Montezuma County Multi-Jurisdictional

Hazard Mitigation Plan

September 2020

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1 Introduction

1.1 Purpose

Montezuma County, Colorado, including the participating jurisdictions of the City of Cortez, Town of Dolores, Town of Mancos, and the Cortez Fire Protection District have prepared this local hazard mitigation plan to guide hazard mitigation planning to better protect the people and property of the County from the effects of hazard events. This plan demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This plan was also developed to make Montezuma County and the participating jurisdictions eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) and Building resilient Infrastructure and Communities (BRIC) program, as well as to make the County and jurisdictions more disaster resistant. This plan demonstrates the 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: 2017 Interim 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 Montezuma County's hazard mitigation planning process, identifies relevant hazards and risks and identifies the strategy the County and the participating jurisdictions will use to decrease vulnerability and increase resiliency and sustainability.

This plan underwent a comprehensive update in 2020 in fulfillment of the five-year update requirement. Several factors initiated this planning effort:

- Montezuma County is exposed to hazards that have caused past damage.
- Limited local resources make it difficult to be pre-emptive in reducing risk. Eligibility for federal financial assistance is paramount to promote successful hazard mitigation in the area.
- Montezuma County and its partners participating in this plan want to be proactive in preparing for the probable impacts of natural hazards.

This plan was originally prepared in 2015-2016, 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 went through a plan update process in 2020. Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act, or 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 Montezuma County planning and response 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 Montezuma County 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.

This hazard mitigation plan identifies resources, information, and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. This plan will help guide and coordinate mitigation activities throughout the planning area. The plan was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to use federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Montezuma County hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the county and puts all partners on the same planning cycle for future updates.
- Meet the planning requirements of FEMA's Community Rating System (CRS), allowing planning partners that may choose to participate in the CRS program to enhance their CRS classifications.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.

1.3 Multi-Jurisdictional Planning

All citizens and businesses of Montezuma County are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the county. It provides a viable planning framework for all foreseeable natural hazards that may impact the county. Participation in development of the plan by key stakeholders in the county helps ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide, and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

The Montezuma County Hazard Mitigation Plan is a multi-jurisdictional plan that geographically covers everything within Montezuma County's jurisdictional boundaries (hereinafter referred to as the planning area). Unincorporated Montezuma County and the following communities and a special district participated in the 2020 update planning process:

- Montezuma County

- City of Cortez
- Town of Dolores
- Town of Mancos
- Cortez Fire Protection District*

*New participating jurisdiction in 2020

1.4 Plan Organization

The Montezuma County Hazard Mitigation Plan is organized as follows:

- Chapter 1: Introduction
- Chapter 2: Planning Process
- Chapter 3: Community Profile
- Chapter 4: Hazard Identification and Risk Assessment (HIRA)
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption, Implementation and Maintenance
- Appendix A: Acronyms and Definitions
- Appendix B: References
- Appendix C: Planning Committee Members
- Appendix D: Menu of Mitigation Alternatives
- Appendix E: Plan Adoptions and Approval
- Appendix F: Planning Process and Public Outreach Documentation

2 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.*

2.1 Background on Mitigation Planning in Montezuma County

Montezuma County originally developed this Hazard Mitigation Plan (HMP) in 2015-2016. The plan underwent a comprehensive update in 2020 to comply with the five-year update cycle required by the DMA 2000. The planning process and update of this plan was originally initiated in early 2020 under the coordination of the Montezuma County Emergency Manager. Funding was secured through a FEMA Pre-Disaster Mitigation planning grant to enable a consultant to be hired to facilitate the process and develop the plan. Wood Environment and Infrastructure Solutions Inc. (Wood) of Denver, Colorado contracted with the County to provide professional planning services during the development of the original plan. The update of the plan followed a structured planning process that involved various local government departments and other public and private stakeholders. The planning process is described further in this section and documented in Appendix F.

2.1.1 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 initial 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.

