Memorial Day weekend;
- The landslides and debris flows in May 2015 damaged train tracks and blocked the highway for a few days.
- Another incident in the Canyon caused a train derailment May 2010. Crew was transported to hospital with hypothermia from being in the river. The derailment was caused by a boulder on the track.
- Also has the potential to trigger a transportation hazardous materials incident.

While the risk is primarily in the unincorporated areas the municipalities are all vulnerable to indirect impacts of landslides when the highway or railroad is impacted.

Critical Facility Analysis

A GIS analysis of critical facilities identified a total of 8 critical facilities located within landslide hazard areas with the highest susceptibility. Of those facilities 7 are communication facilities and 1 transportation. All 8 are located in unincorporated Hot Springs County. In addition, the County has 26 critical facilities (16 communication facilities, 4 energy facilities, and 6 transportation) located in the moderately high susceptibility hazard areas. Thermopolis has 5 critical facilities in (3 communication, 1 energy, and 1 safety and security) located in the moderately high susceptibility landslide hazard areas. Refer to Chapter 4 for further details on the critical facility analysis.

6.3.12 Lightning

Vulnerability to lightning is not noticeably different from the rest of the region. The CPT noted the following regarding this hazard in Hot Springs County:

- Increase of outdoor recreation in the area may increase amount of people exposed to hazard.
- Past of event on a Dude Ranch killed a guest.
- Communications towers are grounded, as are some substations.
- Lightning Detection/Monitoring by Federal Government (BLM/Interagency) helps mitigate wildfire starts by sending maps to fire departments.

6.3.13 Mine Subsidence

During the Hot Springs County Risk Assessment and Goals Meeting, members of the CPT commented that there are some areas of mine and natural subsidence in Hot Springs County.

- The Gebo mine area has been reclaimed per the Wyoming Geological Survey;
- Natural sinkholes in limestone at Legend Rock, golf course, and Anchor Dam; and
- While not a subsidence hazard per se, a potential public safety hazards exist with cisterns in certain areas. These are typically 20' deep by 5' wide.

6.3.14 Pandemic/Epidemic

Based on their experience during the ongoing Covid-19 Pandemic, the CPT felt the local nursing homes did well to mitigate Covid-19 outbreaks. Due to the County's higher than average elderly population (65 and older) vulnerability to pandemic/epidemic is slightly higher compared to the rest of the region. Table 15 compares median age and percentage of elderly population to the region and state.

Refer to Chapter 4 for a discussion of pandemic/epidemic risk related to the Region.

Table 15 Comparison of Median Age and Percentage of Elderly Population

	Median Age	% 65 and Older
Hot Springs County	49.8	24%
State of Wyoming	37	16%
Big Horn County	42	21%
Park County	45	22%
Washakie County	42	21%

Source: U.S. Census, American Community Survey (ACS) 5-Year Estimates, 2015-2019

6.3.15 Tornado

The CPT noted that while tornadoes occur in the county, they historically occur in undeveloped areas and are not very strong. The NCEI database shows 5 records of events between 1984 and 2014 (note: the database was searched from 1950-2020 but no events were recorded before 1984 or after 2014). The CPT added there was an event on May 25,2016 that is not recorded in the NCEI database. Of these recorded events 1 resulted in $25,000 in property damages. The greatest magnitude recorded was an F2, which has an estimated winds of 113-157 miles per hour (mph) and took place in Kirby on July 10, 2001.

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Mobile homes are more vulnerable to the impacts of a tornado event compared to housing types due to methods of construction. Statewide, mobile homes represent about 13% of total housing compared to 6.1% Nationwide. Hot Springs County has a higher percentage of mobile homes as total housing compared to the statewide and national averages. Table 16 shows the breakdown of mobile for each jurisdiction.

Table 16 Percent of Mobile Homes by Jurisdiction

	Total Housing	% Mobile Homes
East Thermopolis	189	36%
Unincorporated County	2,611	16%
Kirby	39	11%
Thermopolis	1,534	10%

Source: U.S. Census, American Community Survey (ACS) 5-Year Estimates, 2015-2019

Refer to Chapter 4 for a discussion of tornado risk related to the Region.

6.3.16 Volcano

Vulnerability to volcano is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of volcano risk related to the Region.

6.3.17 Wildfire

Wildfire is a high significance hazard for the County, consistent with other counties in the Region. Furthermore, the past 100 years of wildland fire suppression have led to heavy vegetation growth, greatly increasing the potential fuel-load for a wildfire to burn. The Hot Springs County CPT, however, noted that the WUI is not as extensive as other parts of Wyoming as many of the forested areas are not inhabited. The group noted that Cottonwood Ventures subdivision in the unincorporated county having the highest risk and highest value homes in the WUI. Range land and grass fires can be a threat both to property and livestock and can also allow invasive species to spread. Thermopolis has been threatened by wildfire in the past. The railroad has also seen impacts from fires. Other impacts include air quality, even from fires hundreds of miles away.

The Federal Wildland Occurrence data recorded 157 fires between 1980 and 2019 in Hot Springs County. The total acres burned over this time period added up to 99,205 acres. According to this data the county has averaged 3 wildfires per year from 2000 to 2019.

The Kate's Basin Fire was a wildfire complex which began burning southwest of Thermopolis and north of Riverton in Hot Springs County, Wyoming. The fire complex started as the Kate's Basin and Blondie #2 fires on August 7, 2000, and by August 18, it had burned over 137,600 acres (556.8 km2). The fire started as a result of lightning. During the fighting of the fire a burn over incident resulted in the death of an engine boss.

By the end of July 2000, the Enos Complex fires had burned over 11,000 acres of limber pine, juniper, Douglas fir, sagebrush, and grass on mostly Bureau of Land Management (BLM) administered public lands. The fire was started by lightning.

Table 17 Wildfires over 1,000 acres in Hot Springs County: 1980-2019

Name	Year	Acres Burned
Black Mountain	2018	2,104
Zimmerman	2018	3,856
Twin Lakes	2016	1,583
Copper Mountain	2007	3,978
Renner DRA	2001	2,974
Kate's Basin	2000	137,600
Middle Enos	2000	10,005
Muddy Creek	2000	3,840
Enos	2000	2,499
Middle Creek	2000	1,400
Lower Gras	1999	1,832
Lower Gras 2	1999	1,410
Larsen	1998	2,640
E. Black Mountain	1996	48,844
Barbeque	1996	1,400

Name	Year	Acres Burned
Black Mountain 2	1996	1,187
Blondie 2	1988	1,000

The 2011 Hot Spring County Community Wildfire Protection Plan outlines potential impacts from wildfires by identifying “communities” most at-risk to wildfire in the WUI areas. The CWPP identified 31 at-risk communities that received a final rating of low, moderate, or high risk based on their community rating, hazard rating, and historical fire occurrence. The top 10 communities ranked as ‘High’ include the following, in priority order:

- Upper Cottonwood Creek
- Upper Grass Creek
- Bighorn River North
- Bighorn River South
- Cedar Ridge
- Missouri Floats
- Woods Basin
- North Fork Owl Creek
- South Fork Owl Creek
- Coyote Run

More details can be referenced in the CWPP document. The Hot Springs County CPT noted that the WUI is not as extensive as other parts of Wyoming as many of the forested areas are not inhabited. The group noted that Cottonwood Ventures subdivision having the highest risk and highest value homes in the WUI. South Thermopolis could have some expansion into areas that could be prone to range fires, but nothing is anticipated in the near future. Range land and grass fires can be a threat both to property and livestock. The railroad has seen impacts from fires. Other impacts include air quality, even from fires hundreds of miles away.

6.3.18 Winter Weather

Vulnerability to winter weather is not noticeably different from the rest of the region. Refer to Chapter 4 HIRA for a discussion of winter weather risk related to Hot Springs Count and the Region. The CPT commented on this hazard in Hot Springs County:

- Power failures have occurred and caused occasional facility damage;
- 2014 shed and roof damage; there are a number of flat roofed buildings in the County;
- East Thermopolis has been undergrounding utilities to help mitigate impacts; and
- Tree damage has also been an issue

7 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 through the use of 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.

7.1.1 Hot Springs County Regulatory Mitigation Capabilities

Table 18 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Hot Springs County and each participating jurisdiction. Excerpts from applicable policies, regulations, plans and programs descriptions follow to provide more detail on existing mitigation capabilities.

Table 18 Hot Springs County and Jurisdictions Regulatory Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Comprehensive, Master, or General Plan	Yes 2020 Land Use Plan	No	No	No
Capital Improvement Program or Plan (CIP)	Yes	No	No	No
Floodplain Management Plan	Yes Regulations exist, but County as no FIRM	No	No	No
Stormwater Program / Plan	No	No	No	No
Community Wildfire Protection Plan (CWPP)	Yes 2011	No County CWPP	No County CWPP	No County CWPP
Erosion / Sediment Control Program	No	No	No	No
Economic Development Plan	No	No	No	No
Building Codes (Year)	Yes State Building, Electrical, Fire Codes and DEQ Septic System Regulations apply	Yes State Building, Electrical, Fire Codes and DEQ Septic System Regulations apply	Yes State Building, Electrical, Fire Codes and DEQ Septic System Regulations apply	Yes State Building, Electrical, Fire Codes and DEQ Septic System Regulations apply
Site Plan Review Requirements	Yes	No	No	No
Zoning Ordinance (Land Use)	No	No	No	Yes
Subdivision Ordinance	Yes	No	No	No
National Flood Insurance Program (NFIP) Participant	Yes Joined 5/3/1993	Yes 5/23/1986	No	Yes 7/17/1978
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	Yes	No	Yes
Floodplain Ordinance	Yes	Yes	No	Yes
Elevation Certificates for Floodplain Development	No	No	No	No
Community Rating System (CRS) Participant	No	No	No	No
Open Space / Conservation Program	No	No	No	No
Growth Management Ordinance	No	No	No	No
Stormwater Ordinance	No	No	No	No

Regulatory Tool (ordinances, codes, plans)	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No			

As indicated in the table above, Hot Springs County has several plans and programs that guide the County's mitigation of development in hazard-prone areas. The County noted the following updates to the regulatory capabilities listed above.

- The County's Land Use Plan was revised in 2020 and was influenced by this EMP drawing attention to several hazards, most notably flooding and soils unsuitable for development.
- The County is currently updating its Natural Resource Plan for public lands, and this EMP has inspired the inclusion of additional policies addressing wildland fires, dam inundation, and flooding.

In addition to the plans listed above the county noted the following plans are also in place in Hot Springs County:

- Public Health plans
- Mass Dispensing plan
- Public Information plans
- CBRNE plan

7.1.2 Hot Springs County Administrative and Technical Mitigation Capabilities

Table 19 identifies the County and Town personnel responsible for activities related to mitigation and loss prevention in Hot Springs County.

Table 19 Hot Springs County Administrative/Technical Mitigation Capabilities

Administrative/Technical Resources	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Planning Board / Commission	Yes Planning Office	No	No	No
Mitigation Planning Committee	Yes	Yes Participation in County	Participation in County	Participation in County
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	Yes	Yes	Yes
Emergency Manager	Yes	Yes	Yes	Yes
Building Official	No	No	No	Yes
Floodplain Administrator	Yes	Yes	No	Yes
Planner/engineer with knowledge of land development/land management practices	Yes	No	No	Yes Private engineering contractor
Personnel Skilled in GIS	Yes	No	No	No
Transportation Planner	No	No	No	No
Civil Engineer	No	No	No	No
GIS Data Resources (Hazard areas, critical facilities, land use, building footprints, etc.)	Yes Assessor's Office	No	No	No
Warning Systems / Services (flood)	Yes	Yes	Yes	Yes

Administrative/Technical Resources	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Warning Systems / Services (other / multi hazard)	Yes Critical Emergency Risk Communications (CERC): CodeRed, Sirens, social media	Yes	Yes	Yes
Grant Writing / Management	No	No	No	No
Other:	Yes Public Health Response Coordinator			

7.1.3 Hot Springs County Financial Capabilities

financial tools or resources that could potentially be used to help fund mitigation activities. There are currently no specific funding sources for hazard mitigation.

 identifies the County and Town financial tools or resources that could potentially be used to help fund mitigation activities. There are currently no specific funding sources for hazard mitigation.

Table 20 Hot Springs County Financial Capabilities

Financial Resources	Hot Springs County	East Thermopolis	Kirby	Thermopolis
	Accessible/ Eligible to Use?			
Levy for Specific Purposes with Voter Approval	Yes	No	No	Yes
Utilities Fees	Yes	Yes	Yes	Yes
System Development / Impact Development Fee	No	No	No	No
General Obligation Bonds to Incur Debt	No	No	No	No
Special Tax Bonds to Incur Debt	No	No	No	No
Open Space / Conservation Fund	No	No	No	No
Stormwater Utility Fees	No	No	No	No
Capital Improvement	Yes	Yes	Yes	Yes

7.1.4 Hot Springs County Education and Outreach Capabilities

Table 21 Hot Springs County Education and Outreach Capabilities

Education and Outreach Capabilities	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Public Education /Outreach Program	Yes	No	No	No

Education and Outreach Capabilities	Hot Springs County	East Thermopolis	Kirby	Thermopolis
Local Citizen Groups That Communicate Hazard Risks	Yes	No	No	No
Firewise	No	No	No	No
StormReady	Yes	Yes	Yes	Yes
Other?				

During the 2021 planning process, Hot Springs County Emergency Management Agency and the County Emergency Manager was recognized by the National Weather Service as a Weather-Ready Nation (WRN) Ambassador of Excellence. Ambassadors of Excellence are recognized as those serving as change agents and leaders in their communities. The following was highlighted by the National Weather Service as why Hot Springs County Emergency Management Agency was chosen as one of the WRN 2021 Ambassadors of Excellence:

> *In addition to their role and sharing of vital weather information as a core partner, Hot Springs Emergency Management Agency, led by Bill Gordon, coordinator, has completed several Weather-Ready Nation Ambassador projects with NWS Riverton, Wyoming office. Since 2017, there have been 20 lightning safety toolkit sign locations recognized and "When Thunder Roars, Go Indoors" lightning safety signs installed at numerous locations in Hot Springs County, Wyoming. The locations have ranged from school playgrounds to football, soccer, and baseball fields, to the county fair and rodeo complex and at a golf course, and numerous hiking and backcountry hiking trails. Hot Springs County Emergency Management has also been proactive continuously involving sharing all-hazards preparedness and weather safety information to Hot Springs County residents through collaboration with NWS Riverton, Wyoming. The close collaboration between Hot Springs County Emergency Management and NWS Riverton, Wyoming has led to the development of an Adopt-A-County" initiative that has resulted in NWS Riverton being more involved in the Local Emergency Planning Committee (LEPC) Weather preparedness activities. This initiative has spread farther across central and western Wyoming, undoubtedly resulting in more Weather Ready Wyoming!*

7.1.5 Opportunities for Enhancement

Based on the capabilities assessment, Hot Springs County has several existing mechanisms in place that already help to mitigate hazards. There are also opportunities for the County to expand or improve on their policies, programs and fiscal capabilities and further protect the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County and WOHS. Additional training opportunities will help to inform County and Town staff members on how best to integrate hazard information and mitigation projects into their departments. Continuing to train staff on mitigation and the hazards that pose a risk to the Hot Springs County will lead to more informed staff members who can better communicate this information to the public.

Other opportunities include improved cross-jurisdictional communication on evacuation and awareness to mitigate life safety impacts during dam incidents, floods, or wildfires including the development of brochures and using existing communication capabilities through social media such as Facebook. Another opportunity for taking placed county-wide is raising awareness of lightning and other hazards. Enhancing floodplain management in the Unincorporated County is another opportunity, though made challenging due to the fact that there are not yet any FEMA Flood Insurance Rate Maps. These opportunities have been captured in mitigations action detailed in Section 8. Mitigation Strategy

This section describes the mitigation strategy and mitigation action plan for Hot Springs County. See Chapter 5 of the base plan for more details on the process used to develop the mitigation strategy.

8 Mitigation Strategy

8.1.1 Mitigation Goals

During the 2021 planning process the Hot Springs County CPT added a 4th goal that emphasizes life safety through the mention of lifelines. These goals were based on a review of the 2020 Wyoming State Hazard Mitigation Plan (HMP) and other mitigation plans in the Region but generally align with the Wyoming HMP goals.

Goal 1: Strengthen Public Infrastructure

Goal 2: Improve Existing Mitigation Capabilities

Goal 3: Reduce Economic Losses due to Hazard Events including costs of Response and Recovery

Goal 4: Reduce life safety impacts including vulnerable populations such as those with access and functional needs

8.1.2 Progress of 2016 Actions

During the 2021 planning process the Hot Springs County Planning Team reviewed all the mitigation actions from the 2016 plan. Of their 21 mitigation actions from 2016, 17 of the actions are continuing and are implemented annually, demonstrating ongoing progress and building the community's resiliency to disasters. Three (3) were noted as being continuing not started and 1 action was completed (Table 22)

Table 22 Completed Action

2016 ID	Mitigation Action	Hazards Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
17	Designate and train a County Public Information Officer(s) to provide public education and awareness information prior to and during an event.	Wildfire, Flood, Dam Failure, Winter Storm, Tornado, Hail, Hazardous Materials	County	County Emergency Management and County Public Health	Ongoing as individuals present for training	Low	Low	Completed. Several county staff trained with FEMA courses

8.1.3 Mitigation Actions

As a part of the 2021 regional planning process, the CPT developed a list of hazard mitigation actions or projects specific to Hot Springs County and its jurisdictions. The process used to identify, develop and prioritize these actions is described in Chapter 5 of the base plan.

The County Planning Team identified and prioritized the following mitigation actions based on risk assessments, goals, and objectives. 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. Those that reduce losses to future development are indicated by an asterisk (*) in the Action Identification (ID) column in Table 23.

Also important to reducing losses to future development is continued compliance with the NFIP. The jurisdictions that participate in the NFIP (County, Thermopolis, East Thermopolis, and Kirby) 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. Related to this is the need for better floodplain mapping to support floodplain management which is noted in a specific action in the following table.

Table 23 is grouped by jurisdiction and shows how each action connects to the County's mitigation goals as described in section 8.1.1 and FEMA Lifeline (refer to **Error! Reference source not found.**).

The Status/Implementation Notes column describes the progress made on the actions so far, using the following categories:

- **Continuing-Ongoing:** work has begun on the project and is ongoing.
- **Continue - Not completed:** little or no work has been done on the project to date and the CPT agreed to carry over the action into the updated plan.
- **New in 2021:** The action is new to this plan update; little to no work has been completed.

The Timeline column describes the estimated time of completion for each project. The following are the timeline categories:

- **Short Term**: 1-4 years
- **Long Term:** 5+
- **Annual Implementation:** action is implemented every year

The Cost Estimate column describes the estimated project costs. The following are the cost estimate 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

Table 23 Hot Springs County Mitigation Actions

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
MJ-1	1,2,3,4 Safety & Security	Update Boysen Dam emergency action plan.	Dam Failure	County, Thermopolis, East Thermopolis, and Kirby	County Emergency Management, US Bureau of Reclamation	Annual Implementation	Low HMA Grants	Low	Continuing-Ongoing Annual Basis
MJ-2	2, 4 Safety & Security, Infrastructure	Dam failure evacuation route planning and designations using same concepts as Tsunami evacuation route with signage, mapping and public awareness and emergency notifications. Public information/awareness and/or signage for visitors/tourists could help mitigate loss of life. Finish conducting 5 community-wide exercises.	Dam Failure	County, Thermopolis, East Thermopolis, and Kirby	County Emergency Management, Local Law Enforcement, WHP, WYDOT, Road and Bridge, Thermopolis and E Thermopolis Streets Division, Kirby administration	Long Term	Moderate HMA Grants	High	Continuing-Ongoing
MJ-3	2,3 Safety & Security, Food, Water, Shelter	Coordination and Sharing of Drought Monitoring Information -Education and sharing on sources of information including www.drought.gov -BLM provides fuel moisture monitoring	Drought	County, Thermopolis, East Thermopolis, and Kirby	County Emergency Management in coordination with BLM, municipalities, State Forestry, NWS, NRCS	Annual Implementation	Low HMA Grants, USDA	Medium	Continuing-Ongoing Annually in the spring and more frequently during times of drought

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
MJ-4	2,3,4 Safety & Security,	Provide education and outreach to raise awareness of earthquake hazards so residents understand how they can reduce earthquake losses and react appropriately during an event. This project includes continuing to provide the 'Earthquakes in Wyoming' brochure at county and municipal offices. This project could include annual participation in the Great Wyoming Shakeout as part of a national awareness program held each October.	Earthquake	County, Thermopolis, East Thermopolis, and Kirby	County Emergency Management	Annual Implementation	Low HMA Grants	Low	Continuing-Ongoing. Shakeout participant.
MJ-5*	2,3 Safety & Security	Request NFIP Floodplain Mapping. The County is not mapped in the NFIP which makes it difficult to properly assess risk and regulate floodplain development. Maps for Thermopolis and E Thermopolis exist but are outdated and not in digital format. This project entails requesting additional mapping studies from FEMA through the state.	Flood	County, Thermopolis, East Thermopolis, and Kirby	Planning, WYOHS, FEMA	Long Term	High, FEMA and State WYOHS	High	Continuing- Not Completed. Dam is seen as mitigation action. In 2021 requests mad once again to WOHS for mapping.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
MJ-6	1,3 Transportation	Encourage WYDOT to continue landslide stabilization / rock fall mitigation efforts in Wind River Canyon to reduce direct and indirect impacts to travelers. Areas that need attention have been identified but more funding needs to be secured to address the hazard more holistically.	Landslide	County, Thermopolis, East Thermopolis, and Kirby	WYDOT	Long Term	High - Projects could run in the millions of dollars. WYDOT and FHWA	High	Continuing-Ongoing. Ongoing through 2030. Several projects completed since 2016.
MJ-7*	2 Safety & Security; Food, Water, Shelter	Community Information on Fire Wise Practices.	Wildfire	County, Thermopolis, East Thermopolis, and Kirby	County Fire Warden, Thermopolis Fire Department, County Emergency Management	Annual Implementation	Low HMA Grants	Low	Continue-Ongoing. Town of Thermopolis has a weed/nuisance officer to notify hazardous properties.
MJ-8*	2,3,4 Safety & Security; Food, Water, Shelter	Reduce fuel loads (both man-made and natural) within incorporated and unincorporated areas of the county. -Fuel loads include junk vehicles, old buildings, brush piles, high grasses, sagebrush -Consider stricter enforcement of ordinances that deal with cleanliness of property	Wildfire	County, Thermopolis, East Thermopolis, and Kirby	County Fire Warden, Thermopolis Fire Department and Town Planner, County Emergency Management, County Land Use Planning Board	Long Term	Low HMA Grants	Medium	Continuing-Ongoing

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		-Consider adopting other ordinances							
MJ-9	2,4 Safety & Security Communication	Develop a community action plan for community evacuation.	Wildfire, Flood, Dam Failure, Volcano, Hazardous Materials	County, Thermopolis, East Thermopolis, and Kirby	County Emergency Management with local law enforcement, WYDOT, WY Highway Patrol	Short Term	Low	Low	Continuing-Ongoing. Planning in process.
MJ-10	1,2,4 Transportation	Identify list of all agencies and businesses with mass transport ability. Also discuss situation with school busses.	Wildfire, Flood, Dam Failure, Volcano, Hazardous Material	County, Thermopolis, East Thermopolis, and Kirby	County EM LEPC HS County School Dist #1	End 2022	None to low	Medium	New in 2021.
MJ-11	1,2,3,4 Energy, Infrastructure	Install a generator quick connect on the Courthouse and elsewhere, similar to the one installed on Alternate EOC Building, as funding becomes available	Wildfire, Flood, Wind, Winter Storm, Extreme Cold, Tornado, Hail, Lightning	County, Thermopolis, East Thermopolis, and Kirby	County EM, Road and Bridge, Planning	Short term	Moderate; HMA Grants	Low	New in 2021.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
MJ-12	1,2,3,4	Identify locations in the towns as well as out in the county where generators exist, Permanent as well as mobile, and where more are needed.	Wildfire, Flood, Wind, Winter Storm, Extreme Cold, Tornado, Hail, Lightning	County-wide	County EM & LEPC	Mid-2022	None	Low	New in 2021.
MJ-13	2,4 Communications	Improve communication on evacuation and awareness to mitigate life safety impacts during dam incidents, floods, or wildfires including the development of brochures.	Dam incident, flood, wildfire, volcano	County, Thermopolis, East Thermopolis, and Kirby	County EM	Short term	Low; General funds, state and FEMA grants	Medium	New in 2021.
MJ-14	1,2,4	Identify evacuation routes and signage including the possibility of use of US Hwy 20N for evacuation to mitigate loss of life	Dam incident, flood, wildfire, volcano	County, Thermopolis, East Thermopolis, and Kirby	County EM & LEPC	Mid to End 2022	Signage costs and install FEMA grants	Medium	New in 2021.
MJ-15	2,4 Safety & Security	Improve hazard education and awareness to the growing outdoor recreation community. Lightning warning signs to be placed at local trail heads and state park.	Lightning	County, Thermopolis, East Thermopolis, and Kirby	County EM, Chamber of Commerce, State Park, Municipalities	Short term	Low; General funds	Low	New in 2021.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
HS-1*	2,3,4 Infrastructure, Safety & Security	Improve identification of expansive soils in areas of new development through geotechnical testing and require appropriate mitigation techniques such as engineered foundations. Include the Identification of high groundwater areas needing special consideration for septic systems.	Expansive Soils, Land Subsidence	County	Planning and County Emergency Management	Long Term	Low	Low	Continuing-Ongoing. In areas slated for development a new procedure adopted for 'construction notice' will help give planning a heads up (advisory only).
HS-2*	1,3 Transportation	Mitigate stormwater runoff problems on existing and future county road improvements. This project would reduce stormwater runoff problems through incorporation of runoff considerations associated with new road development or improvements. Existing problem areas that need mitigation will be identified and investigated further.	Flood	County	County Road and Bridge & Municipal Public Works	Long Term	High - Project funding could be FEMA, state	Low	Continuing-Ongoing.
HS-3*	2,3 Safety & Security	Enhance floodplain management in the Unincorporated County. The county is not mapped in the NFIP which makes it difficult to properly assess risk and regulate floodplain	Flood	County	Planning	Long Term	Low HMA Grants	Low	Continue-Not Completed. New 'construction notice' process being used.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		development (see related action on floodplain mapping) to reduce flood risk. This project would investigate ways to monitor and recommend safe development in suspected, but not mapped, floodplain areas. This could include developing a system to track new buildings with a permit system. This could also include first floor elevation requirements for new buildings in close proximity of the Bighorn River.							
HS-4	1 Transportation	Mitigate repetitive flooding on Kirby Creek between Black Mountain Road and Bighorn River (near Highway 172 and Skelton Rd). Flooding occurs on a nearly annual basis that threatens agricultural areas, livestock, roads and some homes and other structures.	Flood	County	County Road and Bridge, County Emergency Management	Long Term	Medium; funding sources County, state, HMA grants	High	Continue-Not Completed. Road and Bridge advise on new development in the areas.
HS-5	2,3,4 Safety & Security HazMat	Improve public education with how to respond / shelter during hazardous materials incidents.	Hazardous Materials	County	County Emergency Management	Long Term	Low - ERGs are online and available for free	High	Continuing-Ongoing. Ongoing through 2026