2.1.2 2016 Plan Section Review and Analysis

During the 2020 update process, the Hazard Mitigation Planning Committee (HMPC) updated each section of the previously approved plan to include new information and improve the organization and formatting of the plan's contents. The HMPC and Wood analyzed each section using FEMA's local plan update guidance to ensure that the plan met the latest requirements. Upon review the HMPC and Wood determined that nearly every section of the plan would need some updates to align with the latest FEMA planning guidance and requirements. The overall format and structure of the plan changed to align the plan with modern hazard mitigation planning practices and to simplify the document from 19 chapters to six. The Risk Assessment in Section 4 was substantially revised to incorporate recent events and reflect recent development trends with an updated GIS-based risk assessment. Information within has been updated throughout the plan where appropriate. The mitigation strategy in Section 5 has been updated to reflect current priorities and mitigation actions moving forward from the 2016 plan.

2.2 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 Montezuma County Hazard Mitigation Plan's HMPC, "participation" meant:

- Attending and participating in the HMPC meetings,
- Providing available data requested of the HMPC,
- Reviewing and providing comments on the plan drafts,
- Advertising, coordinating, and participating in the public input process, and
- Coordinating the formal adoption of the plan by the governing boards.

Montezuma County's Hazard Mitigation Plan is a multi-jurisdictional plan that geographically covers everything within Montezuma County, as described further in Chapter 3 Community Profile. Unincorporated Montezuma County, City of Cortez, Town of Dolores, Town of Mancos and the Cortez Fire Protection District participated in the planning process and are seeking FEMA approval of this plan. The County and municipalities have the authority to regulate development.

2.3 Planning Process

Montezuma County and Wood worked together to establish the planning process for Montezuma County's plan update using the DMA planning requirements and FEMA's associated guidance. The original FEMA planning 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

FEMA's March 2013 Local Mitigation Planning Handbook recommends a nine-step process within the original four phase process. 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 programs. Thus, the modified 10-step process used for this plan meets the funding eligibility requirements of the Hazard Mitigation Assistance grants (including Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities grant, High Hazard Potential Dams grant, and Flood Mitigation Assistance grant), Community Rating System, and the flood control projects authorized by the U.S. Army Corps of Engineers (USACE). Table 2-1 summarizes the four-phase DMA process, the detailed CRS planning steps and work plan used to develop the plan and the nine handbook planning tasks from FEMA's 2013 Local Mitigation Planning Handbook. The sections that follow describe each planning step in more detail.

Table 2-1 Mitigation Planning Process Used to Update the Plan

FEMA's 4-Phase DMA Process	Modified 10-Step CRS Process	FEMA Local Mitigation Planning Handbook Tasks
1) Organize Resources		
201.6(c)(1)	1) Organize the Planning Effort	1: Determine the planning area and resources
201.6(b)(1)	2) Involve the Public	2: Build the planning team - 44 CFR 201.6 (C)(1)
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies	3: Create an outreach strategy - 44 CFR 201.6(b)(1)
		4: Review community capabilities - 44 CFR 201.6 (b)(2)&(3)
2) Assess Risks		
201.6(c)(2)(i)	4) Identify the Hazards	5: Conduct a risk assessment - 44 CFR 201.6 (C)(2)(i) 44 CFR 201.6(C)(2)(ii)&(iii)
201.6(c)(2)(ii)	5) Assess the Risks	
3) Develop the Mitigation Plan		
201.6(c)(3)(i)	6) Set Goals	6: Develop a mitigation strategy - 44 CFR 201.6(c)(3)(i); 44 CFR 201(c)(3)(ii) and 44 CFR 201.6(c)(3)(iii)
201.6(c)(3)(ii)	7) Review Possible Activities	
201.6(c)(3)(iii)	8) Draft an Action Plan	
4) Implement the Plan and Monitor Progress		
201.6(c)(5)	9) Adopt the Plan	7: Review and adopt the plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan	8: Keep the plan current
		9: Create a safe and resilient community - 44 CFR 201.6(c)(4)

2.3.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

Wood worked with the Montezuma County Emergency Manager to establish the framework and organization for the update of this Plan. Wood and the County Emergency Manager identified the key county, municipal, and other local government and initial stakeholder representatives. Invitations were

emailed to invite them to participate as a member of the HMPC and to attend a kickoff meeting. Representatives from the following County and the departments and boards as well as special districts participated on the HMPC and the development of the plan:

Montezuma County

- County Administration
- County Emergency Manager
- Public Health Director
- Public Health Emergency Manager
- Public Information Officer
- Planning Department Director
- Natural Resources Director
- Sheriff
- Undersheriff
- CSU Extension Office Director
- Geographic Information Systems
- County Commissioner
- County Landfill

City of Cortez

- City Manager
- Police Department – Police Chief
- Parks & Recreation Director
- Marketing and Events Manager

Town of Dolores

- Mayor
- Town Administrator
- Building Inspector

Town of Mancos

- Town Administrator
- Town Marshal
- Fire Chief

Cortez Fire Protection District

- District Chief
- Lieutenant
- Community Outreach

A list of specific HMPC representatives is included in Appendix C. Other local, state, federal, and private stakeholders invited to participate in the HMPC are discussed under Planning Step 3.

During the plan update process, the HMPC communicated with a combination of face-to-face meetings, online webinars, phone interviews, and email correspondence. Three planning meetings with the HMPC were held during the plan's development between March 2020 and June 2020. The meeting schedule and topics are listed in the following table. The meetings were held as a combination of in person and webinars due to the global COVID-19 pandemic that required social distancing. The sign-in sheets and agendas for each of the meetings are included in Appendix F.

Table 2-2 Schedule of Meetings

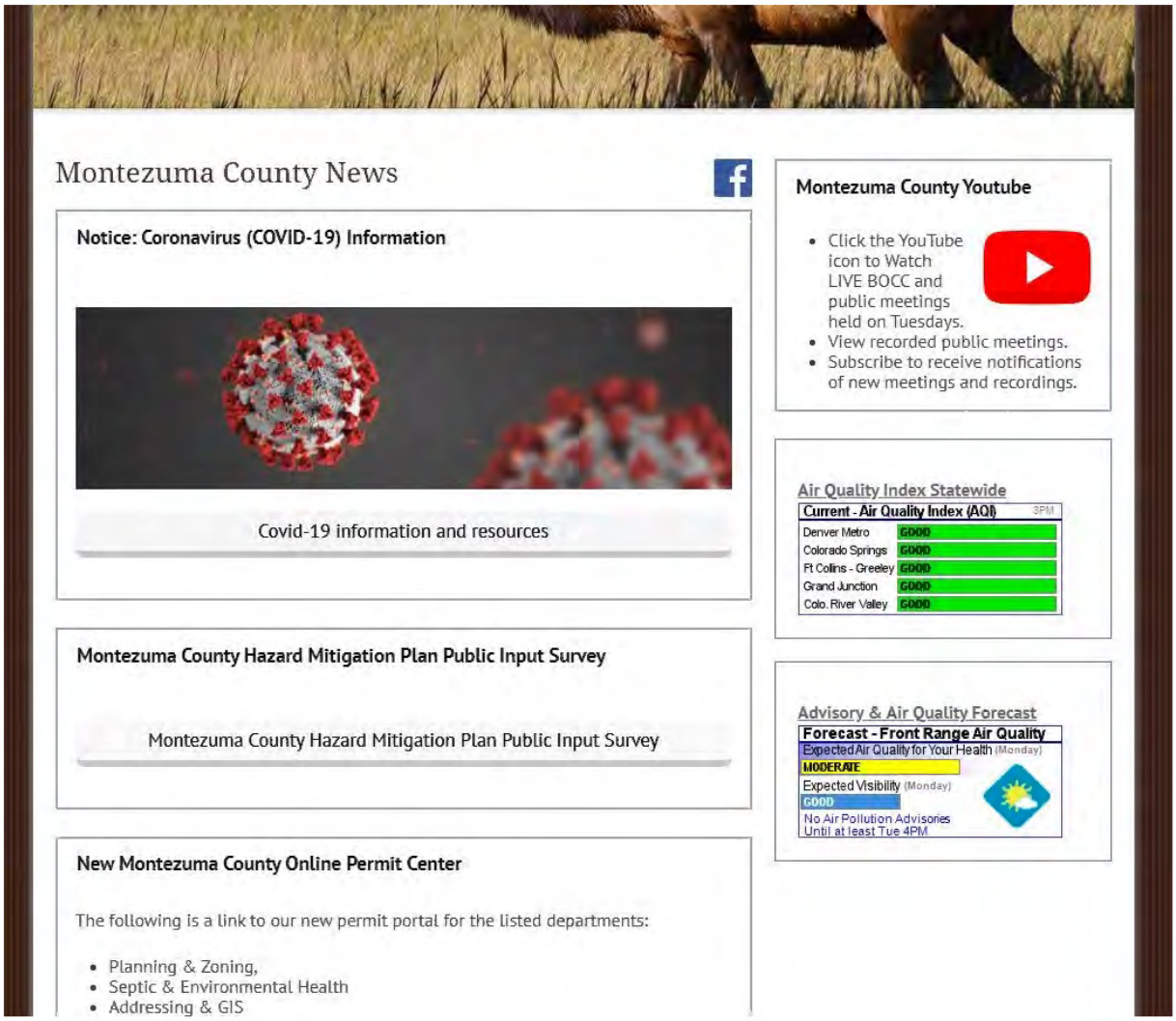
HMPC Meeting	Meeting Topic	Meeting Date
1	Kickoff Meeting: Introduction to DMA Planning and overview of Update Process	March 9, 2020
2	Risk Assessment Summary/Goals Development	May 6, 2020
3	Mitigation Strategy Development	June 4, 2020