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		Implementation ideas include: Build on DOT Emergency Response Guides (ERGs) Encourage the use of Code Red and smart phone apps.							
HS-6	1,2,3 Transportation	Coordination with BNSF to see if information sharing could be enhanced related to any improved monitoring systems related to rockfall and landslides in Wind River Canyon.	Landslide	County	County Emergency Management and Burlington Northern, Northern Arapahoe and Eastern Shoshone Emergency Management	Long Term	Low BNSF, HMA Grants	Medium	Continue-Ongoing. Improved/better communications systems to warn trains.
HS-7	2,4 Communications	Develop community awareness of Sirens and Code Red.	Wildfire, Flood, Dam Failure, Winter Storm, Extreme Cold, Tornado, Hail, Hazardous Materials	County	County Emergency Management	Annual Implementation	Low HMA Grants	Low	Continue-Ongoing daily. 2021 all sirens overhauled. Brochure explains tones and public is able to hear tone examples on www.hscounty.com Ongoing annually through 2026.
HS-8*	2,4 Safety & Security	Explore the applicability of building codes in the unincorporated county to reduce vulnerability of	Wildfire, Flood, Wind, Winter	County	County Land Use Planning Board and Hot Springs	Long Term	Low Staff Budget	Low	Continuing-Ongoing. Cost limited to have building inspector. Construction practices

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		structures to weather and wildfire events.	Storm, Extreme Cold, Tornado, Hail, Lightning		County Board of Commissioners				have improved in general. Open to idea of informing regulations.
HS-9	1,2,3,4 Safety & Security	Implement wildfire mitigation recommendations identified in the County CWPP.	Wildfire	County	County Fire Warden, Thermopolis Volunteer Fire Department	Annual Implementation	Low Staff Budget	Medium	Continuing-Ongoing. Fire warden available to advise property owners.
HS-10	2,3 Safety & Security, Food, Water, Shelter	Rangeland wildfire mitigation through management practices.	Wildfire	County	County Fire Warden and BLM	Annual Implementation	Low HMA Grants	Medium	Continuing-Ongoing.
HS-11	1,2,4 Communications	Implement 911 system improvements to include and improve warning and notification of pending emergency.	Wildfire, Flood, Dam Incident, Winter Storm, Extreme Cold, Tornado, Hail, Hazardous Materials	County	Thermopolis PD County SO County EM	Short term	Moderate; HMA Grants	High	New in 2021.
HS-12	1,2,3,4	Discuss, evaluate and potentially integrate the HSC PH Critical Emergency Risk Communication (CERC) capability	Weather, Flood, Evacuation	County	County Public Health County Emergency Management	Long term	None to Low	Medium	New in 2021. Discussions To begin ASAP

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
HS-13	2,4 Health & Medical	Develop a COVID-19 After Action Report and implement recommendations for improvement to mitigate impacts from future epidemics and pandemics	Pandemic/ Epidemic	County	County Public Health	Short term	Little to no cost Staff Budget	High	New in 2021.
HS-14	1,2,3,4 Communications	Enhance and improve utilization of Social Media for all aspects of public information	All-Hazards	County	HSC Emergency Management HSC Public Health	Annual Implementation	Low	Medium	New in 2021.
K-1	1,2,4 Communications	Implement Tornado warning improvements including outreach to mobile homeowners and regular siren testing.	Tornado	Kirby	Kirby Administration, County EM	Short term	Low; General funds	Medium	New in 2021.
T-1	1,3 Transportation	Rehabilitate or remove the old 6th street bridge over the Bighorn River between Thermopolis and the water treatment plant to prevent buildup of debris and diversion of water during high flows into the treatment plant and wastewater lagoon. At a minimum removing the decking on the bridge may alleviate some issues. This bridge also is a hazard to boaters due to its	Flood	Thermopolis	Town of Thermopolis Public Works, County Emergency Management	Long Term	Medium; HMA Grants	Medium	Continue-Ongoing. Noted in public survey as a concern. Safety/Warning signs posted at boat launches at 3000 5000, 7000 cfs, flows in Big Horn River

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		minimal freeboard during higher flows.							
T-2	4 Safety & Security	Leverage Decision Support Services by NWS Riverton, through County EM, to enhance warning capabilities for all large, outdoor events.	Severe Weather, Rain, Hail, Wind, Lightning, Tornado	Thermopolis	NWS Riverton HSC EM	Annual Implementation	Low Grants	Medium	New in 2021.
ET-1	1.3.4 Flooding	Evaluate needs to improve and maintain clear, unobstructed stream channel in Spring Creek into Big Horn River to prevent/minimize flash flooding	Flood	East Thermopolis	East Thermopolis Mayor, Council and Public Works	Long Term	Low; General Funds	Low	New 2021.

*Addresses avoiding losses to future development

9 Implementation

Moving forward the Hot Springs County CPT will use the mitigation action table in the previous section to track progress on implementation of each project. Implementation of the plan overall is discussed in Chapter 6 of the Base Plan.

Incorporation into Existing Planning Mechanisms

Also discussed in Chapter 6 is the importance of implementation and incorporation of the principles of this plan into other planning mechanisms.

As described in the capability assessment, the County already implements 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 or community comprehensive plans
- County or community development codes
- County Emergency Operations Plans (New update in review stages as of November 2021)
- Threat and Hazard Identification and Risk Assessments (THIRA)
- Community Wildfire Protection Plan (CWPP)
- 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
- Hot Springs State Park Master Plan
- Hot Springs County Natural Resource Plan (Update ongoing)
- Hot Springs County Land Use Plan (2020)
- WYDOT Wind River Canyon rockfall and landslide mitigation
- Other plans, regulations, and practices with a mitigation aspect

The process for incorporation of the Regional Hazard Mitigation Plan into other planning mechanisms can be as simple as cross-referencing the Hazard Mitigation Plan where applicable. Integrated planning is a key to building community resiliency.

While the jurisdictions did not specially incorporate or reference the 2016 HMP in county or municipal plans or planning mechanisms, a process to do so with the 2022-2027 plan is outlined in Chapter 6.

1 Mitigation Planning and County Planning Team

Park County developed this annex during the development of the 2021 Region 6 Hazard Mitigation Plan. This County Annex builds upon the 2016 Region 6 Hazard Mitigation Plan and Park County Annex. 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 jurisdictions participated in the DMA planning process for the County.

- Park County
- City of Cody
- City of Powell
- Town of Meeteetse

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. Additional details on what local government departments participated and who represented them are listed in Appendix A.

Geographically the planning area includes all areas of Park County including the portion of the County that extends into Yellowstone National Park. Specific mitigation within park boundaries or related to park facilities is not within the scope of this plan. The plan does recognize that some hazards such as wildfire or earthquake could affect the unincorporated County areas within and adjacent to the Park. Portions of the Town of Frannie extend into Park County but the town buildings and populations are in Big Horn County and are addressed in the Big Horn County Annex.

2 Geography and Climate

Park County was created on February 15, 1909. The county was named for Yellowstone National Park, which is mostly within the boundaries of Park County. After minor boundary adjustments in 1929 and 1931, the county officially has a total area of 6,967 square miles. Counties adjacent to Park include Big Horn, Washakie, Hot Springs, Fremont, and Teton counties in Wyoming and Park, Carbon, and Gallatin counties in Montana. Communities in Park County include the City of Cody (the county seat), the City of Powell, the Town of Meeteetse, and a portion of the Town of Frannie.

Most of the developed areas in Park County are situated in the eastern half of the county. The western half of the county is largely mountainous, high-elevation, public lands along the mountain front of the Absaroka Range. The highest point in the county is Sunlight Peak north and west of Cody, at 11,810 feet above sea level.

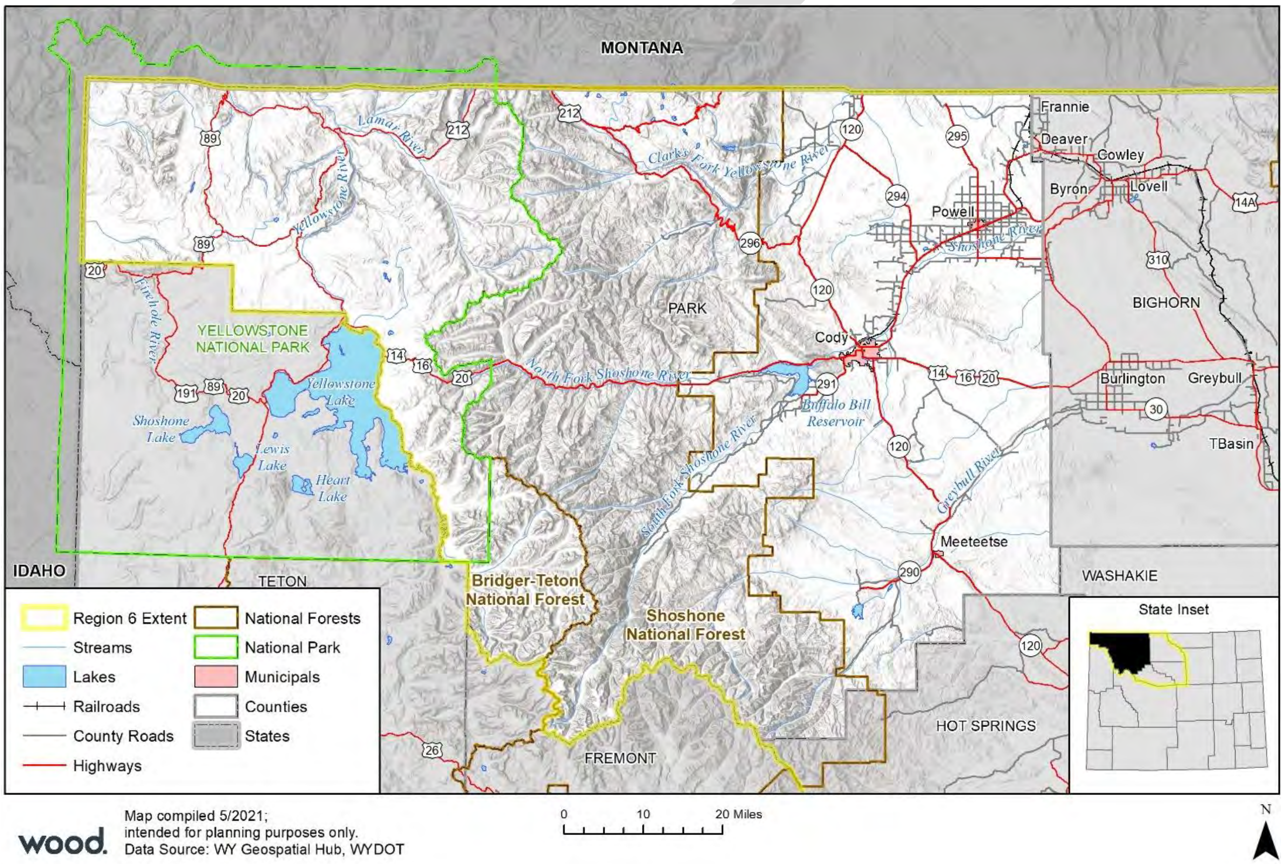
Development that has occurred in the western areas of the county is largely along river valley bottoms such as the unincorporated areas of Wapiti along the North Fork of the Shoshone River and Clark along the Clarks Fork of the Yellowstone River. The lowest point in the county is 3,910 feet above sea level in the north end of the county near Clark.

The more eastern areas of the county are relatively flatter, more arid, and less densely timbered or not timbered at all. Agriculture – where water is used for irrigation – and grazing lands dominate the eastern areas in the county. This is also where oil and gas resources have been developed. The Bureau of Land Management owns just over 3.5 million acres of land in the eastern portions of Park County.

Major surface water features in the county include the North Fork of the Shoshone, the Greybull, and the Clarks Fork Rivers. The county general drains towards the east and north. While the high country is dotted with small lakes, there are no sizeable lakes in the county. Buffalo Bill Reservoir managed by the U.S. Bureau of Reclamation impounds the North Fork of the Shoshone and lies just west of Cody. Sunshine Reservoir is west of Meeteetse on the Greybull. Not counting National Forest or National Park lands, there are 6,754 acres of surface waters in the county.

The County experiences a semi-arid climate with highly variable conditions due to the variety of terrain. The average high temperature is 59 degrees Fahrenheit and the average low temperature is around 34 degrees Fahrenheit, with the average annual precipitation around 10.19 inches per year.

Figure 1 Park County Base Map



3 Population Trends

According to the 2019 United States Census Bureau American Community Survey (ACS), there were a total of 29,148 people living in Park County, making it the largest county in Region 6 by population. With a population of 28,205 people recorded in the 2010 US Census, the county's population has increased by 3.3% from 2010 to 2019. Table 1 provides a summary of the population change in the county and municipalities from 2014 to 2019.

The City of Cody is the County's principal population center and county seat.

Table 1 Population Estimates for Communities 2014-2019

	2014	2015	2016	2017	2018	2019
City of Cody	9,785	9,792	9,772	9,826	9,761	9,764
City of Powell	6,439	6,462	6,396	6,412	6,349	6,295
Town of Meeteetse	329	326	338	302	295	459
County Total	29,126	29,228	29,083	29,276	29,121	29,148

Source: American Factfinder, U.S. Census www.census.gov

Select Census demographic and social characteristics for Park County are shown in Table 2. The table indicates the proportion of the population that may have special needs, such as the elderly or children under 5 years of age.

Table 2 Park County Demographic Profile

People	Park County
Gender/Age (% of Total Population)	
Male	49.2
Female	50.8
Under 5 Years	5.3
65 Years and Over	22.2
Race/Ethnicity (% of Total Population)	
White	94.8
American Indian/Alaska Native	1.0
Asian	0.5
Black or African American	0.7
More than One Race	2.0
Hispanic or Latino (of any race)[1]	5.4
Education (% of Total Population, 25+ years)	
High school graduate or higher	93.2
Bachelor's degree or higher	27.4
Source: U.S. Census Bureau, 2015-2019 5-Year American Community Survey: https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2019/ 1The U.S. Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race. The population self-identified as "Hispanic/Latino" is also represented within the categories in the "Race" demographic.	

4 Development Trends

During the 2021 Regional Plan development the CPT discussed growth and development trends in the County including:

- There has been a large influx in new subdivisions in the County;
- There has been some growth in the wildland urban interface areas;
- Oil industry downturn has resulted in a number of abandoned sites that will become maintenance issues. Most of the lands on which there is oil and gas exploration, development, and production are managed by the Bureau of Land Management. The county is not involved in review of these actions; and
- Powell has growth potential to the west and north, but no direct hazard concerns in these areas.

5 Economy

The economy in Park County is based on a mix of agriculture, oil and gas, and tourism. Yellowstone National Park is a major destination in the summer months that brings tourists from around the United States and world through the East Entrance located in Park County to the west of Cody.

Table 3 Park County Economic Profile

	Park County
Families Below Poverty Level	4.5%
Individuals Below Poverty Level	8.4%
Median Home Value	$268,500
Median Household Income	$63,582
Per Capita Income	$35,147
Population >16 Years Old in Labor Force	59.9%
Population Employed	58%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Table 4 shows the breakdown of employment in Park County by the industry sector. According to data from the U.S. Census Bureau ACS, the leading employment sectors in the county are the educational services, and health care and social assistance, arts, entertainment, and recreation, and accommodation and food services sectors, and retail trades sector.

Table 4 Park County Occupations and Industries

Industry	Number Employed	Percent of Labor Force
Educational services, and health care and social assistance	3,440	24.70%
Arts, entertainment, and recreation, and accommodation and food services	1,845	13.30%
Retail trade	1,645	11.80%
Agriculture, forestry, fishing and hunting, and mining	1,349	9.70%
Construction	1,319	9.50%
Professional, scientific, and management, and administrative and waste management services	879	6.30%
Manufacturing	691	5.00%
Public administration	688	4.90%
Other services, except public administration	656	4.70%
Transportation and warehousing, and utilities	517	3.70%
Finance and insurance, and real estate and rental and leasing	504	3.60%
Information	279	2.00%
Wholesale trade	110	0.80%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

6 Hazard Identification and Risk Assessment

6.1 Identified Hazards

The CPT reviewed significant hazards for inclusion in the hazard mitigation plan. For the sake of consistency, the list of hazards for consideration began with the list of hazards found in the State of Wyoming's Hazard Mitigation Plan, updated in 2020. In the 2021 update the CPT decided to add the following hazards: pandemic/epidemic and volcano. The following table notes the summary of significance for each jurisdiction in the County.

Table 5 Overall Hazard Significance* Summary Table

Hazard	Park County	Cody	Powell	Meeteetse
Avalanche	Low	Low	Low	Low
Dam Failure	Low	Low	Low	Low
Drought	High	Medium	Medium	Medium
Earthquake	Medium	Medium	Low	Medium
Expansive Soils	Low	Low	Low	Low
Extreme Cold	Medium	Medium	Medium	Medium
Flood	Medium	Low	Medium	Medium
Hail	High	High	Medium	Medium
Hazardous Materials	Medium	Low	Low	Low
High Winds and Downbursts	Medium	Low	Low	Low
Landslide	Medium	Low	Low	Low
Lightning	Medium	Low	Low	Medium
Mine Subsidence	Low	Medium	Low	Medium
Tornado	Medium	Medium	Medium	Medium
Severe Winter Weather	High	High	High	High
Wildfire	High	Medium	Medium	Medium
Pandemic/Epidemic	Medium	High	Medium	High
Volcano	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 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.

6.2 Building Inventory and Assets

In addition to people, structures, critical facilities and infrastructure, and other important assets in Park County are potentially exposed to hazards identified in this plan. Table 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 as an assessment of the overall property exposed within the County and by jurisdiction.

The 2020 Parcel and Assessor Data was obtained through the Wyoming Cama website which is maintained by the Wyoming Department of Revenue. This information provided the basis for building exposure and property types. The available data is annually updated on the site and contains all counties within Wyoming. Data current as of 2020 was downloaded for all the counties within the Region and joined by Parcel Number in a separate database for analysis using GIS.

Table 6 Park County's Building Inventory and Value by Jurisdiction

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure
Cody	Agricultural	2	$1,049,396	$1,049,396	$2,098,792
	Commercial	545	$215,224,544	$215,224,544	$430,449,088
	Improved Vacant Land	11	$3,548,719	$3,548,719	$7,097,438
	Industrial	11	$17,478,076	$26,217,114	$43,695,190
	Residential	3,808	$787,830,889	$393,915,445	$1,181,746,334
	Total	**4,377**	**$1,025,131,624**	**$639,955,218**	**$1,665,086,842**
Meeteetse	Commercial	16	$1,827,298	$1,827,298	$3,654,596

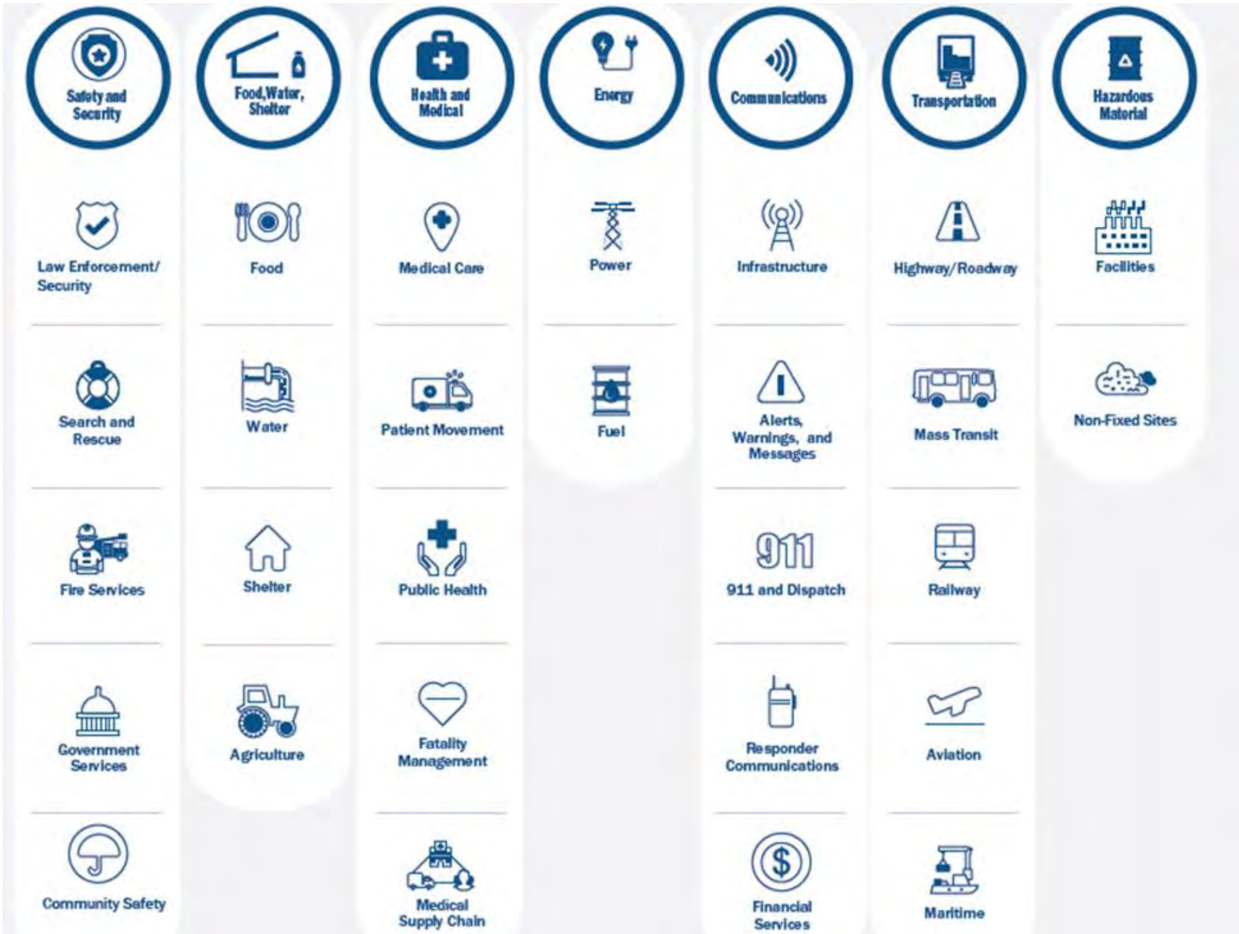
Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure
	Residential	181	$16,997,474	$8,498,737	$25,496,211
	Total	**197**	**$18,824,772**	**$10,326,035**	**$29,150,807**
Powell	Commercial	259	$63,070,318	$63,070,318	$126,140,636
	Improved Vacant Land	9	$1,806,680	$1,806,680	$3,613,360
	Industrial	4	$2,532,199	$3,798,299	$6,330,498
	Residential	2,052	$313,126,570	$156,563,285	$469,689,855
	Total	**2,324**	**$380,535,767**	**$225,238,582**	**$605,774,349**
Park Unincorporated	Agricultural	109	$29,710,784	$29,710,784	$59,421,568
	Commercial	92	$30,984,306	$30,984,306	$61,968,612
	Exempt	9	$0	$0	$0
	Improved Vacant Land	42	$6,543,139	$6,543,139	$13,086,278
	Industrial	14	$21,776,107	$32,664,161	$54,440,268
	Residential	5,599	$1,445,322,747	$722,661,374	$2,167,984,121
	Total	**5,865**	**$1,534,337,083**	**$822,563,763**	**$2,356,900,846**
	Grand Total	**12,763**	**$2,958,829,246**	**$1,698,083,597**	**$4,656,912,843**

Source: (http://cama.state.wy.us/)

6.2.1 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. FEMA organizes critical facilities into seven lifeline categories as shown in Figure 2.

Figure 2 FEMA Lifeline Categories



A summary of the critical facilities exposure analysis can be found in Table 7 and Figure 4-2 in the Base Plan illustrates the location of critical facilities in Region 6.

Table 7 Summary of Park County Critical Facilities by Jurisdiction

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Cody	65	2	-	-	4	26	3	**100**
Meeteetse	1	2	2	-	1	2	1	**9**
Powell	35	1	-	1	4	19	2	**62**
Unincorporated	369	39	4	5	2	16	189	**624**
Total	**470**	**44**	**6**	**6**	**11**	**63**	**195**	**795**

Source: Park County CPT, HIFLD

6.2.2 Natural, Historic, and Cultural Assets

Assessing the vulnerability of Park County to disasters 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 a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.

- If these resources are impacted by a disaster, knowing 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 Resources

By definition, a historic property not only includes buildings of other types of structures, such as bridges and dams, but also includes prehistoric of Native American sites, roads, byways, historic landscapes, and many other features. Given the history of the County, these types of historic properties exist in the planning area.

Information about historic assets in Park County came from the following sources:

- The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.

Table 8 lists the properties and districts in Park County that are on the National Register of Historic Places.

Table 8 Park County Historic Properties

Site	Jurisdiction	Address
Park	Clark	Pioneer School
Park	Clark	Clay Butte Lookout
Park	Cody	Hayden Arch Bridge
Park	Cody	Downtown Cody Historic District
Park	Cody	Buffalo Bill Statue
Park	Cody	Irma Hotel
Park	Cody	Stock Center
Park	Cody	T E Ranch Headquarters
Park	Cody	Pahaska Tepee
Park	Cody	Buffalo Bill Boyhood Home
Park	Cody	Colter's Hell
Park	Cody	Buffalo Bill Dam
Park	Cody	Dead Indian Campsite
Park	Cody	Horner Site
Park	Cody	Mummy Cave
Park	Cody	Blair, Quintin, House
Park	Cody	Stock, Paul, House
Park	Cody	Absaroka Mountain Lodge
Park	Cody	Red Star Lodge and Sawmill
Park	Cody	Elephant Head Lodge
Park	Cody	Goff Creek Lodge
Park	Mammoth	Obsidian Cliff Kiosk
Park	Mammoth	Obsidian Cliff
Park	Mammoth Hot Springs	Lamar Buffalo Ranch

Site	Jurisdiction	Address
Park	Mammoth Hot Springs	Fort Yellowstone
Park	Meeteetse	Anderson Lodge
Park	Meeteetse	First National Bank of Meeteetse
Park	Powell	US Post Office--Powell Main
Park	Ralston	Heart Mountain Relocation Center
Park	Ralston	Ralston Community Clubhouse
Park	Wapiti	Wapiti Ranger Station
Park	Wapiti	UXU Ranch
Park	Yellowstone	US Post Office--Yellowstone Main
Park	Yellowstone National Park	Norris, Madison, and Fishing Bridge Museums
Park	Yellowstone National Park	Norris Museum/Norris Comfort Station
Park	Yellowstone National Park	Roosevelt Lodge Historic District
Park	Yellowstone National Park	Mammoth Hot Springs Historic District
Park	Yellowstone National Park	North Entrance Road Historic District
Park	Yellowstone National Park	Grand Loop Road Historic District

Sources: National Register Information System, www.nr.nps.gov/

Another site of importance in terms of historic, cultural, and natural resources is Hot Springs State Park 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 areas protects sensitive habitat as well as attenuates and stores floodwaters.