During the kickoff meeting, Wood presented information on the scope and purpose of the plan, 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) was discussed. Wood also revisited the hazard identification section of the plan with the HMPC members.

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 the County and participating jurisdictions through social media and posted to the County's website.

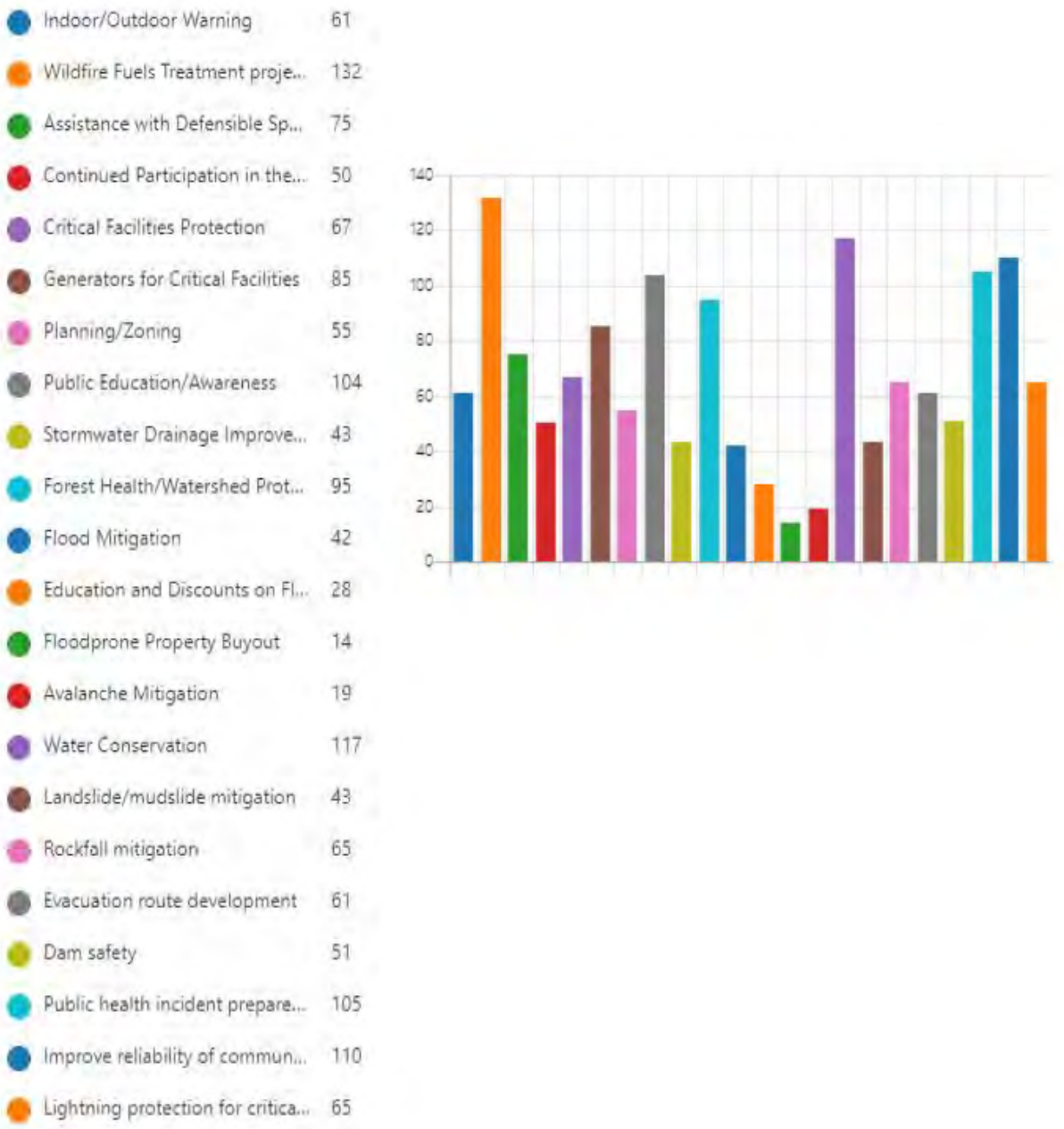
Figure 2-1 Montezuma County Website Notice of Public Survey



The survey provided an opportunity for public input during the planning process, prior to finalization of the plan update. The public survey received responses from 180 individuals. Responses reflect the public perception that the most significant hazards to be drought, followed by wildfire, severe winter storms, and severe wind.

Figure 2-2 below displays the results from Question 3, which asked respondents to consider potential mitigation actions and to indicate which types of actions should have the highest priority in the updated County Mitigation Strategy. These results were considered during the planning process and in the development of new mitigation actions. As indicated by the survey excerpt below, the highest priority action items should include wildfire fuels treatment projects (132 responses), water conservation treatment (117 responses),improve reliability of communication systems (110 responses), public health incident preparedness (105 responses) and public education/awareness (104 responses). Further results of the public survey are provided in Appendix F.

Figure 2-2 Montezuma County Public Survey Results, Question 3



The public was given an opportunity to review and comment on the draft plan in August 2020. Montezuma County made copies of the plan available on the County website and a hardcopy was made available at the Cortez Public Library by appointment only due to the COVID-19 pandemic. A public input comment form was available with the online plan. The plan was advertised by the County through their Facebook, Twitter and the County website. The public was given a two-week period to review and provide comments. In total three individuals responded to the online public input form, one identified as a member of the public and the others as part of local government and state or federal government. The public review produced two set of comments left on the online comment form. As a result of the review and comments an additional multi-jurisdictional plan was referenced (Dolores River Emergency Alert and Notification Plan, 2016). There were also suggestions for additional details on the Wildland Urban

Interface on the maps; these can be referenced in the County's Community Wildfire Protection Plan, which will also be undergoing an update in 2020. Another comment suggested adding more emphasis on water quality. The HMPC felt that the plan already specifies which hazards can affect water quality, namely drought and wildfire, and that other planning mechanisms more appropriately focus on the issue. In addition the Empire Electric Association, Inc provided an email with review comments, in addition to a mark-up of the draft with suggested edits. This resulted in several edits to Chapter 4 to ensure hazard impacts to power infrastructure was captured more thoroughly, where applicable. The Empire Electric Association also noted their interest in supporting some of the specific goals, objectives, and mitigation actions detailed in this plan, indicating they align with the Association's resiliency and mitigation efforts. Record of public advertisements, public input, and sign-in sheets can be found in F.