A number of natural resources exist in Park County, including wetlands, endangered species, and imperiled plant communities. Also, the scenery itself, and access to the scenic backcountry, are economic drivers for the County and its communities. A major site of importance in terms of both historic and natural resources is Yellowstone National Park. The National Park is a major economic driver for the County and surrounding communities and has been impacted by wildfires, most notably in 1988. Closures of the Park due to wildfire can have a significant ripple effect on the local economy.

Wetlands

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. Wetlands reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. They also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital.

Endangered Species

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. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

As of July 2016, there are eight federally-recognized endangered, threatened, or candidate species in Park County according to the U.S. Fish and Wildlife Service. These species are listed in Table 9 along with state listed species.

Table 9 Endangered and Threatened Species in Park County

Common Name	Scientific Name	Type of Species	Status
Bald eagle	*Haliaeetus Leucocephalus*	Bird	Recovery
Greater sage-grouse	*Centrocercus urophasianus*		Resolved Taxon
Whitebark pine	*Pinus albicaulis*	Conifers and Cycads	Proposed Threatened
Ute ladies'-tresses	*Spiranthes diluvialis*	Flowering Plant	Threatened
Monarch Butterfly	*Danaus plexippus*	Insects	Candidate
Western glacier stonefly	*Zapada glacier*		Threatened
Grizzly bear	*Ursus arctos horribilis*	Mammal	Threatened
Black-footed ferret	*Mustela Nigripes*		Experimental Population, Non-Essential
Gray wolf	*Canis lupus*		Recovery
Canada Lynx	*Lynx Canadensis*		Threatened
North American wolverine	*Gulo luscus*		Resolved Taxon

Source: http://www.fws.gov/endangered/

6.3 Vulnerability to Specific Hazards

This section details vulnerability to specific hazards, where quantifiable, only where it differs from that of the Region. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas and 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.

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Extreme Cold
- Expansive Soils
- Flood
- Hail
- Hazards Materials
- High Winds and Downbursts
- Landslide, Debris Flow and Rockfall
- Lightning

- Mine Subsidence
- Pandemic/Epidemic
- Tornado
- Volcano
- Wildfire
- Winter Weather

6.3.1 Avalanche

Similar to the rest of the Region, avalanche risk is rated low due to isolated impacts primarily in backcountry areas. Members of the CPT noted the following relative to avalanches in Park County:

- Hazard along Sylvan Pass and some on National Forest and in Beartooths;
- Closures near Sylvan Pass periodically for mitigation; and
- According to the CPT a cabin is being built near an old mining area near Silver Creek/Sunlight near a runout zone.

6.3.2 Dam Failure

Unlike the rest of the Region dam failure is a low significance hazard for the County but medium in significance for Meeteetse. The High and Significant Hazard dams that are located within Park County are summarized in Table 10 below.

Table 10 High and Significant Hazard Dams in Park County

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Park County						
Greybull Valley	Greybull Valley Irrigation District	Red Clay Draw	H	Unnamed Ranch	0.3	Y
Buffalo Bill - Diamond Creek Dike	Bureau of Reclamation	Shoshone River	H	Cody	0.0	Y
Buffalo Bill	Bureau of Reclamation	Shoshone River	H	Cody	7.0	Y
Buffalo Bill - North Fork Dike	Bureau of Reclamation	Shoshone River	H	Cody	0.0	Y
Upper Sunshine	Greybull Valley Irrigation District	Greybull	H	Meeteetse	11.0	Y
Lower Sunshine	Greybull Valley Irrigation District	Sunshine Creek Offstream	H	Meeteetse	6.0	Y
Diamond Creek Dike	USBR	Diamond Creek	H	Cody	6.0	N
Deaver	USBR	Shoshone River Offstream	S	Deaver	3.0	N
Beck Lake	Cody Canal Assn. (Aka Cody Canal, Inc.)	South Fork Of Shoshone	S	Cody	0.0	N
Cody Municipal	City of Cody	S Fork Shoshone Offstream	S	Cody	36.0	Y

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Corral	M C Land & Cattle Co	Corral Draw, Trib. Snyder Draw	S	Burlington	28.0	N
Stonebridge	Pierre Williams	Whit Creek Offstream	S	Wapati	2.0	N
Markham	City of Cody	S Fork Shoshone Offstream	S	Cody	1.0	Y

Buffalo Bill Dam is a concrete arch-gravity dam on the Shoshone River about 6 miles upstream of Cody in Park County. It is operated by the U.S. Federal Bureau of Reclamation and is designated a High Hazard Dam. The dam was last inspected on August 15, 2017. A downstream Emergency Action Plan (EAP) for Buffalo Bill dam includes inundation maps and downstream warning and notification plans, including local emergency services agencies and municipal contacts to be used in the event of a breach or imminent threat. If Buffalo Bill Dam failed, impacts could be significant, primarily downstream in Big Horn County, however, Cody would be relatively unaffected. Dam failure and associated flooding can cause damage to and loss of irrigation structures such as head gates and ditches. Loss or damage to water structures negatively impacts agricultural producers of crops and livestock—and can be costly to repair. According to GIS analysis done utilizing dam inundation data, there are approximately 161 improved parcels and 343 residents residing within dam inundation areas in Park County.

Although earthquake or seismic activity has received a very low priority rating in terms of a detrimental impact, active faults lie very close to Buffalo Bill Cody Dam. The dam exists near what is known to be one of the most seismically active areas of the United States, that of the Yellowstone Caldera. This geothermal region experiences 1,000 to 2,000 measurable earthquakes each year and has been known to experience as many as 3,000 such events in a matter of months.

Upper and Lower Sunshine Dams are located above the Town of Meeteetse. A breach of either or both of these dams could quickly flood Meeteetse. Impacts could include property loss and damage, damage to municipal infrastructure, interruption of traffic and commerce, even loss of life.

6.3.3 Drought

Similar to the rest of the Region drought is a high significance hazard for the County. Drought is a regular and widespread occurrence in the State of Wyoming. Since 2012 there have been 15 USDA Disaster Designations in Park County for drought. According to the U.S. Drought Monitor records for Park County, in the 1,096-week period from 2000 through 2020, the county spent 808 weeks (74% of the time) in Abnormally Dry (D0) conditions. Approximately 50% of the time, or 549 weeks, was spent in Moderate Drought (D1) conditions. Weeks in drought between 2000 and 2020 are summarized in Table 11 and shown in time series from January 2000 and August 31, 2021, in Figure 3.

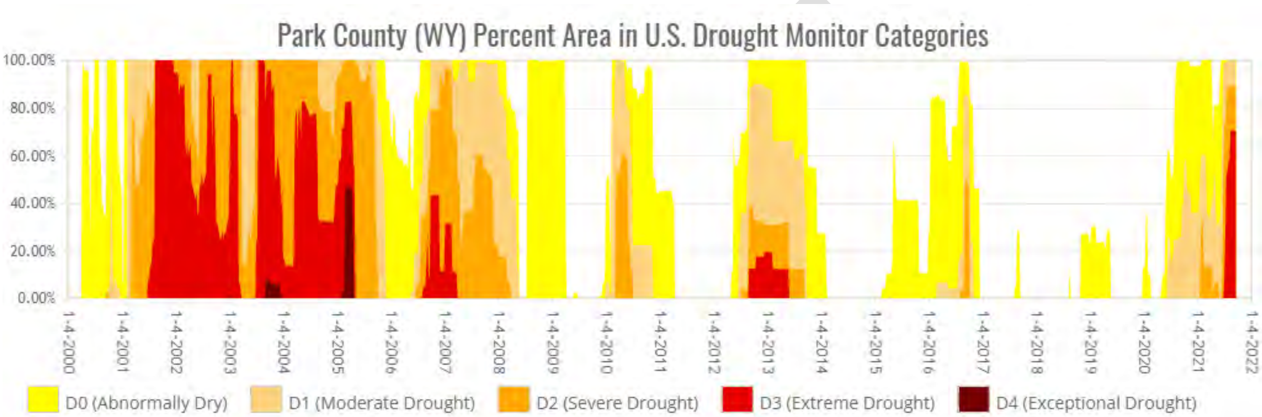
Table 11 Park County Weeks in Drought by Intensity 2000-2020

Category	Description	Palmer Drought Severity Index (PDSI)	Standardized Precipitation Index (SPI)	Park County Weeks in Drought, 2000-2020
D0	Abnormally Dry	-1.0 to -1.9	-0.5 to -0.7	808
D1	Moderate Drought	-2.0 to -2.9	-0.8 to -1.2	549

Category	Description	Palmer Drought Severity Index (PDSI)	Standardized Precipitation Index (SPI)	Park County Weeks in Drought, 2000-2020
D2	Severe Drought	-3.0 to -3.9	-1.3 to -1.5	420
D3	Extreme Drought	-4.0 to -4.9	-1.6 to -1.9	266
D4	Exceptional Drought	-5.0 or less	-2.0 or less	36

Source: U.S. Drought Monitor

Figure 3 Park County Drought Intensity, 2000- August 31, 2021



Source: U.S. Drought Monitor

Members of the CPT noted the following regarding water supply and impacts from drought in Park County:

- 2002-2004 was worst in recent history, caused wildfires, effects on agriculture; and
- Fires, vs drought, have greater effect on tourism.

Refer to the Chapter 4 in the Base Plan for additional discussion of drought risk related to the Region and the County.

6.3.4 Earthquake

Park County includes portions of Yellowstone National Park, one of the most volcanically and seismically active regions in the United States. According to the USGS, 1,500 to 2,500 earthquakes typically occur in and around Yellowstone each year, leaving Wyoming Region 6 as generally higher earthquake exposure relative to the rest of the state. Many known active faults are exposed in the greater Yellowstone area and thousands of earthquakes have been recorded inside the Park boundaries since the late 1800s. Smaller earthquake swarms occur in Yellowstone Park relatively frequently and are not necessarily signs of an imminent eruption or major earthquake (Wyoming Hazard Mitigation Plan 2020).

The first earthquake recorded in Park County occurred on February 2, 1920. This intensity III event was located in north-central Park County, approximately 18 miles northwest of Cody. People reported feeling it and hearing a rumbling sound (Humphreys, 1921).

On October 3, 1944, an intensity IV earthquake occurred in south-central Park County approximately six miles north of Pitchfork. Several people in Yellowstone National Park and at Flag Ranch reported feeling three distinct tremors that rattled dishes and canned goods, swung suspended objects, and even caused buildings to sway. "Subterranean sounds" were also reported from the Flag Ranch (Bodle, 1946).

Two earthquakes occurred in Park County during the 1950s. The first was recorded on April 10, 1950, 18 miles north of Wapiti. This intensity IV event shook lamps, rattled loose objects, and caused buildings to creak (Murphy and Ulrich, 1952). On April 25, 1952, an intensity III earthquake occurred approximately 35 miles west-northwest of Clark near the Wyoming/Montana border. The earthquake lasted for a few seconds and was felt by only one person (Murphy and Cloud, 1954).

Four earthquakes occurred in Park County during the 1960s. All four were recorded in western Park County near the Yellowstone National Park border. No one reported feeling the earthquakes (U.S.G.S. National Earthquake Information Center). The March 22, 1963 event was reported approximately 40 miles west-northwest of Clark in the extreme northwestern corner of Park County. On June 25, 1963, a magnitude 4.2 earthquake occurred 22 miles southwest of Valley. A magnitude 3.6 earthquake was recorded on May 15, 1965, approximately 22 miles southwest of Valley. Another magnitude 3.6 earthquake occurred 25 miles north-northwest of Wapiti on January 21, 1967.

On April 21, 1973, a magnitude 4.4 earthquake was recorded on the western edge of Park County approximately 36 miles west-northwest of Wapiti. People in the area reported feeling the earthquake (Coffman et al., 1975). On January 16, 1980, a magnitude 2.6 earthquake occurred 20 miles north-northwest of Wapiti. No one reported feeling this event (U.S.G.S. National Earthquake Information Center).

Two earthquakes occurred in the county during the 1990s. A magnitude 3.6 earthquake was recorded on January 1, 1994, and a year later, a magnitude 3.7 earthquake was felt on January 17, 1995. The earthquakes had epicenters approximately 29 and 28 miles west-northwest of Wapiti, respectively. No damage was reported, and nobody reported feeling either event (University of Utah Seismograph Station Epicenter Listings).

As discussed in Chapter 4 earthquakes are medium probability but could have considerable impacts in Park County. Refer to Chapter 4 for details on economic losses from HAZUS analysis. During the 2016 Regional Plan development the CPT noted the following consequences of earthquake hazards in Park County:

- A M3.6 earthquake occurred a few years ago was thought to have triggered an ice fall that killed an ice climber in Shoshone Canyon

6.3.5 Expansive Soils

Expansive soils cause occasional problems in the County but this hazard is considered low significance for the County and municipalities. During the 2016 Regional Plan development the CPT noted the following consequences of expansive soils in Park County:

- Buckling pavement on Chief Joseph Highway
- Highway 14 repaired frequently by WYDOT
- Bentonite clay exists and causes localized issues;
- Golf course has had issues; and
- Highway 120 north and south of Cody has had issues including buckling pavement. WYDOT repairs frequently.

See Chapter 4 for more description on the expansive soils hazard.

6.3.6 Extreme Cold

Vulnerability to extreme cold is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of extreme cold risk related to the Region.

6.3.7 Flood

A flood, as defined by the National Flood Insurance Program (NFIP), is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from overflow of waters, unusual and rapid accumulation or runoff of surface waters from any source, or a mudflow. Floods can be slow or fast rising, but generally develop over a period of many hours or days. The documented flood history for the Region extends back to 1917, when a 1% annual chance flood occurred in nearby Hot Springs County along the Big Horn River and impacted Thermopolis.

During the development of the 2021 State of Wyoming Hazard Mitigation Plan, 23 flood events, $2 million in property damage, and $17,000 in crop losses were noted specific to Park County. Figure 4 through Figure 6 below shows the extent of the 1% annual chance and 0.2% annual chance floodplains in Park County, the City of Cody, and the Town of Meeteetse, respectively.

Table 12 and Table 13 below provide some detail specific to Park County on the county's potential flood losses and participation in the NFIP. Refer to Chapter 4 of the base plan for a discussion of the flood risk relative to Park County, with details on property and critical facility risk from flood for the County and the wider Region.

Figure 4 **Park County FEMA Flood Hazards**

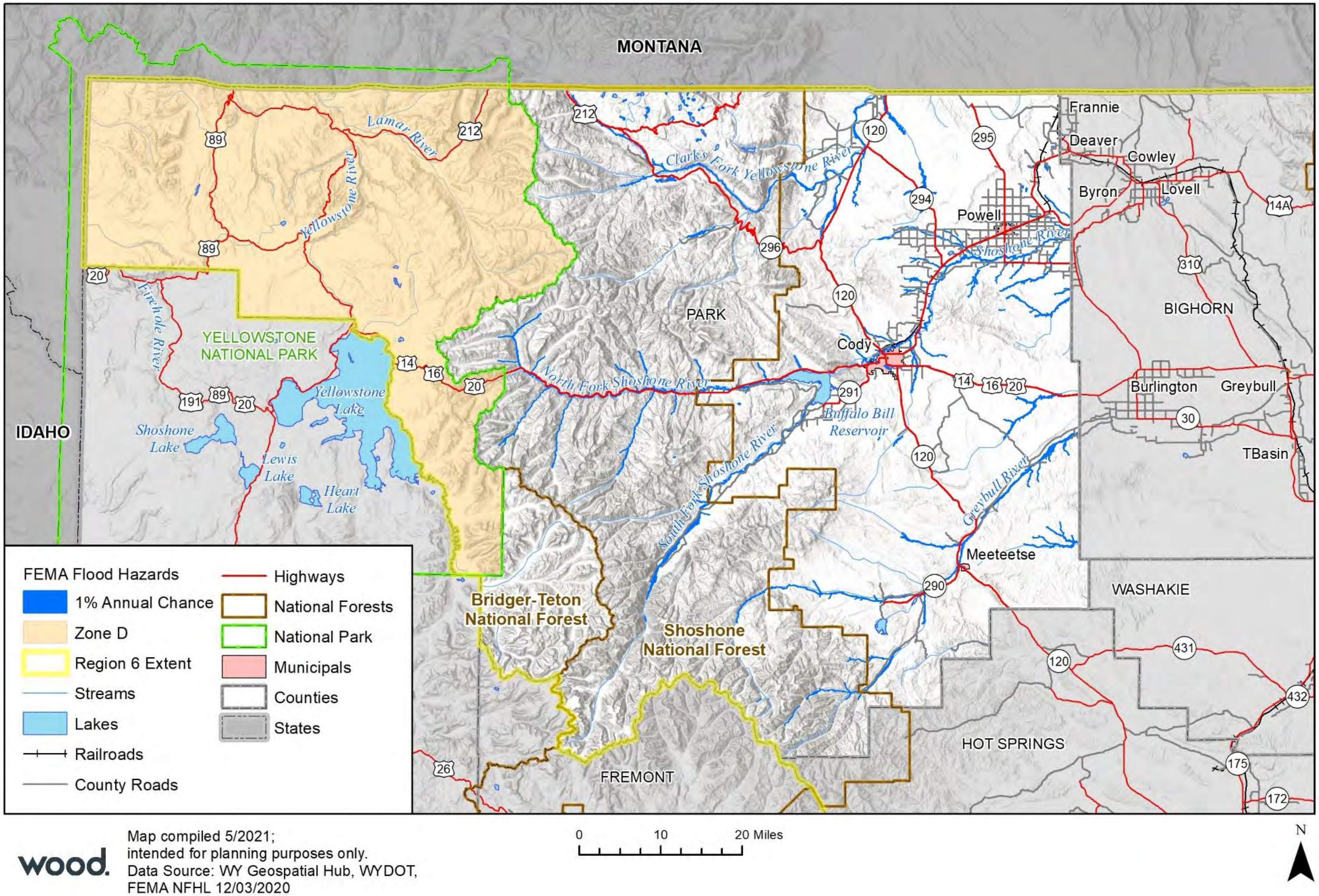


Figure 5 City of Cody FEMA Flood Hazards

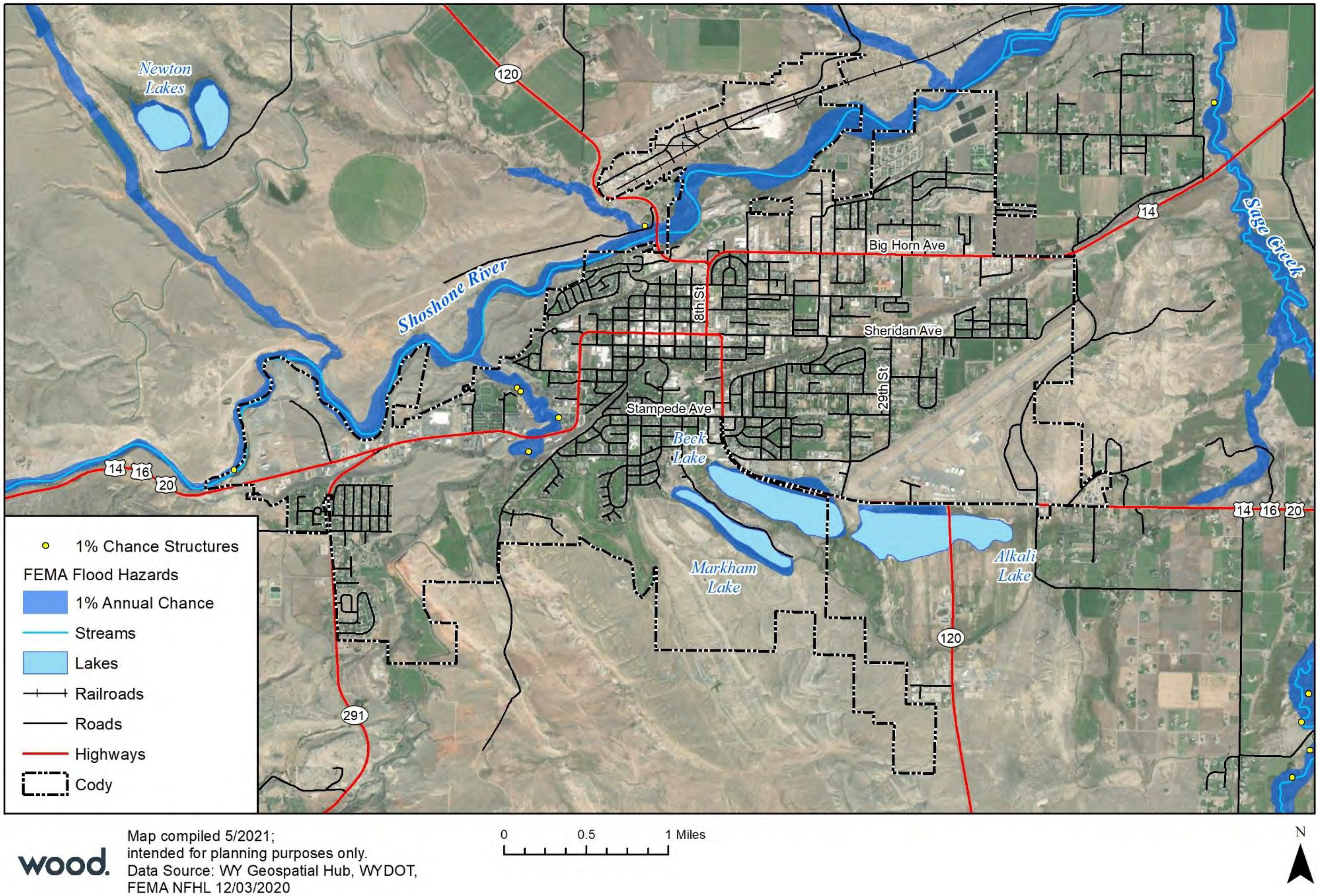
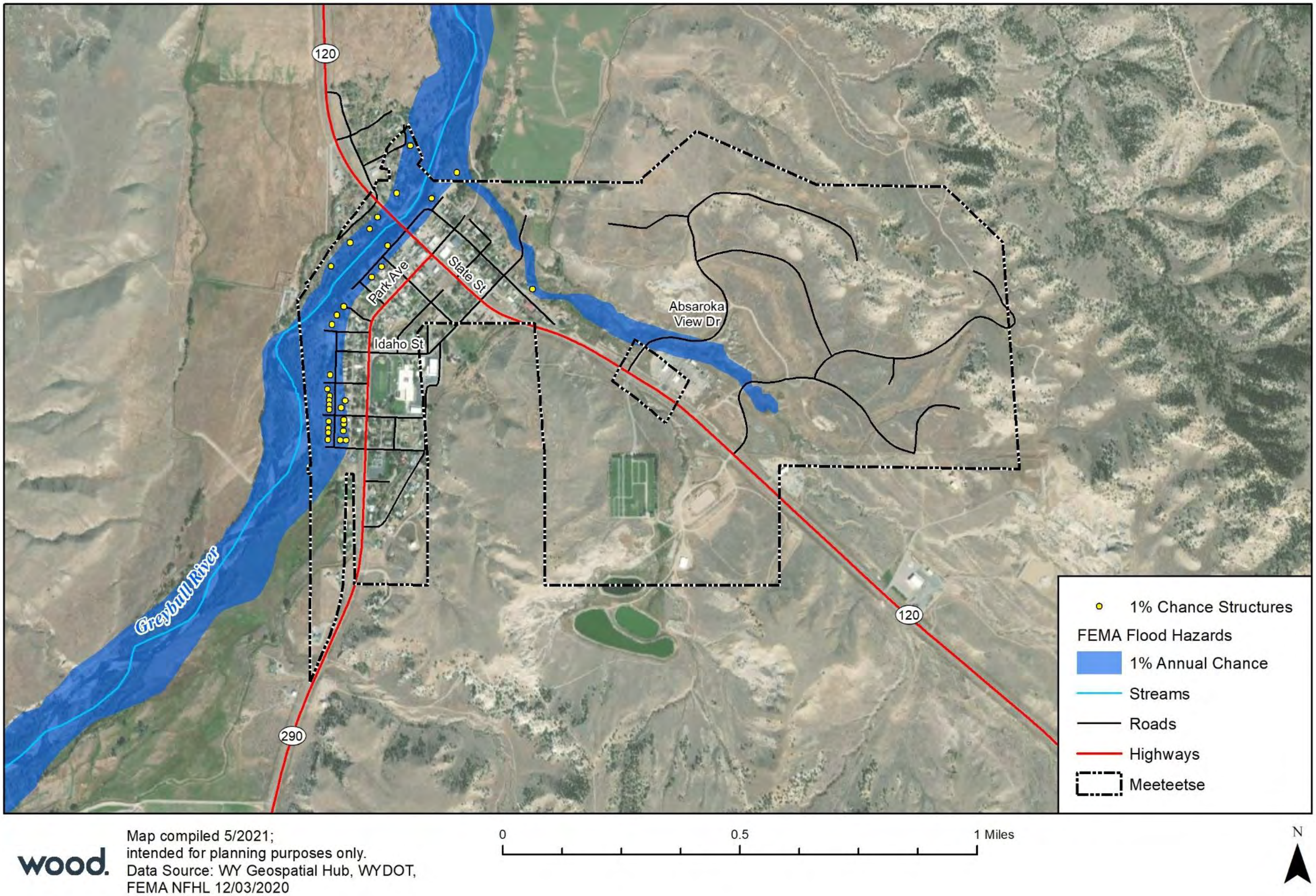


Figure 6 Town of Meeteetse FEMA Flood Hazards



Parcel Level Analysis

The following results show potential impacts from flooding, including the number or people vulnerable, total building exposure, and associated costs related to a 1% annual chance flood incident based on a parcel level analysis. Based on this analysis, the unincorporated County area has the most parcels at risk to the 100-year flood. A total of 212 improved parcels in Park County are within the 100-year floodplain for a total value of $24.7 million exposed; most of these are residential but some agricultural and commercial parcels are exposed. Meeteetse has 31 properties at risk, all residential. Cody and Powell are minimally flood prone, based on NFIP mapping, but Powell has noted issues with stormwater flooding that are not reflected in the table below.

Table 12 Potential Loss by Jurisdiction and Property Type 1% Annual Chance Flood Zone

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss	Population
Cody	Commercial	2	$468,867	$468,867	$937,734	$234,434	
	Residential	3	$901,083	$450,542	$1,351,625	$337,906	7
	Total	**5**	**$1,369,950**	**$919,409**	**$2,289,359**	**$572,340**	**7**
Meeteetse	Residential	31	$2,723,810	$1,361,905	$4,085,715	$1,021,429	72
Powell	Commercial	1	$131,186	$131,186	$262,372	$65,593	
Unincorporated	Agricultural	11	$5,200,454	$5,200,454	$10,400,908	$2,600,227	
	Commercial	2	$1,209,239	$1,209,239	$2,418,478	$604,620	
	Exempt	1	$0	$0	$0	$0	
	Residential	161	$52,815,172	$26,407,586	$79,222,758	$19,805,690	375
	Total	**175**	**$59,224,865**	**$32,817,279**	**$92,042,144**	**$23,010,536**	**375**
	Grand Total	**212**	**$63,449,811**	**$35,229,779**	**$98,679,590**	**$24,669,897**	**454**

Flood Insurance Claims Analysis

The table below lists details regarding the flood insurance policies in the County.

Table 13 NFIP Insurance Policies and Claims Analysis (as of April 30, 2016)

Community	Date Joined	Current Map Date	Policies in Force	Insurance in Force	Number of Paid Losses	Total Losses Paid
County	8/1/1987	6/18/2010	47	$12,543,000	21	$253,407
Cody	2/2/1984	6/18/2010	1	$280,000	1	$96,060
Meeteetse	10/1/1986	6/18/2010	6	$686,500	0	$0
Powell	7/15/1985	6/18/2010	1	$350,000	0	$0

Source: FEMA NFIP Community Information System

Repetitive Loss Properties: There are no reported Repetitive Loss properties in the County. One previous Repetitive Loss property has been mitigated.

Community Rating System: Park County participates in the CRS program, with a current rating of Class 10. None of the municipalities in the county participate in the CRS program.

6.3.8 Hail

According to records from the National Center for Environmental Information (NCEI) Storm Events Database, in the past 64 years there have been 49 hail events in Park County and incorporated communities. Most of the events took place in Unincorporated Park County (14) and Meeteetse (11) followed by Cody (9) and Powell (3). The largest hailstone recorded in the County was 2 inches on June 29, 1964, and July 18, 1997. Past hail events have resulted in a total of $585,000 in property damages. The following is a description of the most damaging events:

- July 20, 1995 - Hail damaged crops and fields south and east of Powell. Some crops were totally destroyed. Some roofs south of Powell were also damaged. Estimated $50,000 In total property damages.
- June 9, 2000 – Severe thunderstorm produced swath of large hail from the Cody area northeast to Powell and into extreme northwest Big Horn County. Largest hail apparently fell over south and southeast parts of Powell, with official reports of golf ball size and unofficial reports of softball size. Property damage is an estimate. Preliminary crop damage estimates expected to reach into the millions of dollars. Severe damage to sugar beet, barley, and bean crops. Wind gusts from 60 to 65 mph were also reported with the storm in the Powell area. Estimated $500,000 in total property damages.

Park County has received 1 USDA Disaster Designation for hailstorms in 2018. In terms of insured crop losses, according to the USDA Risk Management Agency (RMA) between 2007 and 2020,10,744 acres were lost to hail and $1,717,970 indemnity payments made to farmers in Park County. This equates to $132,152 of average annualized crop losses due to hail.

Vulnerability to hail is noticeably different from the rest of the region. The hazard significance rating for Park is high. Refer to Chapter 4 for a discussion of hail risk related to Park County and the Region.

6.3.9 Hazardous Materials

Hazardous materials vulnerability is significant in the County for transportation accidents due to the highways and railroad that passes through the County and all municipalities. Hazardous Materials facilities are listed along with the county's critical facilities in Table 7 in the Building Inventory and Assets section of this annex. According to the Wyoming State Hazard Mitigation Plan, there have been 246 hazardous materials incidents in Park County from 1990 to 2019. According to the Right-to-Know network database, there are six facilities in Park County required to generate a Risk Management Plan. There are also multiple pipelines transporting hazardous materials across the county.

Refer to Chapter 4 for a discussion of hazardous materials risk in the Region and County.

6.3.10 High Wind

According to NCEI records between 1964 and 2018 (note records were searched from 1950 to 2020 but no records of events were found before 1964 or after 2018 in the database) there were 44 high wind events in Park County. A majority of the events took place in Unincorporated Park County (45), followed by Cody (6), Meeteetse (5) and Powell (2). The highest recorded event in was 82 miles per hours thunderstorm wind on September 2, 1980. The most damaging event recorded in the NCEI database also took place on July 19, 2011. The event took place east of Cody as a result of outflow wind from collapsing thunderstorms. A recreational trailer was toppled at a residence and large limbs were felled at another causing damage to an automobile and power lines. In total the event resulted in $10,000 in property damages.
In terms of insured crop losses, according to the USDA Risk Management Agency between 2007 and 2017 1,497 acres were lost to wind and $231,894 indemnity payments made to farmers in Park County. Average annualized crop losses in the County due to wind is estimated to be $23,189.

Vulnerability to wind is considered medium significance for the County. The CPT noted the following consequences regarding this hazard in Park County:

- High winds exacerbate snow conditions and can lead to road conditions to deteriorate;
- Major issue for power system - Cody has power outages often due to wind;
- Strong winds occur along mountain front from Clark to Meeteetse;
- Clark area experiences very high winds (asphalt blowing off roads, roof damages, and power outages was noted as often associated with events);
- Meeteetse Water System shut down by power outage that lasted a week in February of 2015. A generator was purchased to mitigate future incidents; and
- Semi-trucks and horse trailers occasionally get blown off road.

6.3.11 Landslide, Debris Flow and Rockfall

Relative to other counties in the Region, Park County has a higher hazard significance rating than most counties in the region due to more extensive landslide deposits and their potential to impact limited road infrastructure. The members of the CPT noted the following consequences of landslides:

- A landslide event on Squaw Creek Rd about 3 years ago destroyed 2 cabins near Crandall.
- The Stagecoach Trail area west of the tunnels was also an area of rockfall concern.
- The Chief Joseph Highway near the intersection of 296 is an area where WYDOT does a lot of mitigation work.
- Stagecoach Road is the backup road to North Fork from Deer Creek area;
- Elk Basin slide has had some mitigation work; and
- The North Fork Road has experienced closures for several hours due to landslides

Critical Facility Analysis

A GIS analysis of critical facilities identified 491 facilities located in moderate to highest susceptibility landslide hazard areas in Park County. A majority are located in unincorporated Park County (467). Communication facilities (278) were the most common identified across all jurisdictions and hazard areas followed by Energy (125) and Transportation (66). In addition, the 2016 GIS analysis found one public school (Wapiti Elementary) located within landslide hazard areas as well as the Yellowstone National Park's Fire Department/EMS station near the East Entrance also intersected a landslide hazard area. Refer to Chapter 4 for further details on the critical facility analysis.

6.3.12 Lightning

Records from the NCEI Storm Events Database showed 6 lightning events between 2000 and 2019 (note, the database was searched from 1950 to 2020 but no records were found before 2000 or after 2019). In total these events resulted in 1 death and 9 causalities, all from individuals recreating outside either camping or on a golf course. A total of $80,000 in property damages in recorded the database. The following is a description of the most damaging event:

- July 16, 2019 - In Yellowstone Park, a lightning strike on Mount Holmes set the historic fire lookout on fire. The building was a total loss. A radio repeater was also damaged by the lightning strike. An estimated $50,000 in total property damages.

Vulnerability to lightning is considered medium for the County and low to medium for the municipalities. The CPT noted the following regarding this hazard in Park County:

- Major issue for power system;
- Powell golf course strikes; and
- Forest fires are a common after-effect

6.3.13 Mine Subsidence

The CPT commented that there are some areas of mine and natural subsidence in Park County, but generally this is a low to negligible significance hazard to the County and municipalities. Naturally occurring subsidence can occur and should be reviewed when siting future development.

- Sinkholes near Trail Creek noted;
- Natural subsidence associated with limestone karst terrain does exist; and
- In Heart Mountain natural subsidence ruptured pipes in the irrigation district.

6.3.14 Pandemic/Epidemic

Vulnerability to pandemic/epidemic is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of pandemic/epidemic risk related to the Region and Covid-19 statistics.

Based on their experience during the ongoing Covid-19 Pandemic, the CPT felt that the local medical capacity was prepared, and outbreaks were noted as low compared to the record high visitation in Yellowstone in the fall of 2020. Actions were taken to provide public information on the ongoing event including a phone bank was stood up to provide public information. The CPT also noted a cascading effect of the pandemic had been economic impacts from the public health restrictions.

6.3.15 Tornado

The NCEI database shows 10 records of events between 1964 and 2017 (note: the database was searched from 1950-2020 but no events were recorded before 1964 or after 2017). These recorded events resulted in a total of $77,750 in property damages. The greatest magnitude recorded is an F2 on June 26, 1964, and July 11, 1978. The CPT noted that while tornadoes occur in the county, they historically occur in undeveloped areas and are not very strong. Refer to Chapter 4 for a discussion of tornado risk related to the Region.

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Mobile homes are more vulnerable to the impacts of a tornado event compared to housing types due to methods of construction. Statewide, mobile homes represent about 13% of total housing compared to 6.1% Nationwide. In Park County mobile homes represent 10% of total housing. Table 14 shows the breakdown of mobile for each jurisdiction.

Table 14 Percent of Mobile Homes as Total Housing, by Jurisdiction

Jurisdiction	Total Housing	% Mobile Homes
Unincorporated County	14,452	10.1%
Cody	4,858	6.3%
Meeteetse	225	11.1%
Powell	2,735	7.5%

Source: U.S. Census, American Community Survey (ACS) 5-Year Estimates, 2015-2019

6.3.16 Volcano

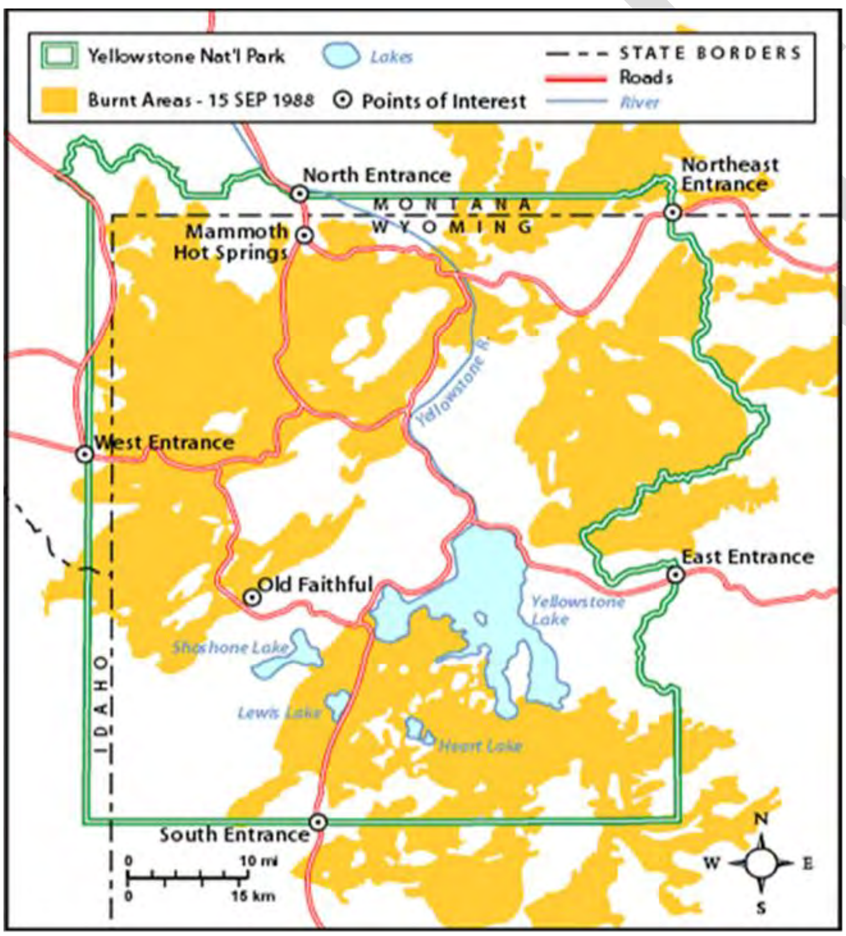
Vulnerability to volcano is different from the rest of the region for the fact that the County includes portions of the Yellowstone Caldera and would likely be the first in the region to experience the effects of a resurgence in volcanic activity. Refer to Chapter 4 for a discussion of volcano risk related to the Region.

6.3.17 Wildfire

Wildfire is a high significance hazard for the County, consistent with other counties in the Region, but the County has more vulnerability in comparison. The past 100 years of wildland fire suppression have led to heavy vegetation growth, greatly increasing the potential fuel-load for a wildfire to burn. Fire occurrence often coincides with times of drought which can create especially severe fire seasons. This was well-demonstrated by the Yellowstone Fires in the late 1980s. The Yellowstone National Park fires of 1988 were the largest series of fires in the northern Rockies during the last 50 years. Fifty fires started in the park that year. These fires, along with other natural and human-caused fires that began outside the Park boundaries, eventually burned more than a third of the Park, nearly 800,000 acres. Another 700,000 acres outside the Park also burned. Figure 7 displays the burned area extent from the fires. Approximately 25,000 firefighters worked to put out the fires. The costs exceeded $120 million. Roughly half of the national park lies within northwestern Park County.

In Yellowstone National Park, the fire season usually lasts from June to early September. In 1988, several factors led to an abnormal fire season. During June of that year, there was little rain and extremely high temperatures and winds. Yellowstone National Park was suffering from severe drought conditions. The drought left Yellowstone more vulnerable to fires than usual. The fires of 1988 led to an intense public debate regarding the National Park Service's fuel management policy. This policy stated that fires started by natural causes should be allowed to burn to their natural conclusion.

Figure 7 Extent of burn 1988 Yellowstone Fire



Source: Exploring the Environment http://www.cotf.edu/ete/modules/yellowstone/YFsituation.html

Even though most of the damage has been in Yellowstone National Park, Park County has experienced wildfires in many other areas of the county, such as national forests and other forested areas. On July 16, 2003, a fire was started by dry lightning and gusty winds in the Shoshone National Forest east of Deep

Lake in Littlerock Creek Canyon in the Beartooth Mountains, eight miles west of Clark. It burned a total of 6,886 acres and was only 22% contained in the first six days. Fifteen boy scouts had to be rescued via helicopter as the fire approached Deep Lake. Many person-hours, resources, and equipment hours were used to attack this fire, with the estimated cost totaling $1.3 million dollars. There was no loss of life or property.

The Federal Wildland Occurrence data recorded 135 fires between 1980 and 2019 in Park County. The total acres burned over this time period added up to 684,919 acres. According to this data the county has averaged 4 wildfires per year from 2000 to 2019. Table 15 below lists recorded wildfires over 1,000 acres in area that have burned in Park County from 1980-2019.

Table 15 Wildfires over 1,000 acres in Park County: 1980-2019

Name	Year	Acres Burned
Fish hawk	2019	11,177
Powerline	2018	1,794
June	2017	1,631
Hunter Peak	2016	3,545
Maple	2016	45,517
Twin Lakes	2016	1,583
Whit	2016	12,681
Central	2016	1,441
Buffalo	2016	12.681
Fawn	2016	2,703
Spruce	2015	2,553
Swede	2014	1,529
Druid Complex	2013	7,138
Hardluck	2013	24,517
Alum	2013	7,079
Cygnet	2012	3,540
Dewdrop	2012	1,498
Butte Creek	2012	1,514
Sage Creek	2012	1,122
Hole in the Wall	2011	6,343
Point	2011	1,874
Le Hardy	2008	9,604
Gunbarrel	2008	62,253
Citadel	2007	1,991
Beaverdam	2007	1,353
Columbine 1	2007	18,337
Owl	2007	11,973
Magpie	2006	3,235
Stinky	2006	1,005
Deep Lake	2003	6,890
Blackwater Complex	2003	8,102

Name	Year	Acres Burned
East Fire	2003	17,366
Boulder Basin 2	2003	10,985
East	2003	14,513
Grizzly	2003	4,113
Broad	2002	8,775
Phlox	2002	3,585
Sulphur	2001	3,990
Arthur	2001	2,527
Renner Draw Complex	2001	2,974
Renner 2	2000	1,158
Towers	1999	1,944
Rooster	1999	1,540
Antler	1996	4,902
Coyote PNF	1996	4,283
Coyote	1996	4,263
Dano	1996	1,906
Pelican	1996	1,570
Tern	1994	4,728
Raven	1994	3,000
Line Creek	1991	4,506
Clovermist	1988	412,050
Wolf Lake	1988	93,050
Fan	1988	18,100
Clover	1988	10,700
Shallow	1988	5,946
Fan	1988	3,500
Fern	1988	1,985
Lovely	1988	1,666
Mist	1988	1,527

The Park County Community Wildfire Protection Plan (CWPP) outlines potential impacts from wildfires by identifying “communities” most at-risk to wildfire in the WUI areas. The CWPP identified 43 at-risk communities that received a final rating of low, moderate, or high risk based on their community rating, hazard rating, and historical fire occurrence. Rankings of the 43 at-risk communities are captured in Figure 8 below.

Figure 8 Park County CWPP Communities and Hazard Rankings

WUI	Area	Community Rating	Hazard Rating	Fire Occurrence	Final Rating
2	Lower Clarks Fork	3	3	3	4.0
5	Upper Sunlight Creek	3	3	3	4.0
25	Beartooth	3	3	3	4.0
28	Dead Indian West	3	3	3	4.0
33	Upper North Fork	3	3	3	4.0
34	Lower North Fork	3	3	3	4.0
38	Carter Mountain	3	3	3	4.0
3	Russell Creek	3	3	2	3.7
21	Silver Gate	3	3	2	3.7
26	Lower Sunlight Creek	3	3	2	3.7
41	Upper Wood River	3	3	2	3.7
6	Middle Sunlight Creek	3	2	3	3.3
11	Cody Canyon/Cedar Mtn	3	2	3	3.3
22	Cooke City	3	3	1	3.3
23	Upper Clarks Fork	3	2	3	3.3
24	Crandall	3	2	3	3.3
35	Wapiti	3	2	3	3.3
20	Francs/Timber Creek	3	2	3	3.3
27	Stinkingwater	3	3	1	3.3
4	Switchback Ranch	3	2	2	3.0
8	Clarks Fork Canyon	2	2	3	3.0
9	Rock Creek	3	2	2	3.0
17	Upper Meeteetse Creek	3	2	2	3.0
1	Bennett/Line Creek	2	2	2	2.7
7	Trail Creek	2	2	2	2.7
16	Bald Ridge East	2	2	2	2.7
32	Rattlesnake Creek	1	2	3	2.7
40	Lower Meeteetse Creek	2	2	2	2.7
10	Upper South Fork	2	1	3	2.3
18	Upper Greybull River/Pickett Creek	3	1	2	2.3
37	Lower South Fork	1	2	2	2.3
30	Heart Mountain	2	1	2	2.0
36	Canyon Estates	2	1	2	2.0
42	Lower Wood River	2	1	2	2.0
43	South Meeteetse	2	1	2	2.0
12	Gooseberry Creek	2	1	2	2.0
19	Sunshine Reservior	2	1	2	2.0
39	Lower Greybull River	2	1	2	2.0
13	Little Buffalo Basin	1	1	2	1.7
15	Hoodoo Creek Oil Fields	1	1	2	1.7
14	Coal Mine Gulch	1	1	1	1.3
29	Paint Creek	1	1	1	1.3
31	Two Dot Ranch	1	1	1	1.3

(red)	High	3.1 - 4.0
(yellow)	Moderate	2.1 - 3.0
(light blue)	Low	1.0 - 2.0

Refer to Chapter 4 in the base plan for additional discussion of wildfire risk related to Park County.

6.3.18 Winter Weather

Vulnerability to winter weather is ranked high compared to the rest of the Region. Winter weather often results in road closures which can limit first responder access from Cody to Meeteetse and isolate populations but also helps to mitigate stranded travelers. The CPT noted other highways such as 14A and 120 north are not closed and can cause issues. It was also noted that the Badger Basin Highway between Cody and Powell is becoming busier with recent development and is not on the Wyoming Road Report. Refer to Chapter 4 HIRA for a discussion of winter weather risk related to Park County and the Region.

7 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 through the use of 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.

7.1.1 Park County Regulatory Mitigation Capabilities

Table 16 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Park County.

Table 16 Park County and Jurisdictions Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Park County	Cody	Meeteetse	Powell
Comprehensive, Master, or General Plan	Yes	Yes	No	Yes
Capital Improvement Program or Plan (CIP)	Yes	Yes	No	Yes
Floodplain Management Plan	No	No	Yes	No
Stormwater Program / Plan	No	Yes	No	Yes Stormwater Control Plan
Community Wildfire Protection Plan (CWPP)	Yes Updated in 2020	No?	No	No
Erosion / Sediment Control Program	No	No	No	No
Economic Development Plan	No	No	No	No
Building Codes (Year)	No County is required to follow State Fire Marshall codes: 2018 IBC, IFC, IM, IFGC, IEBC	Yes	No	Yes 2021
Site Plan Review Requirements	Yes	No	No	Yes
Zoning Ordinance (Land Use)	No	Yes	No	Yes
Subdivision Ordinance	Yes Requirement for building and sanitation permits for new construction	Yes	Yes	Yes
National Flood Insurance Program (NFIP) Participant	Yes	Yes	Yes	Yes
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	Yes	Yes	Yes
Floodplain Ordinance	Yes	Yes	Yes	Yes

Regulatory Tool (ordinances, codes, plans)	Park County	Cody	Meeteetse	Powell
Elevation Certificates for Floodplain Development	No	No	No	No
Community Rating System (CRS) Participant	No	No	No	No
Open Space / Conservation Program	No	No	No	Yes
Growth Management Ordinance	No	No	No	Yes
Stormwater Ordinance	No	Yes	No	Yes
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	No	No	No
Other	Yes Local Emergency Operations Plan – in process of updating. Will include Cyber Incident annex			Yes Local Emergency Operations Plan Water/Wastewater Plan

7.1.2 Park County Administrative and Technical Mitigation Capabilities

Table 17 identifies the County and municipal personnel responsible for activities related to mitigation and loss prevention in Park County.

Table 17 Park County Administrative/Technical Mitigation Capabilities

Administrative/Technical Resources	Park County	Cody	Meeteetse	Powell
Planning Board / Commission	Yes	Yes	Yes Mayor Appointment	Yes
Mitigation Planning Committee	Yes	Yes Participation on Planning Team	Yes Participation on Planning Team	Yes Participation on County Planning Team
Maintenance Programs (tree trimming, clearing drainage, etc.)	No	Yes – tree trimming	Yes Annual Review	Yes
Emergency Manager	Yes	Yes	No	Yes
Building Official	No	Yes	No	Yes
Floodplain Administrator	Yes County Planner	Yes	Yes	No
Community Planner	Yes	Yes	No	No
GIS Capability	Yes Assessor’s Office	Yes	No	No
Transportation Planner	No	No	No	No
Civil Engineer	No	No	No	Yes Engineering Firm
Warning Systems / Services (flood)	Yes	Yes	Yes Sirens	Yes
Warning Systems / Services (other / multi hazard)	Yes	Yes	Yes	Yes I.T. Dept.

Administrative/Technical Resources	Park County	Cody	Meeteetse	Powell
Grant Writing / Management	Yes Homeland Security	Yes	Yes Admin.	Yes
Other:	Yes Public Health Response Coordinator			

In addition to the administrative and technical capabilities listed int eh table above, the CPT also noted the following capabilities:

- Ready Set Go adoption countywide
- Code Red in place
- Regular siren testing in Cody and a new siren in Meeteetse
- Local EM and Fire Dept access to the State's Aristitech Tier II database

7.1.3 Park County and Jurisdictions Financial Capabilities

Table 18 identifies the County and Town financial tools or resources that could potentially be used to help fund mitigation activities. There are currently no specific funding sources for hazard mitigation.

Table 18 Park County and Jurisdictions Financial Capabilities

Financial Resources	Park County	Cody	Meeteetse	Powell
	Accessible/ Eligible to Use?			
Levy for Specific Purposes with Voter Approval	Yes	No	No	No
Utilities Fees	No	No	No	No
System Development / Impact Development Fee	No	No	No	No
General Obligation Bonds to Incur Debt	No	No	Yes	No
Special Tax Bonds to Incur Debt	No	No	No	No
Open Space / Conservation Fund	No	No	No	No
Stormwater Utility Fees	No	No	No	No
Capital Improvement Project Funding	No	No	Yes	No
Community Development Block Grants (CDBG)	No	No	Yes	No

Financial Resources	Park County	Cody	Meeteetse	Powell
	Accessible/ Eligible to Use?			
Other				

FEMA Funding Leveraged for Hazard Mitigation

The County and certain jurisdictions within have received FEMA HMA funding for the following project in the past, as summarized in the following table.

Table 19 Mitigation Actions Funded by FEMA in Park County 2010 to Mid-2020

Year	Funding Source	Jurisdiction	Description
2010	PDM	Park County	Park County Hazard Mitigation Plan

Source; OpenFEMA Data Resources accessed February 2021

7.1.4 Park County and Jurisdictions Education and Outreach Capabilities

Table 20 shows the mitigation education and outreach capabilities the County and jurisdictions have in place now.

Table 20 Park County and Jurisdictions Education and Outreach Capabilities

Education and Outreach Capabilities	Park	Cody	Meeteetse	Powell
Public Education /Outreach Program	Yes	Yes	Yes	Yes
Local Citizen Groups That Communicate Hazard Risks	Yes CERT	Yes	Yes	Yes
Firewise	Yes	No	No	No
StormReady	Yes Renewed 2021	No	No	No
Other?				

7.1.5 Opportunities for Enhancement

Based on the capabilities assessment, Park County has several existing mechanisms in place that already help to mitigate hazards. There are also opportunities for the County and jurisdictions to expand or improve on their policies, programs and fiscal capabilities and further protect the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County, jurisdictions and WOHS. Additional training opportunities will help to inform County, City, and Town staff members on how best to integrate hazard information and mitigation projects into their departments. The follow are specific opportunities the CPT provided or are recommended as an outcome of the 2021 capabilities assessment update.

- Cody suggested using a business license that would allow for improved communication with businesses during the public health outbreaks and other hazard events.
- The County is a Class 10 in the CRS, which is the minimal entry level for the program. The County could consider improving the Class rating to provider lower flood insurance costs.
- The Town of Meeteetse may consider expanding fiscal capabilities to fund mitigation projects, including leveraging grants, general obligation bonds, and CDBG funds. They may also leverage communication and warning capabilities using an "all call" app that was developed to provide public messaging during the COVID 19 pandemic to broadcast warnings on other hazards.

8 Mitigation Strategy

This section describes the mitigation strategy and mitigation action plan for Park County. See Chapter 5 of the base plan for more details on the process used to develop the mitigation strategy.

8.1.1 Mitigation Goals

During the 2021 development of the Regional Plan the Park County CPT reviewed the goals from the 2016 plan. The group thought that they remained valid and suggested no changes to the goals or the associated objectives.

The plan goals are:

1) Mitigate the effect of hazards through education, ordinances, resolutions, and clear definition and implementation of mitigation projects to enhance life-safety and reduce the loss of property of residents and visitors to Park County.
    - Objective 1: Provide public education
    - Objective 2: Provide specialized education
2) Coordinate mitigation activities with all entities of Park County to assess the hazards and take various actions to reduce or eliminate the risk factors of those hazards.
    - Objective 1: Mitigate losses through enhanced emergency response capabilities and integrated planning
    - Objective 2: Provide evacuation and emergency response routes
3) Reduce the local economic impact caused by the effects of hazards in the communities.
    - Objective 1: Address infrastructure and transportation vulnerabilities
    - Objective 2: Reduce wildland fire hazard
    - Objective 3: Adopt new and enforce existing policies and programs to protect property
    - Objective 4: Monitor drought, mitigate impacts

8.1.2 Progress on Previous Mitigation Actions

During the 2021 planning process the Park County Planning Team reviewed all the mitigation actions from the 2016 plan. Of their 23 mitigation actions from 2016, 11 of the actions are continuing and are implemented annually, demonstrating ongoing progress and building the community's resiliency to disasters. Ten (10) were noted as being continuing not started, 2 action were deleted and 2 actions were noted as completed. Table 21 shows the completed and deleted actions.