Planning Step 3: Coordinate with Other Departments

There are numerous organizations whose goals and interests interface with hazard mitigation in Montezuma County. Coordination with these organizations and other community planning efforts is vital to the success of this plan's update and implementation. The HMPC determined that data collection, mitigation strategy development, and plan approval would be greatly enhanced by inviting state and federal agencies and power and communications organizations to participate in the process. An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities was provided either through invitation to meetings, phone and email communication during the process, or provided an opportunity to review and comment on the plan prior to finalization. The following agencies were reached out to during the planning process. Some were present at HMPC meetings (indicated by an Asterix) and/or supplied information to the HMPC that was used to inform the risk assessment. Neighboring jurisdictions were asked to comment on the plan prior to its finalization.

State and Federal Agencies

- Colorado Department of Transportation* - Supervisor
- Colorado Department of Local Affairs – Field Manager
- Colorado Division of Homeland Security and Emergency Management*
- Colorado Division of Fire Prevention & Control
- Colorado Division of Water Resources
- Colorado State Patrol
- Colorado State Forest Service*
- Colorado State University Extension Office*
- US Army Corps of Engineers
- US Bureau of Land Management*
- US Bureau of Reclamation
- US Department of Agriculture*
    - Natural Resources Conservation Service
    - Farm Service Agency
- US National Forest
    - San Juan National Forest – Mancos/Dolores Ranger District
- Environmental Protection Agency

Special Districts

- Mancos School District
- Montezuma-Cortez School District

- Dolores School District
- Mancos Water Conservancy District
- Dolores Water Conservancy District
- Pleasant View Fire Department
- Westfork Volunteer Fire Department
- San Juan Basin Public Health

Non-profit

- Dolores Watershed Resilient Forest
- Salvation Army
- American Red Cross
- Fire Adapted Colorado
- Montezuma County Search and Rescue
- Montezuma County Firewise
- Wildfire Adapted Partnerships

Local Business and Industry

- Empire Electric Association, Inc.
- La Plata Electric Association, Inc.
- Local Emergency Planning Committee
- Montezuma Valley Irrigation
- Southwest Center for Independence
- Tri-State Generation & Transmission
- Cortez Journal
- Williams Pipeline, Inc.
- Kinder Morgan, Inc.
- Axis Health Systems

Neighboring Jurisdictions

- Archuleta County
- Dolores County* - Emergency Manager
- La Plata County
- San Juan County
- San Juan County, New Mexico
- San Miguel County
- Southern Ute Indian Tribe
- Ute Mountain Ute Tribe

Integration with Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is also paramount to the success of this plan. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability from natural hazards. Montezuma County uses 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. Table 2-3 below provides a summary of the key existing plans, studies, and reports that were reviewed during the update process. Information on how they informed the update are noted where applicable.