Table 21 Completed and Deleted Hazard Mitigation Projects

2016 ID	Mitigation Action	Hazards Mitigated	Jurisdiction	Priority	Status/Implementation Notes
3.1.f	Participate in oil field disaster exercise.	Human caused hazards	Cody, Powell, Meeteetse, County	Low	Completed. Done each year.
3.2.d	Update the Community Wildfire Protection Plan to reflect current forest health and WUI conditions.	Wildfire	Park County CWPP Operating Group, Meeteetse Conservation District	High	Completed. Updated 2020.
2.1.c	Inventory shelter supplies in Powell.	Weather Hazards	City of Powell, PC Homeland Security	Low	Deleted. Red Cross trailer/ HS covers Powell. Available upon request
3.2.a	Work with state and federal foresters to monitor spread of pine beetle.	Wildfire	County	Medium	Deleted. Not seen as much of an issue anymore, as for the most part, the beetles have run their course.

8.1.3 Mitigation Action Plan

As a part of the 2021 regional planning process, the CPT developed a list of hazard mitigation actions or projects specific to Park County and its jurisdictions. The process used to identify, develop and prioritize these actions is described in Chapter 5 of the base plan.

The County Planning Team identified and prioritized the following mitigation actions based on risk assessments, goals, and objectives. 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. Those that reduce losses to future development are indicated by an asterisk (*) in the Action Identification (ID) column in Table 22

Also important to reducing losses to future development is continued compliance with the NFIP. The jurisdictions that participate in the NFIP (Cody, Powell, Meeteetse) 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. Related to this is the need for better floodplain mapping to support floodplain management which is noted in a specific action in the following table.

Table 22 is grouped by jurisdiction and shows how each action connects to the County's mitigation goals as described in section 6.2.1 and FEMA Lifeline (refer to Figure 2).

The Status/Implementation Notes column describes the progress made on the actions so far, using the following categories:

Continuing-Ongoing: work has begun on the project and is ongoing.

Continue - Not completed: little or no work has been done on the project to date and the CPT agreed to carry over the action into the updated plan.

New in 2021: The action is new to this plan update; little to no work has been completed.

The Timeline column describes the estimated time of completion for each project. The following are the timeline categories:

Short Term: 1-4 years

Long Term: 5+

Annual Implementation: action is implemented every year

The Cost Estimate column describes the estimated project costs. The following are the cost estimate 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 $1,000,00

Table 22 Park County Planning Team Mitigation Actions

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
Mul-1	1 Safety & Security Communications	Educate the public on communications options during winter storms.	Winter Storm	All	PC Homeland Security, National Weather Service	Annual Implementation	Little to no cost Staff Budget	High	Continued-ongoing. NWS reporting over TV and radio. Weather spotting classes. Smart phone apps have improved over last 2 years
Mul-2	1 Safety & Security Communications	Provide public information on earthquakes.	Earthquakes	All	PC Homeland Security, WY Geological Survey	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing-ongoing. Participated in Great Wyoming Shakeout 2019-2021. Earthquake pamphlets made available at Homeland Security Office, including 'Earthquakes in Wyoming' brochure and 'Preparing your home for an Earthquake'. Additional information in on the county website.
Mul-3	1 Safety & Security Communications	Provide public information on windstorms and tornadoes.	Windstorms, Tornadoes	All	PC Homeland Security, National Weather Service	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing-ongoing. Increased use of social media and HS website updates.
Mul-4	1 Safety & Security Communications	Provide multi-hazard information for the public on the county website and links from local websites.	All Hazards	All	PC Homeland Security	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing-ongoing. HazMit plan on county website. Increased use of social media to educate citizens.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
Mul-5	2,3 Energy Safety & Security	Install generator quick connects to all schools (Cody and Powell, Meeteetse not needed) to ensure continuity of services and power when functioning as shelters.	Earthquake, Extreme Cold, Flood, Hail, Lightning, Tornado, Wildfire, High Wind, Winter Weather, Volcano	All	County Homeland Security, partnered with School District safety coordinator	Short Term	Moderate District Funds, FEMA HMA Grants	Medium	New in 2021
Mul-6	3 Food Water Shelter Safety & Security	Develop plan for catastrophic failure of Shoshone Municipal water treatment plant.	Drought Flood	Cody Powell County	Joint Powers Board, Cody and Powell	Short Term	Low FEMA HMA Grants	Medium	Continuing-ongoing. There are two sources of power from the grid and it has a backup generator. There are pumps in river. This would be a huge issue if the plant was rendered out of service.
Park-1	1 Safety & Security	Continue to support CERT with training.	All Hazards	County	PC Homeland Security Red Cross	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing-ongoing. New CERT program formed. Training meetings once a month. Participation in exercises. Assisted with Covid-19 vaccination clinics and food distribution.
Park-2	1 Safety & Security	Educate homeowners in Wildland Urban Interface areas about defensible space.	Wildfire	County	County Community Wildfire Protection Plan (CWPP) Operating Group, County	Annual Implementation	Low Staff Budget	High	Continuing-ongoing. FS/ BLM continues hazardous fuels reduction. Ongoing social media reminders concerning defensible space

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
					Homeland Security, State Forestry, USFS				
Park-3	1 Safety & Security	Support continued interagency wildland fire training.	Wildfire	County	Park County CWPP Operating Group	Annual Implementation	Little to no cost Staff Budget	High	Continuing-ongoing. This is ongoing and many trainings have been held.
Park-4	1 Transportation	Investigate areas likely to have substantial damage from flooding and train on damage assessment to include substantial damage estimation.	Flood	County	PC Planning; PC Homeland Security; WOHS, FEMA	Short Term	Low Staff Budget	Low	Continuing-ongoing. Collaboration between offices is improving. HS is getting involved with P&Z process.
Park-5	3 Safety & Security	Look for opportunities to implement mitigation in the disaster recovery environment, including the use of FEMA Public Assistance Section 406 mitigation where applicable.	All Hazards	County	PC Homeland Security, County Road and Bridge, WOHS, FEMA	Short Term	Moderate	Low	Continuing- ongoing. Need to get with R&B and P&Z.
Park-6	3 Safety & Security	Support continuation of hazard fuels work with local contractors.	Wildfire	County	Park County CWPP Operating Group	Annual Implementation	Little to no cost Staff Budget	High	Continuing-ongoing. N. Fork done Sunlight being worked on Meeteetse near done
Park-7	3 Safety & Security	Support Lower Wood River Hazard Fuel mitigation project and other state and federal fuel reduction projects.	Wildfire	County	Park Co. CWPP Operating Group, PC Homeland Security,	Annual Implementation	High FEMA HMA Grants	High	Continuing-ongoing. Work on this is in process.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
					Meeteetse Conservation District				
Park-8	3 Safety & Security	Improve flood hazard mapping to include conducting detailed flood studies with base flood elevations for the South Fork, North Fork and Greybull Rivers.	Flood	County	Park County Planning and Zoning, Park County Homeland Security, WYOHS, FEMA	Short Term	High FEMA HMA Grants	High	Continuing- ongoing. P&Z is incredibly busy with the increase in development in the County.
Park-9	3 Safety & Security Communications	Serve as information clearinghouse on drought monitoring, sources of assistance, and coordination in finding replacement pasture.	Drought	County	Cody, Meeteetse, Powell Conservation Districts coordinate with the Bureau of Land Management and the Shoshone National Forest	Annual Implementation	Little to no cost Staff Budget	High	Continuing-ongoing.
Park-10	3 Hazardous Materials	H2S training and detectors for first responders	Hazardous Materials	County	County Homeland Security and Fire Warden	Annual Implementation	Moderate	Medium	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
Park-11	2,3 Transportation Safety & Security	Conduct a feasibility analysis regarding adding additional road closure gates on Highways 120, 14A, 14/16/20 to reduce the potential for stranded motorists during winter storms.	Winter Weather	County	County Homeland Security, Public Works with WYDOT	Short Term	Moderate WYDOT FHWA	Medium	New in 2021
Park-12	3 Transportation Safety & Security	Install snow fences along Highway 120 that links Clark, Cody, and Meeteetse to mitigate impacts to travelers and snow removal costs	High Wind, Winter Weather	County	WYDOT with County Homeland Security and Public Works	Long Term	High WYDOT, FHWA	Low	New in 2021
Park-13	1 Communications	Enhanced communication, capacity, and capability building between agencies for enhanced preparedness to multiple events, including training on equipment, wildland fire response and emergency services.	Extreme Cold, Hail, Lightning, Tornado, High Wind, Winter Weather, Wildfire	County	County Homeland Security, multiple partners	Short Term	Moderate	Low	New in 2021
Park-14	1 Safety & Security	First Aid/SPR/AED training and certification for all employees	Avalanche, Dam Incident, Drought, Earthquake, Expansive Soils,	County	County Homeland Security	Annual Implementation	Low Staff Budget	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
			Extreme Cold, Flood, Hail, Landslide, Lightning, Mine Subsidence, Tornado, Wildfire, High Wind, Winter Weather, HazMat, Pandemic, Volcano						
Park-15	2,3 Energy Safety & Security	Critical facilities protection - Install a generator at Search and Rescue Hall to ensure continuity of operations and resilience during hazard events.	Earthquake, Extreme Cold, Flood, Hail, Lightning, Tornado, Wildfire, High Wind, Winter Weather, Volcano	County	County Homeland Security and SAR	Short Term	Moderate FEMA HMA Grants	High	New in 2021
Park-16	1 Safety & Security	Brochure summarizing hazards in Park County.	Avalanche, Dam Incident, Drought, Earthquake, Expansive Soils,	County	County Homeland Security	Short Term	Low Staff Budget General Funds	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
			Extreme Cold, Flood, Hail, Landslide, Lightning, Mine Subsidence, Tornado, Wildfire, High Wind, Winter Weather, HazMat, Pandemic, Volcano						
Cody-1	1 Safety & Security Communications	Educate Cody population on meaning of warning siren tones and blasts.	Tornado	Cody	Cody, PC Homeland Security	Annual Implementation	Little to no cost Staff Budget	Medium	Continuing- ongoing. Siren tests once a quarter. Social media/ website information provided.
Cody-2	3 Safety & Security	Monitor and address slope stability issues at Law Enforcement Center.	Landslide	Cody	Cody	Short Term	Moderate FEMA HMA Grants	Medium	Continuing-ongoing. Continued monitoring is needed to determine if other slope stabilization efforts are needed.
Cody-3	2,3 Energy Safety & Security	Promote electric line tree trimming program and look for opportunities to expand and improve the program to increase resiliency to winter	Winter Weather, Hail, High wind	Cody	Cody Electric Division	Annual Implementation	Little to no cost Staff Budget	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
		weather, hail, and high wind.							
Powell-1	2 Safety & Security	Conduct tabletop exercise to evacuate and shelter students from dorms at Northwest College.	All Hazards	Powell	PC Homeland Security, LEPC, Northwest College, City of Powell	Short Term	Low Staff Budget	Medium	Continuing – not started. No action taken as of yet.
Powell-2	3 Food Water Shelter Transportation	Complete the wastewater/storm sewer system project on Division Street in Powell for the remaining 6 blocks. The area has seen flooding deep enough for kayakers in streets.	Flood	Powell	City Water Dept	Short Term	Very High General Funds FEMA HMA Grants	Low	New in 2021
Meet-1	1 Hazardous Materials	Conduct a tabletop exercise for a hazmat spill in Meeteetse.	Hazardous Materials	Meeteetse	PC Homeland Security, Local Emergency Planning Committee (LEPC), Meeteetse Fire Dept	Short Term	Low General Funds	Medium	Continuing-ongoing.
Meet-2	1 Health and Medical	Continue emergency medical training to maintain first responder capability in Meeteetse.	Pandemic	Meeteetse	West Park Hospital, County Public Health	Short Term	Low General Fund	High	Continuing-not started. Discussed with State EMS coordinator to come up with plan. Most locally-based responders are gone during day

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
Meet-3	2 Food Water Shelter	Inventory shelter supplies in Meeteetse.	All Hazards	Meeteetse	Town of Meeteetse, PC Homeland Security	Annual Implementation	Low General Fund	Low	Continuing-ongoing. Inventory checks are ongoing.
Meet-4	2 Health and Medical	Coordinate with Meeteetse, West Park Hospital, and County Public Health to establish and maintain medical supply cache in Meeteetse.	Pandemic	Meeteetse	Town of Meeteetse, PC Homeland Security West Park Hospital, County Public Health, Meeteetse Fire Dept.	Short Term	Moderate Staff Budget	Medium	Continuing-ongoing. Still needs action and coordination.
Meet-5	1 Safety & Security Communications	Educate Meeteetse population on meaning of warning siren tones and blasts. There are 3 tones that can be programmed. The action would include using the community bulletin and "one call" phone messaging capability to educate residents.	Dam Failure, Flood, Tornado, Wildfire	Meeteetse	Town Administration	2022 then Annual Implementation	Little to no cost Staff Budget	High	New in 2021
Meet-6	3 Food Water Shelter	Evaluate potential erosion risk to water and sewer infrastructure; a study needs to be done to determine if there is future risk to	Flood	Meeteetse	Town Administration	2023	Moderate FEMA HMA	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/Implementation Notes
		infrastructure adjacent to the Greybull River.							

9 Implementation

Moving forward the County CPT will use the mitigation action table in the previous section to track progress on implementation of each project. As noted in the action table Status Update column much progress has been made since the plan was originally developed in 2006. Implementation of the plan overall is discussed in Chapter 6.

Incorporation into Existing Planning Mechanisms

Also discussed in Chapter 6 is the importance of implementation and incorporation of the principles of this plan into other planning mechanisms.

As described in the capability assessment, the County and municipalities 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 or community comprehensive or land use plans
- County or community development codes
- County or community Emergency Operations Plans
- Threat and Hazard Identification and Risk Assessments (THIRA)
- Community Wildfire Protection Plan (CWPP)
- 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
- WYDOT rockfall and landslide mitigation efforts
- Other plans, regulations, and practices with a mitigation aspect

During the 2016 planning process the CPT discussed the importance of coordinating the mitigation plan with other planning processes, and vice versa. The group discussed opportunities to cross reference the hazard mitigation plan in other upcoming planning efforts. Since the 2016 update, the county has incorporated the HMP in their Emergency Operations Plan. The County Land Use Plan was noted as a possibility. The County Planner noted that the Land Use Plan was being updated and could incorporate the mitigation plan by reference. The next update of the Community Wildfire Protection Plan will be another possibility once funding is secured. While the other Town's did not specially incorporate or reference the 2016 HMP in municipal plans or planning mechanisms, a process to do so with the 2022-2027 plan is outlined in Chapter 6.

1 Mitigation Planning and County Planning Team

Washakie County developed this annex during the development of the 2021 Region 6 Hazard Mitigation Plan. This County Annex builds upon previous versions of the 2016 Region 6 Hazard Mitigation Plan and Washakie County Annex. 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 jurisdictions participated in the DMA planning process for the County.

- Washakie County
- City of Worland
- Town of Ten Sleep

More details on the planning process followed and how the County, municipalities and stakeholders participated can be referenced in Chapter 3 of the base plan. Additional details on what local government departments participated and who represented them are listed in Appendix A.

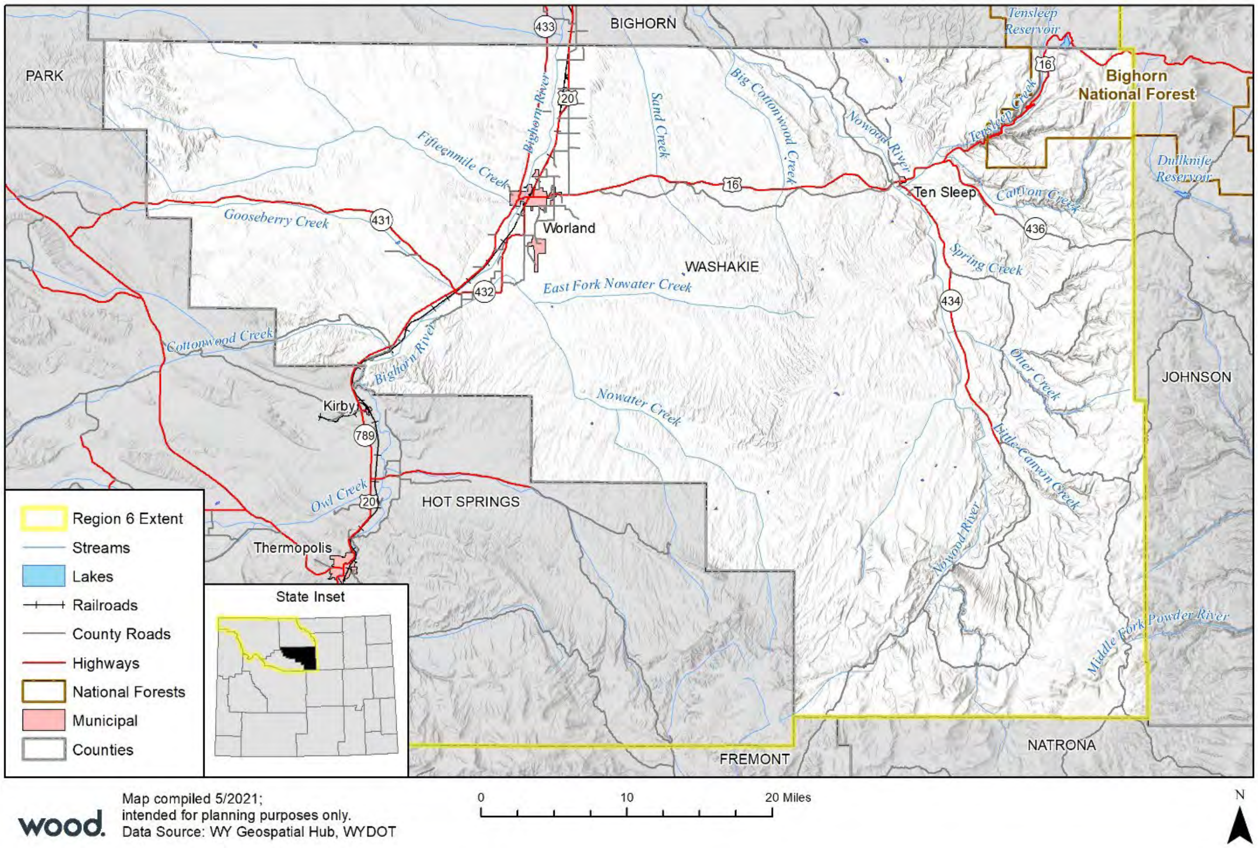
2 Geography and Climate

Named after one of the most renowned Shoshone leaders in American history, Washakie County is nestled in the heart of the Bighorn Basin in north-central Wyoming with the Big Horn Mountains rising along its eastern border. The County's two incorporated communities include the City of Worland and the Town of Ten Sleep. It is bordered by Big Horn County to the north, Johnson County to the east, Natrona County to the south, Fremont County to the southwest, Hot Springs County to the west, and Park County to the northwest. Washakie County has a total area of 2,243 square miles.

- The City of Worland is located at an elevation of 4,065 feet and has a total area of 4.2 square miles.
- The Town of Ten Sleep is located at an elevation of 4,426 feet and has a total area of 0.2 square miles.

Washakie County is favored by 310 days of sunshine a year. The average annual rainfall and snowfall are 7.5 inches and 21.1" respectively. The average annual high temperature is 60°F and the average low temperature is 30°F. The Bighorn River flows northerly through the County, with Worland lying close to its banks. The Nowood River, a tributary of the Bighorn, also passes through Washakie County. Worland, the county seat, lies just west of the foothills of the Big Horn Mountains.

Figure 1 Washakie County Base Map



Major topographical features include the Big Horn Mountains. Agricultural lands are a dominant part of the landscape with 426,500 acres of farms and ranchland and 46,785 acres of cropland. Part of Big Horn National Forest lies in the northwestern part of the County. There are five vegetation zones in Washakie County including sub-alpine, montane, foothills, basins and badlands. Vegetation in these zones varies widely from shrubs, sagebrush, and grasses to aspen trees, cottonwood trees, Russian olive trees, Lodgepole Pine, Douglas Fir, Ponderosa Pine, spruce, fir, and juniper (Washakie County Conservation District, http://www.conservewy.com/lrpfinl.pdf).

3 Population Trends

According to the 2019 United States Census Bureau American Community Survey (ACS), there were a total of 8,027 people living in Washakie County. With a population of 8,533 people recorded in the 2010 US Census, the county's population decreased by 5.9% from 2010 to 2019. Table 1 provides a summary of the population change in the county and municipalities from 2014 to 2019.

Table 1 Population Estimates for Incorporated Communities 2010-2015

	2014	2015	2016	2017	2018	2019
City of Worland	5,362	5,372	5,383	5,310	5,236	5,180
Town of Ten Sleep	253	254	195	210	176	214

	2014	2015	2016	2017	2018	2019
County Total	8,444	8,400	8,351	8,253	8,129	8,027

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Select Census demographic and social characteristics for Washakie County are shown in Table 2. The table indicates the proportion of the population that may have special needs, such as elderly or children under 5 years of age.

Table 2 Washakie County Demographic Profile

People	Washakie County
Gender/Age (% of Total Population)	
Male	50.6
Female	49.4
Under 5 Years	5.7
65 Years and Over	21.1
Race/Ethnicity (% of Total Population)	
White	93.4
American Indian/Alaska Native	2.6
Asian	0.0
Black or African American	2.0
More than One Race	3.8
Hispanic or Latino (of any race)[1]	14.2
Education (% of Total Population, 25+ years)	
High school graduate or higher	89.8
Bachelor's degree or higher	23.4
Source: U.S. Census Bureau, 2015-2019 5-Year American Community Survey,https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2019/ 1The U.S. Census Bureau considers the Hispanic/Latino designation an ethnicity, not a race. The population self-identified as "Hispanic/Latino" is also represented within the categories in the "Race" demographic.	

4 Development Trends

The Washakie Development Association (WDA) is a private economic development organization for Washakie County that assists private businesses with relocation and expansion in Worland, Ten Sleep, and the rest of the county. WDA states "Washakie County has one of the most diversified economies in the State of Wyoming."

As indicated in the previous section population has been declining in the County. Some development has occurred since the 2010 plan including:

- Most of the ongoing development in Washakie County is happening in agricultural areas along existing county roads and away from the floodplain and other hazard areas. Growth is expected to remain in this pattern for the foreseeable future.
- Subdividing property along T.S. Creek (which is a hazard area due to flooding)
- Ranchers around Ten Sleep have subdivided their properties.
- Ten Sleep has become a major attraction for rock-climbing.

- The oil industry downturn may result in a number of well, tank, and treater sites that, with the lack of funding may have preventive maintenance shortfalls. This coupled with the loss of experienced personnel in the oilfield due to layoffs, could create a hazardous environment.

Continued growth has occurred in the Wildland Urban Interface in Washakie County as a whole; both in the Worland and the Ten Sleep areas. Residential development is ongoing in Canyon Creek County and Village, areas just outside of Ten Sleep noted for their scenic beauty. Both areas are identified as Firewise communities. It is important to note that neither the County nor the two incorporated communities have zoning ordinances to govern people building in the wildland-urban interface. Given the natural beauty in the County, and the less restrictive building requirements it is expected that people will continue building their homes in the wildland-urban interface outside of City and Town boundaries. This may increase the risk to people and property from hazards such as wildland fire.

5 Economy

In spite of its comparatively small population, Washakie County's business sector is rich in diversity. Major Washakie businesses and employers include Wyoming Sugar Company, Fremont Beverages – Pepsi-Cola Bottling plant, Coors Brewing Company, Bentonite plant, Crown Cork & Seal, NOCORA, Bureau of Land Management, Washakie Medical Center of Banner Health, and several others. Washakie County has a labor force of 4,168 people, with a job growth rate of 1.48% since 2014 and an unemployment rate of 5.3%.

Select economic characteristics for Washakie County from the U.S. Census American Community Survey are shown in Table 3.

Table 3 Washakie County Economic Profile

	Washakie County
Families Below Poverty Level	5.7%
Individuals Below Poverty Level	10.5%
Median Home Value	$165,800
Median Household Income	$54,158
Per Capita Income	$28,101
Population >16 Years Old in Labor Force	61.5%
Population Employed	59%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

Table 4 shows the breakdown of employment in Washakie County by the industry sector. According to data from the U.S. Census Bureau ACS, the leading employment sectors in the county are the educational services, and health care and social assistance, arts, entertainment, and recreation, and accommodation and food services sectors, and retail trades sector.

Table 4 Washakie County Occupations and Industries

Industry	Number Employed	Percent of Labor Force
Educational services, and health care and social assistance	840	22.20%
Agriculture, forestry, fishing and hunting, and mining	386	10.20%
Retail trade	381	10.10%
Arts, entertainment, and recreation, and accommodation and food services	334	8.80%

Industry	Number Employed	Percent of Labor Force
Manufacturing	327	8.70%
Construction	305	8.10%
Transportation and warehousing, and utilities	260	6.90%
Other services, except public administration	240	6.40%
Professional, scientific, and management, and administrative and waste management services	192	5.10%
Public administration	175	4.60%
Finance and insurance, and real estate and rental and leasing	169	4.50%
Wholesale trade	138	3.70%
Information	30	0.80%

Source: U.S. Census Bureau ACS 5-year estimates, 2015-2019

6 Hazard Identification and Risk Assessment

6.1 Identified Hazards

The CPT reviewed significant hazards for inclusion in the hazard mitigation plan. For the sake of consistency, the list of hazards for consideration began with the list of hazards found in the State of Wyoming's Hazard Mitigation Plan, updated in 2020. In the 2021 update the CPT decided to add the following hazards: pandemic/epidemic and volcano. In addition, the CPT also considered the following human caused hazards but ultimately decided to keep them separate from this plan because they are already covered in other County plans.

Table 5 provides a summary of the overall hazard significance for the hazards evaluated in this plan.

Table 5 Overall Hazard Significance* Summary Table

Hazard	Washakie County	Ten Sleep	Worland
Avalanche	Low	Low	Low
Dam Failure	Medium	Medium	Medium
Drought	High	High	High
Earthquake	Medium	Medium	Medium
Expansive Soils	Low	Low	Low
Extreme Cold	High	High	High
Flood	High	Medium	High
Hail	Medium	Medium	Medium
Landslide	Low	Low	Low
Lightning	Low	Low	Low
Mine Subsidence	Low	NA	NA
Tornado	Medium	Medium	Medium
Wildfire	High	High	Medium
High Wind and Downbursts	Low	Low	Low

Hazard	Washakie County	Ten Sleep	Worland
Winter Storm	Medium	Medium	Medium
Hazardous Materials	Medium	Medium	High
Pandemic/Epidemic	Medium	Medium	Medium
Volcano	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 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.

6.2 Building Inventory and Assets

In addition to people there are buildings, critical facilities and infrastructure, and other important assets in Washakie County are potentially exposed to hazards identified in this plan. Table 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 as an assessment of the overall property exposed within the County and by jurisdiction.

The 2020 Parcel and Assessor Data was obtained through the Wyoming Cama website which is maintained by the Wyoming Department of Revenue. This information provided the basis for building exposure and property types. The available data is annually updated on the site and contains all counties within Wyoming. Data current as of 2020 was downloaded for all the counties within the Region and joined by Parcel Number in a separate database for analysis using GIS.

Table 6 Washakie County Building Inventory and Value by Jurisdiction

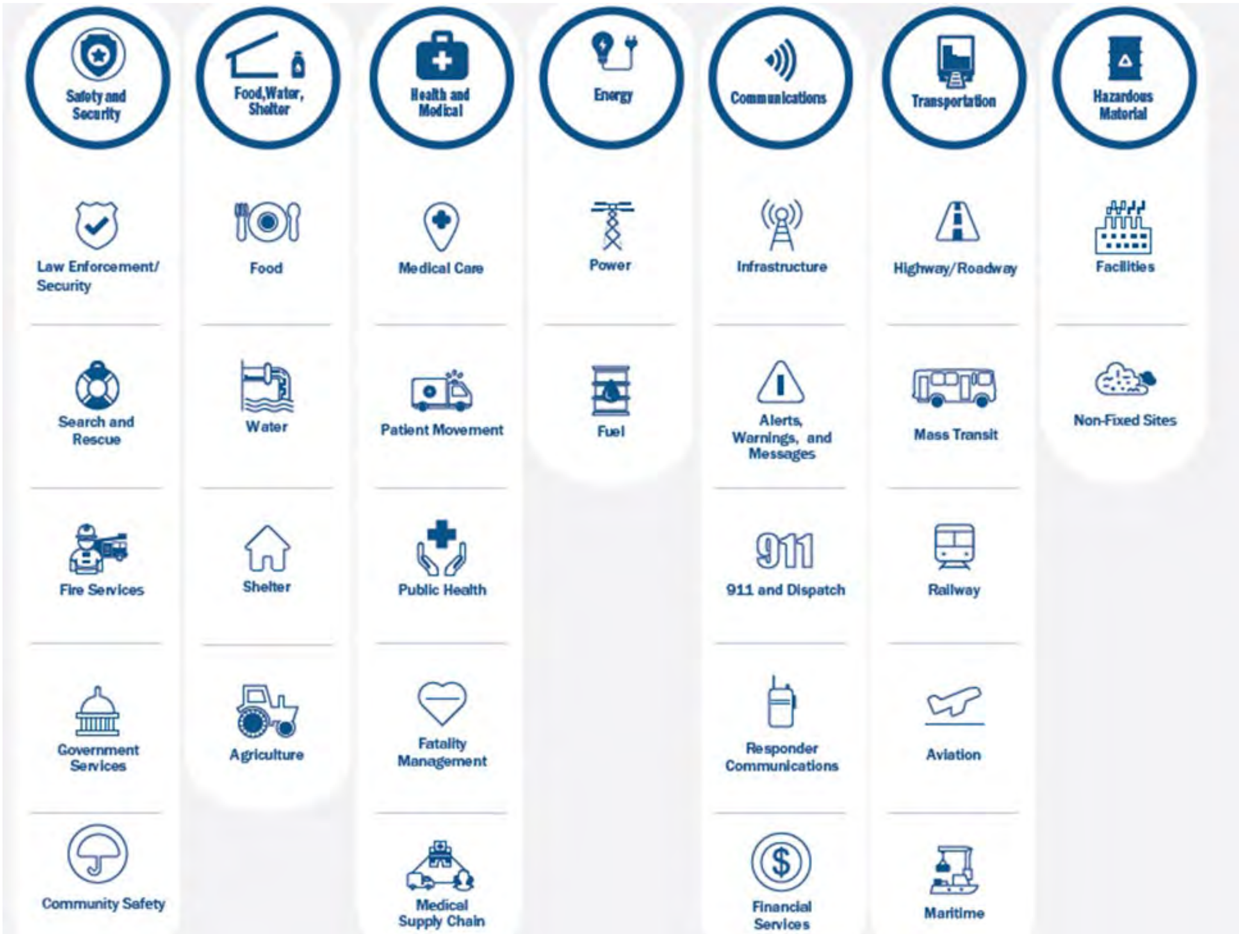
Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure
Ten Sleep	Commercial	14	$1,821,813	$1,821,813	$3,643,626
	Improved Vacant Land	2	$229,887	$229,887	$459,774
	Residential	105	$12,665,559	$6,332,780	$18,998,339
	Total	**121**	**$14,717,259**	**$8,384,480**	**$23,101,739**
Worland	Agricultural	1	$487,765	$487,765	$975,530
	Commercial	296	$64,971,125	$64,971,125	$129,942,250
	Improved Vacant Land	5	$869,689	$869,689	$1,739,378
	Industrial	23	$14,254,821	$21,382,232	$35,637,053
	Residential	1,946	$210,997,323	$105,498,662	$316,495,985
	Total	**2,271**	**$291,580,723**	**$193,209,472**	**$484,790,195**
Washakie Unincorporated	Agricultural	74	$20,499,961	$20,499,961	$40,999,922
	Commercial	111	$14,423,251	$14,423,251	$28,846,502
	Exempt	3	$180,930	$180,930	$361,860
	Improved Vacant Land	25	$3,008,701	$3,008,701	$6,017,402
	Industrial	15	$7,763,231	$11,644,847	$19,408,078
	Residential	1,135	$214,982,520	$107,491,260	$322,473,780
	Total	**1,363**	**$260,858,594**	**$157,248,950**	**$418,107,544**
	Grand Total	**3,755**	**$567,156,576**	**$358,842,901**	**$925,999,477**

Source: (http://cama.state.wy.us/)

6.2.1 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. FEMA organizes critical facilities into seven lifeline categories as shown in Figure 2.

Figure 2 FEMA Lifeline Categories



A summary of the critical facilities exposure analysis can be found in Table 7 and Figure 4-2 in the Base Plan illustrates the location of critical facilities in Region 6.

Table 7 Summary of Washakie County Critical Facilities by Jurisdiction

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation	Total
Ten Sleep	2	-	-	-	1	2	-	5
Worland	21	7	-	-	4	17	5	54
Unincorporated	71	11	2	3	-	2	58	147
Total	**94**	**18**	**2**	**3**	**5**	**21**	**63**	**206**

6.2.2 Natural, Historic, and Cultural Assets

Assessing the vulnerability of Washakie County to disaster 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 a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing 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 Resources

By definition, an historic property not only includes buildings of other types of structures, such as bridges and dams, but also includes prehistoric of Native American sites, roads, byways, historic landscapes, and many other features. Given the history of the County, these types of historic properties exist in the planning area.

Information about historic assets in Washakie County came from the following sources:

- The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.

Table 8 lists the properties and districts in Washakie County that are on the National Register of Historic Places.

Table 8 Washakie County Historic Properties

Property	Jurisdiction	Address	Date Listed
Ainsworth House/Greet Ranch	Big Trails	Spring Creek Road	Sept. 11, 1986
Parks, Emerson House	Ten Sleep	504 2nd Street	May 16, 2016
Saban, James T., Lookout	Ten Sleep	Approx. .9 mi. SW. of US 16 & FS Rd. 429	November 15, 2016
Ten Sleep Mercantile/Ten Sleep Hardware Store	Ten Sleep	2nd and Pine Streets	Sept. 11, 1986
Worland House	Worland	520 Culbertson	Feb. 27, 1986
Worland Ranch	Worland	U.S. Highway 20 and Wy 433	March 5, 1992

Sources: National Register Information System, www.nr.nps.gov/

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 areas protects sensitive habitat as well as attenuates and stores floodwaters.

A number of natural resources exist in Washakie County. This includes wetlands, endangered species, and imperiled plant communities. Also, the scenery itself, and access to the scenic backcountry, are economic drivers for the County, Worland and Ten Sleep.

Wetlands

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. Wetlands reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water. They also provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital.

Endangered Species

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. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

As of September 2021, there are six federal endangered, threatened, or candidate species in Washakie County according to the U.S. Fish and Wildlife Service. These species are listed in Table 9 along with state listed species.

Table 9 Endangered and Threatened Species in Washakie County

Common Name	Scientific Name	Type of Species	Status
Bald eagle	*Haliaeetus Leucocephalus*	Bird	Recovery
Greater Sage-grouse	*Centrocercus Urophasianus*	Bird	Resolved Taxon
Canada Lynx	Lynx Canadensis	Mammal	Threatened
Gray Wolf	*Canis lupus*	Mammal	Under Review
Monarch Butterfly	*Danaus plexippus*	Insects	Candidate
Ute Ladies'-tresses	*Spiranthes diluvialis*	Flowering Plants	Threatened

Source: http://www.fws.gov/endangered/

6.3 Vulnerability to Specific Hazards

This section details vulnerability to specific hazards, where quantifiable, only where it differs from that of the Region. The results of detailed GIS analyses used to estimate potential for future losses are presented here, in addition to maps of hazard areas and 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.

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Expansive Soils
- Extreme Cold
- Flood
- Hail
- Hazards Materials
- High Wind and Downbursts

- Landslide, Debris Flow and Rockfall
- Lightning
- Mine Subsidence
- Pandemic/Epidemic
- Tornado
- Volcano
- Wildfire
- Severe Winter Weather

6.3.1 Avalanche

Vulnerability to avalanche is limited to the higher terrain in the Big Horn Mountains but generally has little impacts except to the occasional back country enthusiast and first responders. Refer to Chapter 4 in the base plan for a discussion of general avalanche risk in the Region.

6.3.2 Dam Failure

There is one High and one Significant Hazard dam in Washakie County proper, however, there are many dams upstream in Hot Springs and Fremont Counties which could have potentially the biggest impact on Washakie County. Chapter 4 in the base plan includes a table and map of High and Significant Hazard dams both in and upstream of the County.

Table 10 High and Significant Hazard Dams in Washakie County

Dam Name	Owner	River	Hazard Class	Nearest Downstream Community	Distance to Nearest Downstream Community (Miles)	EAP
Washakie County						
Ten Sleep	USDA Forest Service	East Tensleep Creek	H	Ten Sleep	16.015.0	NY
Flathead	Ken Tanner, (Flathead Ranch)	Gomer Gulch	S	Manderson	25.0	N

There is a high hazard dam above the town of Ten Sleep along East Ten Sleep Creek. Ten Sleep Dam abuts a block slide complex, exposing the dam to landslide hazards. It is possible the dam could be breached if the landslide destabilizes. Flathead Dam along Gomer Gulch is a significant hazard dam in the county. Other dams in the county are low hazard dams.

Boysen Dam is located along the Wind River, another name for the upper Bighorn River in adjacent Fremont County. The current dam is operated by the U.S. Federal Bureau of Reclamation and is an earth-filled dam with a structural height of 220 feet. Washakie County has emergency action plans on file for Boysen and Ten Sleep Dams. These emergency action plans include specific information on flood damages if either of these dams failed.

Table 11 Washakie County Structures within Inundation Areas

Jurisdiction	Property Type	Improved Parcels	Population
Ten Sleep	Residential	2	5
Unincorporated	Agricultural	6	
	Residential	31	73
	Total	**37**	**73**

Jurisdiction	Property Type	Improved Parcels	Population
	Grand Total	**39**	**77**

Source: County Assessor Data, Wood GIS Analysis

Refer to Chapter 4 in the Base Plan for additional discussion of dam incident risk related to the Region and the County.

6.3.3 Drought

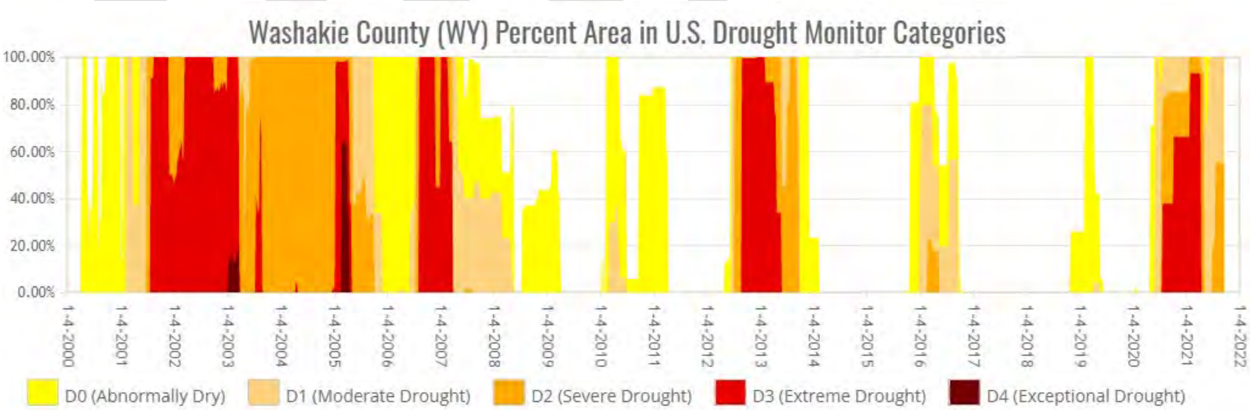
Similar to the rest of the Region drought is a high significance hazard for the County. Drought is a regular and widespread occurrence in the State of Wyoming. Since 2012 there have been 9 USDA Disaster Designations in Washakie County for drought. According to the U.S. Drought Monitor records for Washakie County, in the 1,096-week period from 2000 through 2020, the county spent 745 weeks (68% of the time) in Abnormally Dry (D0) conditions. Approximately 48% of the time, or 524 weeks, was spent in Moderate Drought (D1) or worse conditions. Weeks in drought between 2000 and 2020 are summarized in Table 12 and shown in time series from January 2000 and January 4, 2021, in Figure 3.

Table 12 Washakie County Weeks in Drought by Intensity, 2000-2020

Category	Description	Palmer Drought Severity Index (PDSI)	Standardized Precipitation Index (SPI)	Big Horn County Weeks in Drought, 2000-2020
D0	Abnormally Dry	-1.0 to -1.9	-0.5 to -0.7	745
D1	Moderate Drought	-2.0 to -2.9	-0.8 to -1.2	524
D2	Severe Drought	-3.0 to -3.9	-1.3 to -1.5	374
D3	Extreme Drought	-4.0 to -4.9	-1.6 to -1.9	210
D4	Exceptional Drought	-5.0 or less	-2.0 or less	19

Source: U.S. Drought Monitor

Figure 3 Washakie County Drought Intensity, 2000-August 2021



Source: U.S. Drought Monitor

The CPT noted that the 2020 drought, starting in June of 2020, related in some sites in the county to have up to 63% of loss of crop production. During the 2016 Regional Plan development the CPT noted that one of their water resources includes an aquifer used by Pepsi. Commercial use of a primary water source can impact and increase the effects of drought. Refer to the Chapter 4 in the Base Plan for a discussion of drought risk for the Region and Washakie County.

6.3.4 Earthquake

According to the USGS, 1,500 to 2,500 earthquakes typically occur in and around Yellowstone each year, leaving Wyoming Region 6 as generally higher earthquake exposure relative to the rest of the state. Several notable earthquake events have occurred in Washakie County, which are summarized below.

The first earthquake recorded in Washakie County occurred on December 12, 1970. This magnitude 4.9 event was centered approximately 8 miles southwest of Ten Sleep. No damage was reported.

On September 19, 1974, a magnitude 4.4, intensity V earthquake occurred approximately 6 miles north-northwest of Ten Sleep. Residents reported that shock waves were felt in the Ten Sleep Canyon area (Casper Star-Tribune, September 21, 1974).

A magnitude 3.5 earthquake was detected approximately 10 miles south of Ten Sleep on November 16, 1993. No damage was reported from the event.

A magnitude 3.3 earthquake occurred in Washakie County on April 5, 2002. The earthquake's epicenter was located approximately 10 miles southwest of Worland. Although the Washakie County Emergency Management agency reported ground shaking, the earthquake did not cause any damage.

Two earthquakes occurred near Ten Sleep in 2021. A magnitude 3.9 earthquake occurred 32 miles south of Ten Sleep on April 13, 2021. On July 4, 2021, a 3.6 magnitude earthquake occurred 27 miles south of Ten Sleep.

As discussed in Chapter 4 of the base plan, earthquakes are low probability but could have considerable impacts in Washakie County. Refer to the Chapter 4 in the Base Plan for a discussion of earthquake risk related to Washakie County and the wider Region.

6.3.5 Expansive Soils

During the 2016 Regional Plan development, the HMPC noted the following consequences of expansive soils hazards in Washakie County:

- Highway 16 between Worland and Ten Sleep has several issues with expansive soil particularly near mileposts 9 to 12. An $800,000 project is underway to address impacts to the highway. This road has heavy truck traffic; and
- Highway 434 also has issues.

The Town of Ten Sleep has had occasional problems with expansive soils. Refer to the Chapter 4 in base plan for further discussion of expansive soil risk related to the Region.

6.3.6 Extreme Cold

Since 2012, Washakie County has received 4 USDA Disaster Designations for freeze or frost. Extreme cold has caused crop damages and losses. Between 2007 and 2020 freeze and frost has caused 792 acres to be lost resulting in $305,836 indemnity payments countywide. Average annual losses due to extreme cold is estimated to be $25,486. Vulnerability to extreme cold is not noticeably different from the rest of the region and is considered a medium significance hazard. Refer to Chapter 4 for a discussion of this hazard's risk related to Washakie County and the Region. Members of the CPT noted a past extreme cold event that caused sewer lines to freeze in Worland.

6.3.7 Flood

Flood hazards affect areas of the county differently. Flooding events occurring within the boundaries of Washakie County are generally attributed to three factors (1) winter thaws and spring break up on the Big Horn River (sometimes with associated ice jams), (2) rapid snow melt and or heavy rains in higher elevations, and (3) spring or summer deluges that result in flash flooding. Figure 4 through Figure 6 on the following pages show flood hazards in specific areas of Washakie County.

Figure 4 Washakie County FEMA Flood Hazards

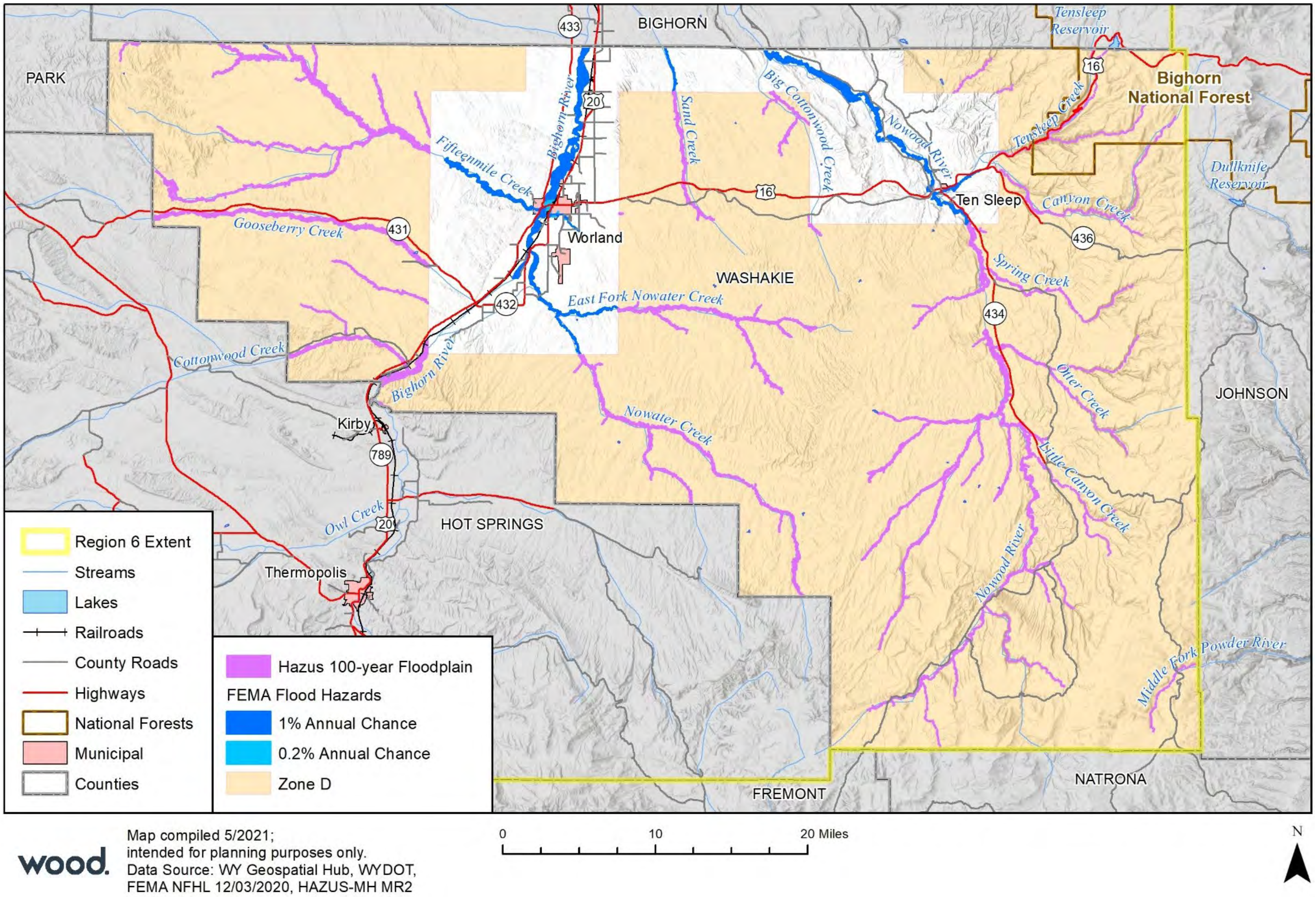


Figure 5 City of Worland FEMA Flood Hazards

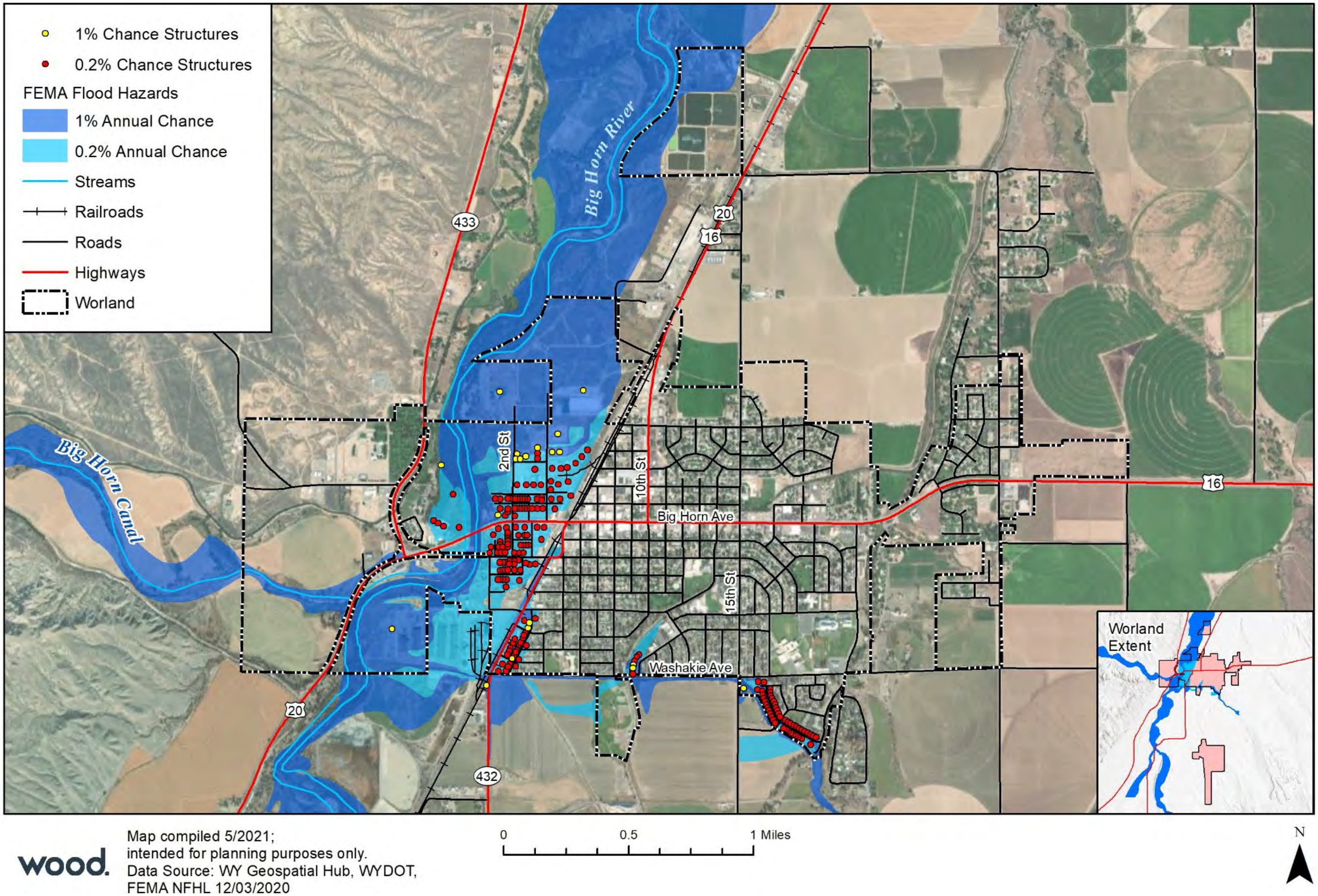
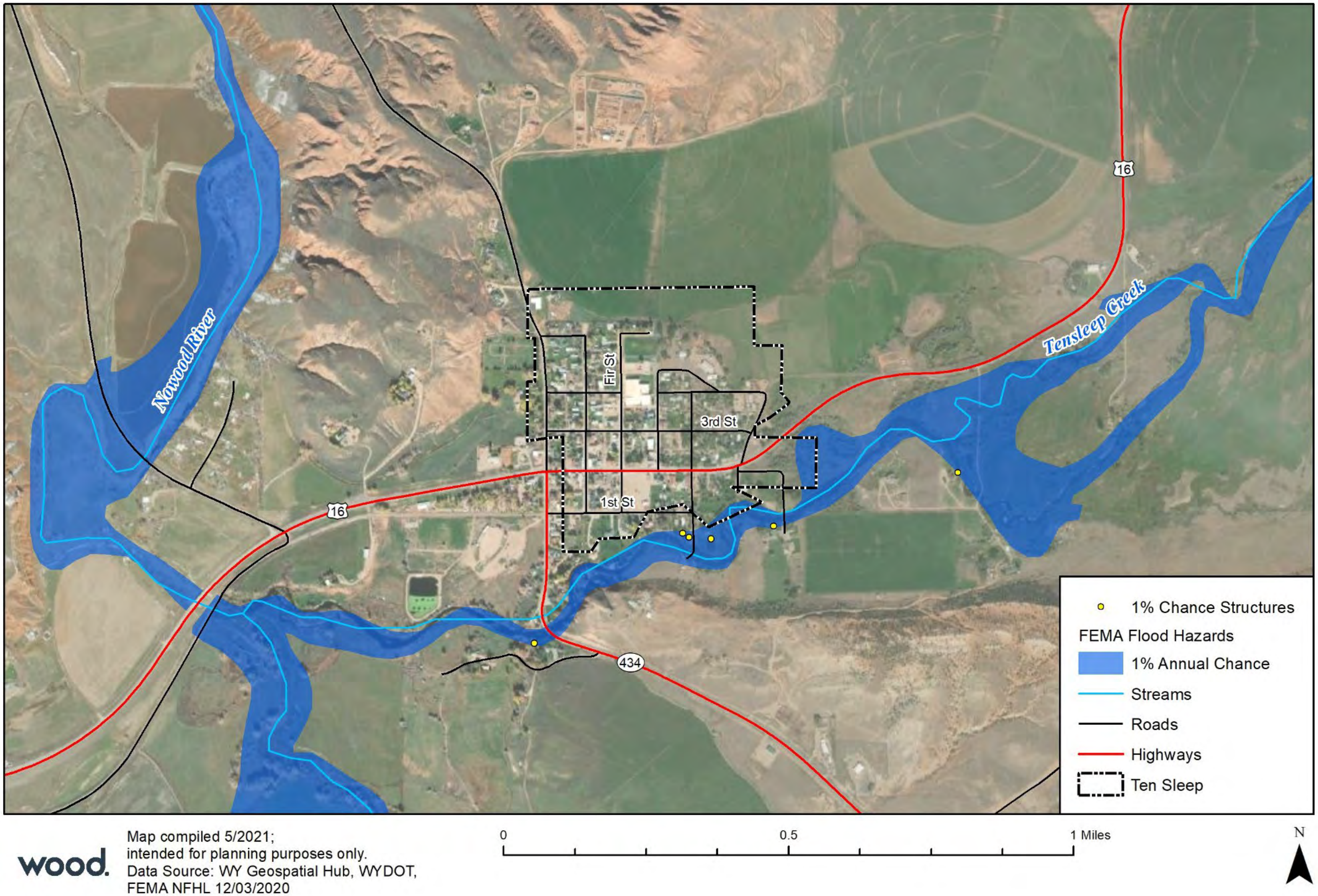


Figure 6 **Town of Ten Sleep FEMA Flood Hazards**



During the development of the 2021 State of Wyoming Hazard Mitigation Plan, 21 flood events, $1.3 million in property damage, and $31,000 in crop losses were noted specific to Washakie County. Table 13 through Table 14 and Table 15 below provide some detail specific to Washakie County on the county's potential flood losses and Table 6-11 summarizes the County's participation in the NFIP. Refer to Chapter 4 of the base plan for a discussion of the flood risk relative to Washakie County, with details on property and critical facility risk from flood for the County and the wider Region. Parcel Level Analysis

The following results show potential impacts from flooding, including the number or people vulnerable, total building exposure, and associated costs related to a general flooding incident based on a parcel level analysis.