Table 2-3 Summary of Key Plans, Studies and Reports

Plan, Study, Report Name	How Plan, Study or Report Informed the HMPC
Montezuma County Community Wildfire Protection Plan (2012)	Reviewed information on past wildfires and wildfire risk to inform the risk assessment
Colorado State Hazard Mitigation Plan (2018 Update)	Reviewed information on past hazard events and hazard risk information to inform the risk assessment Reviewed State goals and objectives
Colorado Drought Mitigation and Response Plan (2018 Update)	Reviewed information on pasts droughts and their impacts on the planning area. Incorporated information into the risk assessment
Colorado Flood Mitigation Plan (2018 Update)	Reviewed information on past flood events and risk analysis for the planning area to inform the risk assessment
Colorado State Demographer Community Demographic Profiles (ACS 5-Year Estimates 2014-2018)	Provide demographic data and trends for Montezuma County and incorporated jurisdictions.
FEMA Flood Insurance Study for Montezuma County and Incorporated Jurisdictions. (2008)	Provided flood risk data for specific hazard areas located within the County.
Comprehensive Plans: Montezuma County (1996), City of Cortez (2008), Town of Mancos (2011), Town of Dolores (1997)	Informed the Community Profile and capability assessments.
Ute Mountain Ute Tribal Hazard Mitigation Plan (2019)	The Ute Mountain Ute Tribe is located in southwestern Montezuma County; the recently updated plan informed the risk and vulnerability assessments where applicable.
The Journal, Cortez	The local newspaper located in the City of Cortez provide background information on past hazard events.
USDA Risk Management Agency Crop Indemnity Reports (2007-2019)	Provided data related to crop losses due to drought and hail.

Integration of 2016 Plan into Other Planning Mechanisms

In addition, the 2016 Hazard Mitigation Plan was incorporated into several County plans and planning mechanisms, including the County's Emergency Operations Plan (EOP) and adopted by reference in the County's Community Wildfire Protection Plan (CWPP). The Town of Mancos uses the 2016 Hazard Mitigation Plan as a reference document and training tool for the Town's Planning Commission. The Town references the HMP where necessary when adopting or readopting any community plans and codes.

The City of Cortez and Town of Dolores did not integrate the 2016 Hazard Mitigation Plan into existing planning mechanisms. Both jurisdictions are in the process of updating their planning documents in 2020 and making an effort to incorporate the 2020 Hazard Mitigation Plan Update into their documents.

2.3.2 Phase 2: Assess Risks

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

Chapter 4, Risk Assessment is the result of a comprehensive effort to identify and document all the hazards that have, or could, impact the planning area. This section was updated to reflect recent hazard events and current assets within the County and jurisdictions. Where data permitted, Geographic Information Systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. The

HMPC conducted a capability assessment update 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. A more detailed description of the risk assessment process and the results are included in Chapter 4. The capability assessment is included in Chapter 3 Community Profile.

2.3.3 Phase 3: Develop the Mitigation Plan

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

Wood facilitated a brainstorming and discussion session with the HMPC during their second webinar to update the goals and objectives from the 2016 plan. During the third HMPC webinar/meeting Wood facilitated a discussion session with the HMPC around a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This included a review of progress on each action identified in the 2016 plan. Some new mitigation actions resulted from this process that were added to the plan in 2020. This process and its results are described in greater detail in Chapter 5.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, Wood produced a complete first draft of the plan. This complete draft was shared electronically for HMPC review and comment. 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 Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA Region VIII to review and approve, contingent upon final adoption by the governing boards of each participating jurisdiction.

2.3.4 Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

To secure buy-in and officially implement the plan, the plan was adopted by the governing boards of each participating jurisdiction on the dates included in the adoption resolutions in Appendix E.

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

The HMPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time. A discussion on the progress with implementation is included in Chapter 5. Each recommended action includes key descriptors, such as a lead manager and possible funding sources, to help initiate implementation. An overall implementation strategy is described in Chapter 6.

Finally, there are numerous organizations within the Montezuma County 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 Montezuma County and is addressed further in Chapter 6. An updated overall implementation strategy and maintenance and a strategy for continued public involvement are also included in Chapter 6.