Table 13 Exposure and Potential Loss in 1% Annual Chance Floodplain by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss	Population
Worland	Commercial	9	$1,378,292	$1,378,292	$2,756,584	$689,146	
	Industrial	2	$5,921,150	$8,881,725	$14,802,875	$3,700,719	
	Residential	7	$579,966	$289,983	$869,949	$217,487	16
	Total	**18**	**$7,879,408**	**$10,550,000**	**$18,429,408**	**$4,607,352**	**16**
Unincorporated	Agricultural	5	$1,618,430	$1,618,430	$3,236,860	$809,215	
	Commercial	6	$112,286	$112,286	$224,572	$56,143	
	Improved Vacant Land	2	$154,143	$154,143	$308,286	$77,072	
	Residential	63	$11,679,692	$5,839,846	$17,519,538	$4,379,885	147
	Total	**76**	**$13,564,551**	**$7,724,705**	**$21,289,256**	**$5,322,314**	**147**
	Grand Total	**94**	**$21,443,959**	**$18,274,705**	**$39,718,664**	**$9,929,666**	**164**

Table 14 Exposure and Potential Loss in 0.2% Annual Chance Floodplain by Jurisdiction and Property Type

Jurisdiction	Property Type	Improved Parcels	Improved Value	Est. Content Value	Total Exposure	Estimated Loss	Population
Worland	Commercial	44	$6,140,449	$6,140,449	$12,280,898	$3,070,225	
	Improved Vacant Land	1	$40,149	$40,149	$80,298	$20,075	
	Industrial	13	$2,861,150	$4,291,725	$7,152,875	$1,788,219	
	Residential	126	$8,617,029	$4,308,515	$12,925,544	$3,231,386	295
	Total	**184**	**$17,658,777**	**$14,780,838**	**$32,439,615**	**$8,109,904**	**295**

Flood Insurance Claims Analysis

The table below lists details regarding the 11 total flood insurance policies in the County.

Table 15 NFIP Insurance Policies and Claims Analysis

Community	Date Joined	Current Map Date	Policies in Force	Insurance in Force	Number of Paid Losses	Total Losses Paid	Repetitive Loss Buildings/ Losses
County	8/29/1978	3/2/2009	3	$894,000	1	$0	0/0
Ten Sleep	12/13/1974	3/2/2009	1	$350,000	0	$0	0/0
Worland	5/3/1974	3/2/2009	7	$1,959,400	4	$0	0/0

Source: FEMA NFIP Community Information System

Repetitive Loss Properties: There are no reported Repetitive Loss properties in the County.

Community Rating System: Neither the County nor any of the communities participate in the CRS program.

6.3.8 Hazardous Materials

Hazardous materials vulnerability is significant in the County for transportation accidents due to the highways and railroad that passes through the County and all municipalities. According to the Wyoming State Hazard Mitigation Plan, there have been 37 hazardous materials incidents in Washakie County from 1990 to 2019. According to the Right-to-Know network database, there are three facilities in Washakie County required to generate a Risk Management Plan. There are also multiple pipelines transporting hazardous materials across the county.

Washakie County is susceptible to accidents involving hazardous materials on roads, highways, and at fixed facilities that manufacture, use, or store dangerous chemical substances. Primary issues of concern include chemicals used for agricultural purposes, such as pesticides and insecticides; grain storage; bentonite mining; storage, sale, usage and transportation of liquid propane gas; materials transported along the Burlington Northern Santa Fe rail line; federally regulated pipeline transportation systems; gas-fired residential appliances; and other miscellaneous examples. Certain facilities keep specific hazardous materials in storage, depending on the function of the facility.

A listing of the Risk Management Plan facilities present in Washakie County is presented in the table below. The chemicals that are extremely hazardous in Washakie County as a result of the RMP facilities are presented in Table 16 below. Most of these facilities are located in Worland. There are some potentially significant problems that could develop in Washakie County if select chemicals in Table 17 are released. No additional information is available for this plan due to Homeland Security concerns.

Table 16 Risk Management Plan (RMP) Facilities in Washakie County

County	Site
Washakie	Washakie Mid-Stream (former Hiland Gas Plant)
Washakie	UAP Northwest, Basin
Washakie	Devon (formerly Worland Gas Plant)

Table 17 Hazardous Chemicals in Washakie County

County	Chemical
Washakie	Butane Mix
Washakie	Fuels (Butane)
Washakie	Fuels (Gasoline)
Washakie	Fuels (Propane)

County	Chemical
Washakie	Lubricant Oil
Washakie	Solvents (Methanol)
Others associated with Tier 2 Reporting	Anhydrous Ammonia, Liquid CO2, Liquid O2, and Liquid Nitrogen, Acids, etc.

Begun in 1988, the Toxics Release Inventory (TRI) is a federal program established by the U.S. Environmental Protection Agency that contains information on releases of nearly 650 chemicals and chemical categories from industries including manufacturing, metal and coal mining, electric utilities, and commercial hazardous waste treatment, among others. TRI facilities are required to file reports of their disposal or other environmental releases as well as other waste management quantities of regulated chemicals if they manufacture, process, or otherwise use more than the established threshold quantities of these chemicals. Washakie County has two facilities that report to the TRI: Crown Beverage Packaging and Wyoming Sugar Company, and over 360 Tier II sites report to the Local Emergency Planning Committee. The names of these facilities will not be discussed in this plan for Homeland Security reasons, but the reports are available at the Washakie County Homeland Security office.

The Worland fire station is located near the Burlington Northern Santa Fe Railroad, placing it at high risk should a train derail near the city and release hazardous materials. The Regional Emergency Response Team 6, a State of Wyoming asset, which provides services to Hot Springs, Big Horn, Park and Washakie counties, has some of its assets housed in the fire station. Further detail regarding the County's vulnerability to hazardous materials will not be discussed in this plan due to homeland security and public safety concerns. Washakie County Homeland Security worked with a local GIS contractor to estimate the County's vulnerabilities to simulated hazardous materials event scenarios. Therefore, the County is aware of potential threats and hazards and is prepared to address those issues should they arise.

Refer to Chapter 4 for a discussion of hazardous materials risk in the Region and County.

6.3.9 Hail

According to records from the National Center for Environmental Information (NCEI) Storm Events Database, in the past 41 years there have been 50 events. Most of the events took place in Unincorporated Washakie County (19), followed by the Towns of Ten Sleep (17) and Worland (14). The largest hailstone recorded in Washakie County was 2.75 inches on July 4,1978. Of the records in the NCEI database, only one record of past hail events resulted in property damages. The following is a description of that damaging event:

August 30, 2010 - Supercell thunderstorm swept across the Badland through eastern Washakie County. Eventually moving into the Norwood River Valley south of Ten Sleep. Ping pong ball sized hail fell for several minutes at ranches just west of State Highway 434. Substantial damage was done to the sorghum crop at one ranch. The event resulted in a total of $30,000 in property damages and $25,000 in crop damages.

In 2018 the County received a USDA Disaster Designation (S4396) for hailstorms, which in some cases caused total crop loss. In terms of insured crop losses, according to the U.S. Department of Agriculture (USDA) Risk Management Agency (RMA) between 2007 and 2020, 1,135 acres were lost to hail and $138,502 indemnity payments made to farmers in Washakie County. Average annualized crop losses in the County due to hail is estimated to be $10,654.

Refer to Chapter 4 in the base plan for a discussion of hail risk related to Washakie County and the Region.

6.3.10 High Wind and Downbursts

According to NCEI records between 1962 and 2020 there were 166 high wind events in Washakie County. A majority of the events took place in Unincorporated Washakie County (24), followed by Worland (14), and Ten Sleep (6). The highest recorded event in was 74 miles per hours thunderstorm wind on August 30, 2010. This even was also the most damaging event recorded in the NCEI database and was associated with the damaging hail noted in the hail section above. The event took place south of Ten Sleep in the Nowood River Valley. Wind damaged roofs, rain gutters, windows, and siding of several homes in the area. The wind also ripped metal roofing from a garage, while another garage was significantly damaged by a toppled Cottonwood tree. A rear flank downdraft associated with a nearby supercell thunderstorm was responsible for the damaging wind.

In terms of insured crop losses, according to the USDA Risk Management Agency between 2007 and 2020 33 acres were lost to wind and $1,55 indemnity payments made to farmers in Washakie County. Average annualized crop losses in the County due to wind is estimated to be $389.

The CPT noted the following consequences of high wind hazards in Washakie County:

- In 2012 multiple houses were hit by downed trees; power lines and roads were also affected;
- In 2020 the Norco building lost siding;
- Roof replacements have been required in the County due to past events.

Refer to the Chapter 4 in the base plan for a discussion of wind risk related to Washakie County.

6.3.11 Landslide, Debris Flow and Rockfall

The CPT noted the following consequences of landslide hazards in Washakie County:

- A slump near lower Nowood caused more than $100,000 of damage;
- Highway 16 crosses an active landslide with potential for $10 million in damages. Indirect losses would be significant due to long detours for truck and other traffic;
- In 2015, Highway 16 was closed on Memorial Weekend due to debris slides and rockfalls. The detours had impacts to Pepsi operations; and
- The large "earth crack" that gained national attention in the fall of 2015 was in Washakie County but did not do any damage.
- The 2019 Black Mountain landslide in Hot Springs County affected oil and gas infrastructure that impacted Washakie County.
- Debris flow issues were noted from the Hatchery Fire burn scar near 16 E.
- Supply chain could be impacted if a landslide hazard was to block the Wind River Canyon in Hot Springs County

Critical Facility Analysis

A GIS analysis of critical facilities identified 60 facilities located in moderate to highest susceptibility landslide hazard areas. All of the exposed critical facilities are located in unincorporated Washakie County. Most of the vulnerable facilities are identified as communication facilities (43) followed by transportation (14) and energy (3). Refer to Chapter 4 for further details on the critical facility analysis.

6.3.12 Lightning

The CPT noted that SCADA repeater sites have been hit, affecting local water systems. In addition, some residences have been struck, and that several fires annually are sparked by lightning. It was also noted there has been occasional to ranching community including livestock losses. Refer to Chapter 4 in the base plan for further discussion of lightning risk related to Washakie County and the Region. All jurisdictions are equally exposed to this hazard.

6.3.13 Mine Subsidence

The HMPC was not aware of issues of mine subsidence in the unincorporated county or municipalities. Refer to Chapter 4 in the base plan for a discussion of mine subsidence risk related to the Region and Washakie County.

6.3.14 Pandemic/Epidemic

Following the initial response to the COVID-19 Pandemic in 2020, Washakie County completed an After Action Report to review their response and identify strategies to take in the next pandemic. Overall, the CPT felt they are better prepared for the next event with PPE, testing and equipment. Vulnerability to pandemic/epidemic is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of pandemic/epidemic risk related to the Region.

6.3.15 Tornado

The NCEI database shows 8 records of events between 1975 and 2018 (note: the database was searched from 1950-2020 but no events were recorded before 1975 or after 2018). These recorded events resulted in a total of $92,500 in property damages. The following are descriptions of the most damaging events.

- August 20, 2010 - A tornado (estimated EF1) swept through Juniper trees on a high ridge before descending the hillside into the Nowood River Valley southeast of Ten Sleep. Destroyed several well-built outbuildings and downed at least 20, century-old Cottonwood trees on ranches in the valley. Estimated total property damages was $70,000.
- June 1, 2018 - Maximum winds at 130 mph touched down in Northeast Washakie County in a heavily forested area at around 8,000 feet. The tornado (estimated EF2) downed and snapped off around 1,000 trees near ground level during its short path. Total damages were estimated to be $20,000.

All property is vulnerable during tornado events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Mobile homes are more vulnerable to the impacts of a tornado event compared to housing types due to methods of construction. Statewide, mobile homes represent about 13% of total housing compared to 6.1% Nationwide. In Washakie County mobile homes represent 10% of total housing. Table 18 shows the breakdown of mobile for each jurisdiction.

Table 18 Percent of Mobile Homes as Total Housing, by Jurisdiction

Jurisdiction	Total Housing	% Mobile Homes
Unincorporated County	3,860	10.2%
Ten Sleep	143	22.4%
Worland	2,459	7.4%

Source: U.S. Census, American Community Survey (ACS) 5-Year Estimates, 2015-2019

Refer to Chapter 4 in the base plan for a discussion of tornado risk related to Washakie County and the Region. All jurisdictions are equally exposed to this hazard.

6.3.16 Volcano

Vulnerability to volcano is not noticeably different from the rest of the region. Refer to Chapter 4 for a discussion of tornado risk related to the Region.

6.3.17 Wildfire

Wildfire is a high significance hazard for the County, consistent with other counties in the Region. Refer to Chapter 4 in the base plan for additional discussion of the County's CWPP and wildfire risk related to Washakie County.

The readily available wildfire history data ranges from 1980-2019. The Federal Wildland Occurrence data recorded 155 fires between 1980 and 2019 in Washakie County. The total acres burned over this time period added up to 105,594 acres. According to this data the county has averaged 5 wildfires per year from 2000 to 2019. Many of these fires were relatively small, burning only a few acres. In fact, the 23 largest fires of 500 acres or more burned 85,099 acres, or nearly 88% of the total burned acreage. 1996 in particular was one of the worst wildfire years for Washakie County. Two of the largest wildland fires occurred in 1996. The Bates Creek Fire and the East Black Mountain Fire burned 38,858 and 48,844 acres, respectively, of sagebrush community. A number of other fires burned in 1996, totaling an additional 18,579 acres. Table 19 details Washakie County wildfires that burned 1,000 or more acres between 1980 and 2020.

Table 19 Wildfires over 1,000 acres in Washakie County: 1980-2019

Name	Year	Acres Burned
Zimmerman	2018	3,856
Terek	2018	42,264
Potter Butte	2018	2,447
Denver Jake	2018	7,157
Hidden Dome	2017	1,132
Speedgoat	2017	1,602
Banjo	2017	3,367
Hatchery	2016	2,802
Upper Bee	2012	3,926
Reservoir	2011	2,200
Blue Bank 2	2007	1,089
Little Canyon Creek	2006	3,017
Nowater Creek	2006	1,082
Devilslide	2005	1,567
Alkali Rim	2001	1,325
Muddy Creek	2000	3,843
Bates	1996	38,858
Willow	1996	4,793
Cedar Ridge	1996	4,525
N. Broken Back	1996	3,741
Buffalo 2	1996	1,466
Eight Mile	1996	1,425
Lake Bed	1996	1,403
Brome	1994	1,665

Name	Year	Acres Burned
Goldmine	1988	1,344
Orchard	1983	1,325

The principal wildfire mitigation plan for Washakie County is the "Washakie County Community Wildfire Protection Plan" (February 2005). Wildland fire hazard assessment was conducted on the landscape and community scales. The landscape scale considered the entire county. Thirty-one communities were identified for the community-level assessment. Communities were designated based on common characteristics for wildland fire assessment. The communities are located around the towns of Worland and Ten Sleep, in the Bighorn River corridor, along Cottonwood and Gooseberry Creeks, and in the forested areas in the northeast and southeast corners of the county. The plan is available at the Washakie County Homeland Security Office.

The 2005 Washakie Community Wildfire Protection Plan identified the following communities with either a high or moderate wildfire hazard rating. See that document for additional descriptions of these communities and mitigation recommendations.

- Canyon Creek Country – High
- Bar C Creek – High
- Middle Fork Headwaters – High
- Middle Fork – High
- Deerhaven Lodge – High
- West Rivere Road Lowland – High
- Lower Ten Sleep Canyon – High
- Middle Fork Campground – Moderate
- State Game and Fish Cabin- Moderate
- Nowood – Moderate
- Cherry Creek Road – Moderate
- Meadowlard Resort – Moderate
- State Fish Hatchery- Moderate

6.3.18 Winter Weather

During the 2021 update, the CPT noted power line damages from past winter weather events have lasted from 2 to 4 hours causing lower income populations as well as home with baseboard heaters to more vulnerable in these situations. According to the U.S. Health and Human Services emPOWER website, which tracks electricity dependent Medicare Beneficiaries, 7% of Beneficiaries in the County (146 of 2,030) are dependent on electricity to live independently in their homes. The County has been efforts to address these vulnerabilities and focusing on power resiliency efforts in the Threat Hazard Identification Risk Assessment (THIRA), identify the need for generators as well as requiring new subdivisions to underground utilities. Other County winter storm mitigation efforts have included strategic road closing to prevent stranded motorists on Cottonwood, Roan Hill and Dry Park roads.

Refer to the Chapter 4 in the base plan for a discussion of winter weather risk related to Washakie County.

7 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 through the use of 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.

7.1 Washakie County Mitigation Capabilities

This section presents Washakie County's mitigation capabilities as well as the capabilities of the City of Worland and the Town of Ten Sleep that are applicable to the planning area. This assessment describes existing capabilities, programs and policies currently in use to reduce hazard impacts or capabilities that could be used to implement hazard mitigation activities. It addresses regulatory mitigation capabilities and administrative/technical mitigation capabilities for the participating jurisdictions.

7.1.1 Washakie County Regulatory Mitigation Capabilities

Table 20 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Washakie County. Excerpts from applicable policies, regulations, plans and programs descriptions follow to provide more detail on existing mitigation capabilities.

Table 20 Washakie County and Jurisdictions Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Washakie County	Worland	Ten Sleep
Comprehensive, Master, or General Plan	Yes 2004	Yes City Code	Yes County Comp Plan
Capital Improvement Program or Plan (CIP)	Yes	Yes	Yes Annual Budget Process for Infrastructure
Floodplain Management Plan	Yes Floodplain Resolution #268	Yes City Code	No
Stormwater Program / Plan	No	Yes Stormwater Plan	No
Community Wildfire Protection Plan (CWPP)	Yes 2004; Most recently updated in 2017	Yes Included in County's plan	Yes Included in County's plan
Erosion / Sediment Control Program	Yes Conservation District	Yes Conservation District	No
Economic Development Plan	No	Yes 2014	No
Building Codes (Year)	Yes County is required to follow State Fire Marshall codes: 2018 IBC, IFC, IM, IFGC, IEBC	Yes Worland ICC adoptions: IBC, IPSDC, IRC (Statewide: IBC, IFC, IFGC, IMC)	Yes Updated 2016
Site Plan Review Requirements	No	Yes	Yes

Regulatory Tool (ordinances, codes, plans)	Washakie County	Worland	Ten Sleep
		City Code	Building Permits
Zoning Ordinance (Land Use)	No	Yes City Code	No
Subdivision Ordinance	Yes 2010 Subdivision and Development Regulations	Yes City Code	Yes
National Flood Insurance Program (NFIP) Participant	Yes Floodplain Resolution #268 Joined 8/29/1978	Yes Joined 12/13/1974	Yes Joined 5/3/1974
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes March 2, 2009	Yes	Yes
Floodplain Ordinance	Yes	Yes City Code	Yes
Elevation Certificates for Floodplain Development	Yes	Yes City Code	Yes Aerial GIS Survey
Community Rating System (CRS) Participant	No	No	No
Open Space / Conservation Program	No	Yes Subdivision Ordinance	No
Growth Management Ordinance	No	No	No
Stormwater Ordinance	No	Yes Subdivision Ordinance	No
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	Yes Flood Damage Prevention Resolution 2009	Yes Burn ordinance for controlled burns	Yes Fire Codes/Ordinances, Snowplow Ordinance
Other	Yes Local Emergency Operations Plans	Yes City of Worland Flood Hazard Mitigation Plan	

Additional Washakie County Plans and Regulations

As indicated in the table above, Washakie County has several plans and programs that guide the County's mitigation of development in hazard-prone areas. Some of these plans and programs are described in more detail below.

Preliminary Report: Sage Creek Watershed, Worland, WY 1985

Although it is several years old, this report still contains valuable information for flood mitigation in the planning area. This report investigates the feasibility of developing a plan for the Sage Creek Watershed. The watershed experiences problems with flooding, erosion, and sediment damage along Sage Creek and near Worland specifically. The report determines threshold levels at which flooding would cause damage to the City of Worland and croplands in the watershed. In order to address the flood threat posed by issues with Sage Creek, the report explores four different mitigation strategies. These four strategies include constructing a dam and reservoir along Sage Creek, enlarging the channel in pre-designated areas, creating a diversion channel to discharge Sage Creek floodwaters into Slick Creek, and creating a diversion channel along Airport Drain. Maps illustrating the potential strategies are included in the report. It was determined that all four strategies would offer flood protection from the 1% annual chance flood along Sage Creek. The feasibility of implementing these strategies is impeded by the construction costs. Therefore, alternative mitigation strategies were proposed including expanding the flood insurance program in the study area; flood proofing, removing obstructions caused by roads, bridges, and pipelines in certain areas; and replacing the Lower Hanover Canal structure, which would likely fail in the event of a large thunderstorm.

Washakie County Comprehensive Plan, 2004

The 2004 Washakie County Comprehensive Plan was prepared by the County's Planning Commission to be used in making decisions that affect the physical, cultural and socioeconomic development of Washakie County. The plan's goals provide general statements reflecting the desires of County residents regarding the use of land. These goals also lay the groundwork for zoning and the land use decision-making process. The policies provide the County's positions as they relate to the identified goals and establish guidelines for direction or action. The overall goal of the plan is to allow gradual, long-term population and economic growth within the County in a manner that does not harm the County's scenery or character and residents' way of life.

Washakie County Natural Resource Management Plan, 2020

The Natural Resource Management Plan (NRMP), a form of land use planning, is a document that serves as the basis for communicating and coordinating with the federal and state government and their agencies on land and natural resource management issues that influence the local area and economy. The NRMP adds to and enhances the WCCP and replaces objectives and policies that relate to public land use and management in some sections of the WCCP.

Washakie County Flood Damage Prevention Resolution, 2009

The 2009 Flood Damage Prevention Resolution was passed by the Board of County Commissioners to replace the 2000 Flood Damage Prevention Resolution (Resolution #152). The purpose of the 2009 Resolution is to minimize public and private losses from flooding. This endeavor includes protecting human life and health, employing cost-effective flood mitigation strategies that do not unduly draw from public money, minimizing flood severity to the extent possible, minimizing business interruptions, and minimizing structural damage from flooding. The resolution outlines methods of reducing losses from flooding. The plan establishes the role and responsibilities of the floodplain manager as well as land use provisions in flood hazard areas.

Washakie County Subdivision and Development Regulations, 2010

The Board of County Commissioners enacted this resolution to protect the general welfare of the County and its residents. The resolution establishes regulations for subdivision and development design to help ensure public health and safety in addition to building a well-planned community.

Additional City of Worland Plans and Regulations

As indicated in the table above, the City of Worland has several plans and programs that guide the City's mitigation of development in hazard-prone areas. Some of the plans identified in the table are described in more detail in the following paragraphs. In addition, in 2011 the City passed a new ordinance regarding contractors. This ordinance increases fines on non-licensed contractors who attempt to do business with the City. The ordinance came about following severe hailstorms in 2010.

City of Worland Flood Hazard Mitigation Plan, 2002 and Washakie County Multi-Hazard Mitigation Plan update to Flood Chapter 2013

The 2002 City of Worland Flood Hazard Mitigation Plan identifies flood risks in the planning area and lays out strategies to reduce those risks. The Plan also describes the planning and public involvement that contributed to the development of the document. The Worland Flood Hazard Mitigation plan includes a description and timeline of previous flood mitigation activities, particularly along Sage Creek which is identified as the primary flooding threat to Worland. The Plan establishes several overarching goals for flood mitigation in the City including mapping and several flood control projects.

The 2013 Flood Chapter Addition included as Appendix D to the 2016 Regional Hazard Mitigation Plan included updated information on Sage Creek, which is reflected in the 2021 update's risk assessment. In 2011, Washakie County obtained a Flood Mitigation Assistance Program (FMA) Grant to make improvements to the Flood Chapter, with a focus on identifying possible flood hazard mitigation projects and strategies. In addition, from 2011 to 2012, the City of Worland prepared and submitted a Letter of Map Revision (LOMR) request to FEMA with the intention of obtaining a significant re-delineation of the Special Flood Hazard Area (SFHA) of the Sage Creek watershed. FEMA approved the LOMR and a revised Flood Insurance Rate Map (FIRM) became effective for Sage Creek as of July 1, 2013.

Mobile Home Tie-Down Ordinance

The City of Worland has enacted a tie-down ordinance to reduce the risk of damage from high wind and tornadoes. This was originally a project identified in the 2005 Hazard Mitigation Plan. Per Ordinance 24-14 Mobile Home Residential District H. Securing and Skirting: All mobile homes shall be securely fastened to the ground to the satisfaction of the building inspector, if required, and if required by other sections of this code. All occupied mobile homes shall be skirted so that the under-floor space is enclosed. Masonry skirting shall be laid up in mortar. (Ord., 6-20-1985)

Worland City Code

The 2009 Worland City Code includes a multitude of ordinances relating to long-term planning, community development and public safety. The Code also establishes authorities required to implement and enforce these ordinances. Specific ordinances relevant to hazard mitigation include buildings and construction, fire protection and codes, flood damage prevention, health and sanitation, subdivisions, water and sewers, and zoning.

7.1.2 Washakie County Administrative and Technical Mitigation Capabilities

Table 21 identifies the County and municipal personnel responsible for activities related to mitigation and loss prevention in Washakie County.

Table 21 Washakie County and Jurisdictions Administrative/Technical Mitigation Capabilities

Administrative/Technical Resources	Washakie County	Worland	Ten Sleep
Planning Board / Commission	Yes	Yes	Yes Town Council

Administrative/Technical Resources	Washakie County	Worland	Ten Sleep
		Board of Adjustments and Planning	
Mitigation Planning Committee	Yes County Mitigation Planning Team	Participation on County Mitigation Planning Team	Participation on County Mitigation Planning Team
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes/No General Road and Bridge responsibilities	Yes Public Works	Yes Public Works
Emergency Manager	Yes County Emergency Management/Homeland Security Coordinator	Yes County	Yes County
Building Official	No	Yes City Engineer, City Planner, Building Inspector	No
Floodplain Administrator	Yes County Planner	Yes Floodplain Manager	Yes County Planner
Community Planner	Yes	Yes	No
GIS Capability	Yes Eagle/Connect Explorer program	Yes City GIS Manager	No
Transportation Planner	No	Yes Urban Systems City and County combined plus 4 at-large members and WYDOT	No
Civil Engineer	Yes	Yes	Yes
Warning Systems / Services (flood)	Yes CodeRed/IPAWS	Yes CodeRed/IPAWS	Yes Sirens, IPAWS/CodeRed
Warning Systems / Services (other / multi hazard)	Yes CodeRed/IPAWS	Yes CodeRed/IPAWS	Yes Sirens, IPAWS/CodeRed
Grant Writing / Management	Yes	No	Yes Part-time
Other:			

Additional Washakie County Administrative and Technical Capabilities

In addition to the capabilities described in the tables above Washakie County has several other capabilities and programs related to hazard mitigation. Since 2005, the County has had an operational solar powered early warning system that provides public warning for tornadoes, floods, or inclement weather. This system includes a voice broadcast capability. Washakie County emergency management also teamed up with personnel from Hot Springs and Big Horn County to develop a Mobile Animal Rescue Evacuation Team (M.A.R.E.T.). Other capabilities include the Search and Rescue (S.A.R.) teams.

The following departments are involved in hazard mitigation in Washakie County:

- **County Commissioners** - Three commissioners comprise the planning area's governing body.
- **Planning Commission** - The Planning Commission makes recommendations to the County's governing body concerning matters related to planning, zoning and land use regulations.
- **Public Health Department** - The Public Health Department works to communicate, educate, and offer services that provide a healthy and safe environment to live and work in. For years, Public Health has been educating the public about emergency preparedness plans and disaster supply kits. The Department speaks at various community groups and provides informational booths and health fairs and other community gatherings.
- **Road and Bridge** - The Road and Bridge Department is responsible for the repair and maintenance of County roads within the planning area.
- **Washakie County Department of Emergency Management/Homeland Security -** This office is responsible for emergency management countywide.

Additional City of Worland Administrative and Technical Capabilities

The following personnel/departments are involved in hazard mitigation in the City of Worland:

- **City Council and Mayor** - The City Council and Mayor comprise the governing body of the City of Worland. The City Council is made up of nine council members.
- **Planning and Building Department** - This department "administers the city land use planning and zoning activities, including comprehensive plan amendments, zone changes, conditional uses, variances, and planned unit permit issuance. [The department also] maintains the City's comprehensive general plan in compliance with the State of Wyoming land use planning laws" (http://www.cityofworland.org/commun.htm).
- **Public Works** - The Public Works Department handles street repair and maintenance as well as maintenance of City buildings and grounds, sanitation, water, and sewer systems.
- **Worland Fire Department** - The Worland Fire Department provides fire protection and suppression throughout the community. Worland Fire Department is the home base for the Region 6 hazardous materials team.

7.1.3 Washakie County and Jurisdictions Financial Capabilities

Table 22 identifies the County and Town financial tools or resources that could potentially be used to help fund mitigation activities. There are currently no specific funding sources for hazard mitigation.

Table 22 Washakie County and Jurisdictions Financial Capabilities

Financial Resources	Washakie County	Worland	Ten Sleep
	Accessible/ Eligible to Use?		
Levy for Specific Purposes with Voter Approval	Yes	Yes	Yes
Utilities Fees	No	Yes	Yes
System Development / Impact Development Fee	No	No	Yes
General Obligation Bonds to Incur Debt	Yes	Yes Has been used in the past	No

Financial Resources	Washakie County	Worland	Ten Sleep
	Accessible/ Eligible to Use?		
Special Tax Bonds to Incur Debt	No	Yes Has been used in the past	Yes
Open Space / Conservation Fund	No	No	No
Stormwater Utility Fees	No	No	Yes
Capital Improvement Project Funding	Yes	Yes	Yes Has been used in the past – 1% sales tax
Community Development Block Grants (CDBG)	Yes	Yes	Yes Has been used in the past
Other			

FEMA Funding Leveraged for Hazard Mitigation

The County received FEMA HMA funding for the following project in the past, as summarized in the following table.

Table 23 Mitigation Actions Funded in Washakie County 2010 to mid-2020

Year	Funding Source	Jurisdiction	Description
2011	FMA	County	Washakie County Flood Mitigation Plan and update to Multi-Hazard Mitigation Plan Flood Chapter

Source: OpenFEMA Data Resources accessed February 2021

7.1.4 Washakie County and Jurisdictions Education and Outreach Capabilities

Table 24 shows the mitigation education and outreach capabilities the County and jurisdictions have in place now. Additional information shared by the CPT is listed after the table.

Table 24 Washakie County and Jurisdictions Education and Outreach Capabilities

Education and Outreach Capabilities	Washakie County	Worland	Ten Sleep
Public Education/Outreach Program	Yes County Emergency Management has outreach programs	No	No

Education and Outreach Capabilities	Washakie County	Worland	Ten Sleep
Local Citizen Groups That Communicate Hazard Risks	No	No	No
Firewise	Yes FireSmart Big Horn Basin Firewise program	No	Yes Canyon Creek Country, Canyon Creek Village, West
StormReady	Yes	No	No
Other?			

The CPT noted the following additional education and outreach mitigation efforts:

- Responsible water education
- Flood education when flooding is an issue
- Public fire education
- Smoke detector program
- Personal preparedness education
- Siren education

7.1.5 Opportunities for Enhancement

Based on the capabilities assessment, Washakie County has several existing mechanisms in place that already help to mitigate hazards. There are also opportunities for the County and jurisdictions to expand or improve on their policies, programs and fiscal capabilities and further protect the community. Future improvements may include providing training for staff members related to hazards or hazard mitigation grant funding in partnership with the County, jurisdictions and WOHS. Additional training opportunities will help to inform County, City, and Town staff members on how best to integrate hazard information and mitigation projects into their departments. Other capability enhancements could include:

Worland and Tensleep:

- Education and awareness on hazards, including warning sirens protocols.
- Training for first responders and the public about common hazardous materials in Washakie County

7.2 Mitigation Strategy

This section describes the mitigation strategy and mitigation action plan for Washakie County. See Chapter 5 of the base plan for more details on the process used to develop the mitigation strategy.

7.2.1 Mitigation Goals

During the 2016 development of the Regional Plan the Washakie County CPT reviewed the goals from the 2016 plan. The group thought that they remained valid but did provide one suggestion on a revision and decided to add additional goal related to lifelines. The only other suggestion was to add "visitors" to goal one be more inclusive in who the plan is considering.

The updated plan goals are:

1) Mitigate the effect of identified hazards through education, ordinances, resolutions, and clear definition and implementation of mitigation projects to reduce the loss of property and enhance life-safety of residents and visitors
2) Coordinate mitigation activities with all entities of Washakie County to assess the identified hazards and take various actions to reduce or eliminate the risk factors of those hazards.
3) Reduce the economic impact on the local economy caused by the effects of identified hazards in the communities.
4) Strengthen Public Infrastructure and Lifelines.

7.2.2 Progress on Previous Mitigation Actions

During the 2021 planning process the Washakie County Planning Team reviewed all the mitigation actions from the 2016 plan. Of their 22 mitigation actions from 2016, 20 of the actions are continuing and 2 actions were noted as completed demonstrating ongoing progress and building the community's resiliency to disasters. Table 25 shows the completed and deleted actions.

Table 25 Completed Hazard Mitigation Projects

Mitigation Action	Hazards Mitigated	Jurisdiction	Priority	Status/Implementation Notes
Implement an Integrated Public Alert and Warning System (IPAWS) alert system as the next generation of the Emergency Alert System.	Multi-Hazard: Avalanche, Earthquake, Extreme Cold, Dam Failure Hailstorm, Lightning, Winter Storm, Tornado Wind, Wildfire, Hazardous Materials	County	Medium	Completed. The county uses CodeRed as a platform to send both CodeRed and IPAWS messages to the community.
Back-up power supply for shelters and critical infrastructure ID key facilities in Worland and Ten Sleep (i.e., community center)	All-Hazards, Winter Storm, Lightning, Hailstorm, Extreme Cold, Tornado, & Windstorm	County Worland Ten Sleep	Medium	Completed. A 25 KW generator has been installed at the Ten Sleep Senior Center. A larger, 50 KW generator will replace the existing generator at the Fairgrounds to run the SAR building and the lg green

Mitigation Action	Hazards Mitigated	Jurisdiction	Priority	Status/Implementation Notes
				Fairgrounds building (for use as a shelter) A transfer switch will be installed on the county EOC building to allow for hook-up to the mobile generator when needed. Ten Sleep Fire Dept also has a generator now.
Establish tornado and severe weather shelter at ballpark.	Tornado, Lightning, Wind, Winter Storm	Worland	Medium	Deleted. Lack of funding to complete the project at this time.
Relocate Public Works building.	Flood	Worland	Medium	Deleted. Explored but reevaluated as longer a priority for the city.

In addition to the complete actions listed in the table above, the CPT noted the following mitigation success stories:

- Firewise mitigation efforts to remove Russian olives, salt cedar/tamarisk trees in the Big Horn River bottom in Washakie and Big Horn counties have also helped to reduce flooding and ice jams. An additional benefit to this mitigation effort is drought mitigation, as these plants are water intensive.
- Flood mitigation efforts have included removal of sand bar/island just below the bridges at Worland has enhanced channel capacity.
- A small levee by Worland was raised with sandbags and K-Rail/Jersey barriers.
- City of Worland has placed backflow preventers in storm drains and redid the storm sewer system.
- Extensive work was done on the riverbank west of Worland near Co-Op to prevent further erosion.

7.2.3 Mitigation Action Plan

As a part of the 2021 regional planning process, the CPT developed a list of hazard mitigation actions or projects specific to Washakie County and its jurisdictions. The process used to identify, develop and prioritize these actions is described in Chapter 5 of the base plan.

The County Planning Team identified and prioritized the following mitigation actions based on risk assessments, goals, and objectives. 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. Those that reduce losses to future development are indicated by an asterisk (*) in the Action Identification (ID) column in Table 26.

Also important to reducing losses to future development is continued compliance with the NFIP. All of the jurisdictions 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. Related to this is the need for better floodplain mapping to support floodplain management which is noted in a specific action in the following table.

Table 26 is grouped by jurisdiction and shows how each action connects to the County's mitigation goals as described in section 6.2.1 and FEMA Lifeline (refer to Figure 6-1).

The Status/Implementation Notes column describes the progress made on the actions so far, using the following categories:

Continuing-Ongoing: work has begun on the project and is ongoing.

Continue - Not completed: little or no work has been done on the project to date and the CPT agreed to carry over the action into the updated plan.

New in 2021: The action is new to this plan update; little to no work has been completed.

The Timeline column describes the estimated time of completion for each project. The following are the timeline categories:

Short Term: 1-4 years

Long Term: 5+

Annual Implementation: action is implemented every year

The Cost Estimate column describes the estimated project costs. The following are the cost estimate 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

Table 26 Washakie County Mitigation Actions

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
Mul -1	1,2,4 Food, Water, Shelter Energy	Back-up power supply for shelters and critical infrastructure. Key facilities in Worland and Ten Sleep (i.e., community center, Worland City Hall and Ten Sleep sewer lagoon)	Multi-Hazards: Flood, Wildfire, Earthquake, Landslide, Lightning, High Wind, Tornado, Dam Failure, Volcano	Multi County Worland Ten Sleep	County Emergency Mgmt., Worland Public Works American Red Cross	Short Term	Moderate FEMA HMA Grants	Medium	Continuing-Ongoing. A 25 KW generator is currently being installed at Ten Sleep Senior Center. A larger, 50 KW generator will replace the existing generator at the Fairgrounds to run the SAR building and the lg green Fairgrounds building (for use as a shelter) A transfer switch will be installed on the county EOC building to allow for hook-up to the mobile generator when needed. *These projects are all part of an existing SHSP grant and should be completed in 2021. Ten Sleep Fire Dept also has a generator now.
Mul -2	1,2 Safety & Security	Public awareness program to include promotion of 3-day kits (for home, work, and car), and distribution of hazard information to residents and businesses (including emergency facilities, public buildings and campgrounds) via	All-Hazards including volcano	Multi County Worland Ten Sleep	County Emergency Mgmt Coordinator	Short Term	Low Staff Budget	Medium	Continuing – On-going. WCEM continues to provide public information at local events. WCEM has run newspaper/social media ads promoting signing up for CodeRed and information about sirens.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
		information booths, talks, videos, and brochures							
Mul -3*	2 Safety & Security	Provide GIS training for local jurisdictions with emphasis on hazards recognition and analysis for application in mitigation planning. Build in-house GIS capability of various personnel (Assessor and planning).	Multi-Hazards: Flood, Wildfire, Earthquake, Landslide, Expansive Soils, Avalanche, Dam Failure, Land Subsidence , Hazardous Materials	Multi County Worland Ten Sleep	County Emergency Mgmt. Coordinator/ Assessor/ Planning	Long Term	Low Staff Budget	Medium	Continuing-Ongoing. GIS training will enable county to quickly analyze hazards and their potential impacts. Assessor's office has been trained. Planner took GIS training in 2012 GIS data for the hazard mitigation plan can be utilized for training and applications for hazard mitigation. Washakie map server
Mul -4	1,2 Health & Medical	Create city/County stockpile of PPE as part of a respiratory protection program.	Pandemic/ Epidemic	Multi County Worland Ten Sleep	County EM and Public Health	Short Term	Low	Medium	New in 2021
Wa -1	1 Food Water Shelter	Public awareness campaign on mitigation efforts related to drought.	Drought	County	County Bureau of Reclamation, NOAA	Annual Implement ation	Low Staff Budget, NOAA	High	Continuing-Ongoing. Public awareness should help to conserve water in times of drought. The Bureau of Reclamation is conducting water supply forecasting and public education. This has been on-going with quarterly updates to councils, water users, mailings, etc.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
Wa -2	1,3,4 Transportation	Road mitigation for paved and unpaved county roads on soils with limited suitability.	Expansive Soils	County	Washakie County, WYDOT	Annual Implement ation	Moderate STIP	Low	Continuing-Ongoing. Identified in 2011 and updated in 2016. Decrease the constant costs to maintain paved roads on limited soil suitability 2014 mag chloride road treatment with dust control – cuts down on need for grading roads WYDOT working on this issue also.
Wa -3*	1,2,3,4 Safety & Security	Continued compliance with NFIP.	Flood	County	County floodplain administrator and elected Officials	Annual Implement ation	Little to No Cost Staff Budget	High	Continuing-Ongoing. Continued compliance with the NFIP will help reduce future flood losses through periodic ordinance update and enforcement, promoting flood insurance, etc.
Wa -4	3,4 Transportation	Replace culverts in areas of repetitive flooding with higher capacity ones, including on roads to Sales Barn (state, city) and South Flat (state).	Flood	County	Washakie County Road & Bridge	Long Term	High FEMA HMA Grants	High	Continuing-Ongoing. County roads wash out nearly every year due to rain and floods. Identified in 2011 but specific areas have not been addressed due to funding limitations.
Wa -5	1,2 Hazardous Materials	H2S training for first responders and City and County employees.	Hazardous Materials	County	Local oil companies. LEPC To help fund employer training (if needed)	Annual Implement ation	Low Company resources, LEPC HMEP Grants $2,600/yr	High	Continuing-Ongoing. H2S training increases awareness of the hydrogen sulfide hazard and may decrease response time to incidents. LEPC can help train people to be aware of the hazard.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
									LEPC purchased DVD video for hazmat library in 2013. Fire and EMS personnel receive training on annual basis
Wa -6	1,2	Winchester River Bottom (fuel reduction).	Wildfires, Flood (Ice Jam)	County	Bureau of Land Mgmt County Fire Warden	Long Term	Moderate NRCS	High	Continuing-Ongoing. Fuel reduction will reduce the likelihood or severity of fires. As of 2016 Russian Olive removal has been ongoing using NRCS funding. A secondary benefit of this program is reduction in ice jam flood potential.
Wa -7	3,4 Safety & Security	Install a river gauge on the Big Horn River after the 15 Mile Creek confluence.	Flood, Dam incidents	County	County EM, USGS	Short Term	Moderate USGS	Low	New in 2021
Wa -8	3,4 Safety & Security	Address sediment issue coming into the Big Horn River (mostly from 15 Mile Creek) that is creating more susceptibility to flooding and ice jams. County takes the lead on sediment issue w/USACE. City would take the lead on levee project.	Flood, Dam incidents	County	County Road and Bridge, Conservation District, County EM, & BLM	Long Term	High FEMA HMA, NRCS, BLM	High	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
Wa -9	3,4 Transportation	Extension of Washakie Avenue from Railway to Highway 20. Extend Washakie Avenue west across Big Horn River with new bridge. Provides alternate river crossing and flood mitigation at Railway and Washakie. Currently in STP for 2025 project completion.	Flood, Dam incidents	County	County Road & Bridge/WYDOT	Long Term	High FEMA HMA, general funds	Low	New in 2021
Wa -10	2,3 Energy	Acquire a backup server for County to improve redundancy and resiliency for cyber incidents.	Cyber	County	County IT	Short Term	Moderate	High	New in 2021
Wa -11	2,3,4 Transportation Safety & Security	Continue various fuel reduction projects to mitigate wildfires: 10 Mile Russian Olive removal (ongoing). Row disking between Worland and Ten Sleep (Blue Bank Rd.). North & South of Highway 16, approximately 4.5 miles each.	Wildfire, Flood, Drought	County	BLM, County	Short Term	High BLM	Medium	New in 2021
Wa -12	1 Food, Water, Shelter	Create a stockpile of blankets, cots, MREs, and other supplies for a critical incident.	All Hazards	County	County EM and other county depts	Short Term	Low	Low	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
Wo -1	3,4 Food Water Shelter	Replace existing city water line. 21 miles of water line to access well water transverses areas of very fine grain "blow sand" which drastically loses shear strength when saturated.	Expansive soils	Worland	Worland City Safety Director	Short Term	High Grant funding from the state or federal govt.	Low	Continuing-Ongoing. Existing line is vulnerable to expansive soils. Loss of water service creates threat to life and safety, including lack of water for firefighting, and causes economic loss when businesses are required to shut down. Only maintenance has been done since 2011. Priority in 2016 changed from medium to low as the City now has over 2 mgd backup capacity through their participation in the Big Horn Regional system.
Wo -2	2,3,4 Transportation	Sage Creek Flood Control.	Flood	Worland	County City of Worland, NOAA	Short Term	Moderate FMA	High	Continuing-Ongoing. County and City of Worland are working on funding for a joint project to rebuild Washakie Avenue which could include Sage Creek flood control items. There is also a potential bridge and road extension project which could also include Sage Creek flood control items.
Wo -3*	1,2,3 Safety & Security	Continued compliance with National Flood Insurance Program.	Flood	Worland	Worland Floodplain Administrator	Annual Implementation	Little to no cost Staff Budget	High	Continuing-Ongoing. Continued compliance with the NFIP will help reduce future flood losses through

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
									periodic ordinance update and enforcement, promoting flood insurance, etc. Added as specific project in 2011. See related projects on map update, flood insurance promotion.
Wo -4	1,2 Safety & Security	Public awareness of flood insurance availability.	Flood	Worland County	City and County Planning Offices, Mortgage Lenders, State OHS	Annual Implement ation	Little to no cost Staff Budget	High	Continuing-Ongoing.
Wo -5	2,4 Safety & Security, Hazardous Materials	Relocate fire station out of hazmat risk area.	Hazardous Materials	Worland	Worland Fire District	Short Term	High	High	Continuing-Ongoing. Facility's proximity to railroad line places it at risk of exposure to hazardous material incidents. All hazmat response is in this building.
Wo -6	2,3,4 Transportation	Establishment of alternate truck bypass route – "North Worland Project".	Hazardous Materials	Worland	Worland Board of Adjustment and Planning WYDOT	Short Term	High	High	Continuing-Ongoing. Bypass routes can reduce the potential for accidents because they avoid high traffic and densely populated areas. Wydot has a project in the STIP for FY2025 to add a bridge across the river aligned with Washakie Ave-$5.7 million (Pete Hallsten, WYDOT)
Wo -7	3,4	Put backflow prevention devices ("duckbill"	Flood	Worland	Worland Public Works	Short Term	Moderate	High	Continuing-Ongoing.

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
	Food Water Shelter, Transportation	check valves) on the Worland storm sewer outlets, starting with the three draining into the Big Horn River (between old and new bridge).							
Wo -8	3,4 Safety & Security	Bank stabilization project along west side of Riverside Park. Erosion caused by prior flood damage and flow diversion from former sediment island in river.	Flood, Dam incidents	Worland	Worland Public Works	Long Term	High NRCS, BLM, FEMA HMA	Medium	New in 2021
Wo -9	2,3,4 Safety & Security	Conduct a feasibility study regarding a levee along the river near Riverside Park to create a more permanent solution to the temporary jersey barrier measures.	Flood, Dam incidents	Worland	Worland Public Works, County EM, USACE	Long Term	Very High FEMA HMA, USACE	Medium	New in 2021
Wo -10	3,4 Safety & Security, Food Water Shelter	Sewer line/lift station improvements in flood boundary for Big Horn River.	Flood, Dam incidents	Worland	Worland Public Works	Long Term	High, FEMA HMA, general funds	High	New in 2021
Wo -11	3,4 Transportation	Stormwater/flood drainage for ditch along Washakie Avenue from east city line to Sage Creek at 15th street.	Flood, Dam incidents	Worland	Worland Public Works	Long Term	High, FEMA HMA, general funds	Low	New in 2021
Wo -12	3,4	Update and Upgrade SCADA systems for	Cyber	Worland	Worland Public Works	Short Term	Moderate	Medium	New in 2021

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
	Safety & Security	security, control, and monitoring of Worland Water and Sewer systems.							
TS-1*	1,2,3 Safety & Security	Continued compliance with NFIP.	Flood	Ten Sleep	Ten Sleep Elected Officials	Annual Implementation	Little to no cost Staff Budget	High	Continuing-Ongoing Continued compliance with the NFIP will help reduce future flood losses through periodic ordinance update and enforcement, promoting flood insurance, etc. Added as specific project in 2011 Ongoing See related projects on, flood insurance promotion Ten Sleep experienced floods in 2012 and 2014 and continues to participate in the program.
TS-2	1 Safety & Security	Hazard awareness for residents of Canyon Creek Country cabin development, Big Horn River Bottom, Canyon Creek Village	Wildfires	Ten Sleep County	Bureau of Land Mgmt County Fire Warden, Ten Sleep Fire Dept	Annual Implementation	Low Staff Budget	High	Continuing-Ongoing Drought conditions, vegetation, and terrain place area at high risk of fire. Updated in 2011 to include Big Horn River Bottom and Canyon Creek Village. Some aspects of this project have been completed including Firewise workshops. NOAA has Wildfire Ready awareness program materials Firewise grant put in place; Firewise position hire 2013; A

ID	Goal(s) and Lifelines	Action Description	Hazard(s) Mitigated	Jurisdiction	Lead Agency and Partners	Timeline	Cost Estimate and Potential Funding	Priority	Status/ Implementation Notes
									Type I and a Type IV fire engine have been placed at Canyon Creek Country as of 2015.
TS-3	1,2,3 Safety & Security	Update Community Wildfire Protection Plan and integrate with the Hazard Mitigation Plan when funding is secured.	Wildfire	Ten Sleep, Worland	County Fire Warden, Worland Fire District, Ten Sleep Fire District, State Forestry, BLM	Short Term	Moderate FEMA HMA Grants	Medium	Continuing-Ongoing. Revised in 2016. Continuation of CWPP Planning will identify potential means of preventing and/or responding to wildland/urban interface fires.
TS-4	3,4 Safety & Security	Acquire services/equipment to backup and protect files, etc. remotely.	Cyber	Ten Sleep	Ten Sleep Administration	Short Term	Moderate	Low	New in 2021
TS-5	2,3 Communications	Install another siren in Ten Sleep.	Tornado	Ten Sleep	Ten Sleep Administration	Short Term	Moderate FEMA HMA Grants	Medium	New in 2021
TS-6	2,3,4 Safety & Security	Explore potential solutions to address repetitive flooding on Ten Sleep Creek	Flood, Dam incidents	County, Ten Sleep	County Road and Bridge, WYDOT	Short Term	Moderate FEMA HMA Grants	Low	New in 2021

8 Implementation

Moving forward the County HMPC will use the mitigation action table in the previous section to track progress on implementation of each project. As noted in the action table Status Update column much progress has been made since the plan was originally developed in 2007. Implementation of the plan overall is discussed in Chapter 6.

8.1 Incorporation into Existing Planning Mechanisms

Also discussed in Chapter 6 is the importance of implementation and incorporation of the principles of this plan into other planning mechanisms.

As described in the capability assessment, the County and municipalities 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 or community comprehensive plans
- County or community development codes
- County or community Emergency Operations Plans
- Threat and Hazard Identification and Risk Assessments (THIRA)
- Community Wildfire Protection Plan (CWPP)
- 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
- WYDOT rockfall and landslide mitigation efforts
- Other plans, regulations, and practices with a mitigation aspect

During the 2021 planning process the HMPC discussed the importance of coordinating the mitigation plan with other planning processes, and vice versa. To date the plan has not been integrated with other planning efforts but a process to do so with the 2022-2027 plan is outlined in Chapter 6. The County Comprehensive Plan is a possibility for integrating the HMP, as is the next update of the Community Wildfire Protection Plan once funding is secured.