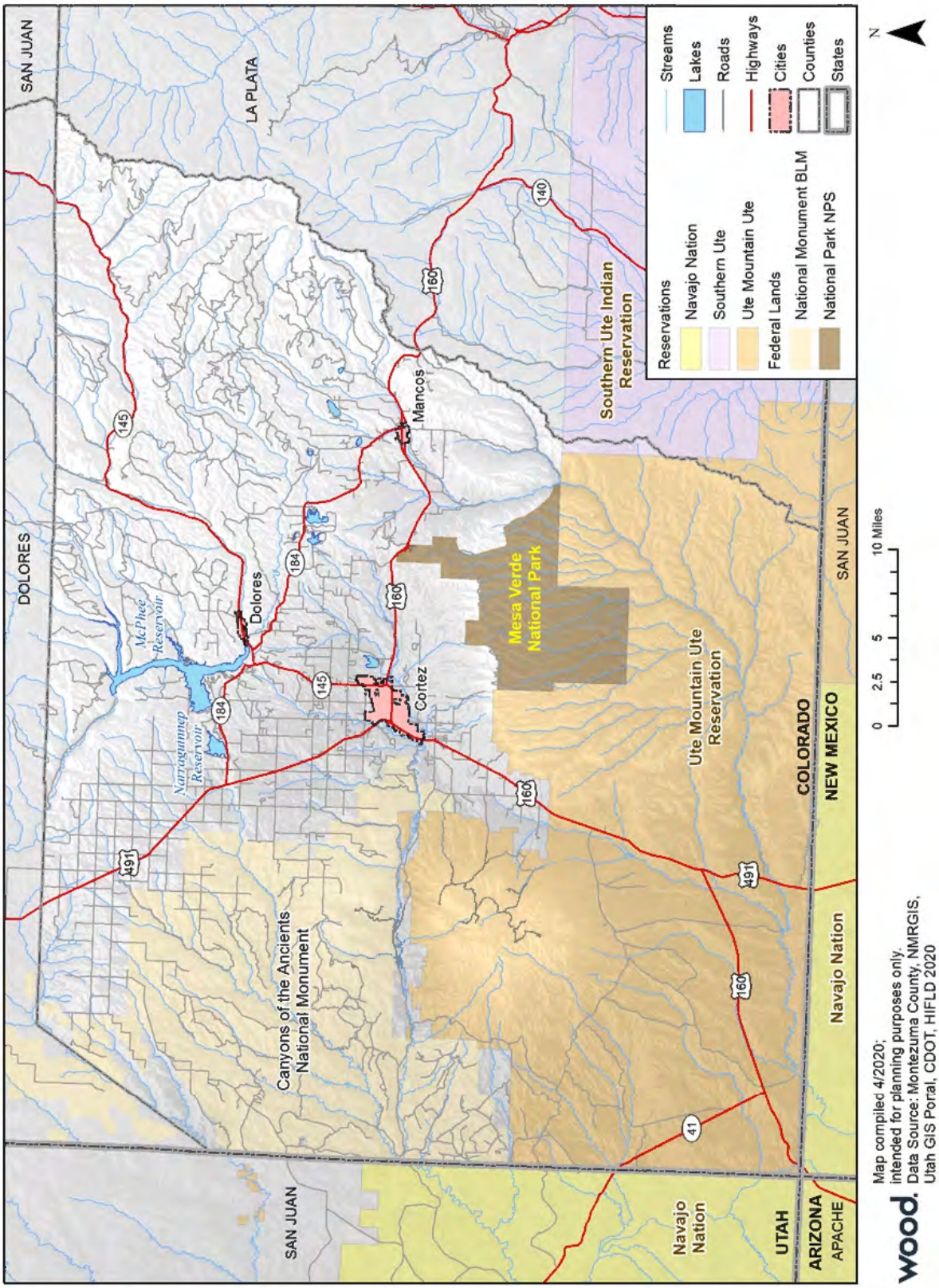
3 Community Profile

Montezuma County covers approximately 2,000 square miles in southwest Colorado. It is the southwestern-most county in Colorado (Refer to Figure 3-1). The elevation of Montezuma County is between approximately 6,000 feet to more than 14,000 feet above mean sea level. There are three incorporated municipalities in Montezuma County, the City of Cortez, the Town of Dolores, and the Town of Mancos, and many unincorporated communities, including Towaoc, Lewis, Arriola, Mesa Verde, Lebanon, Stoner, Weber, and Battle Rock. Cortez is the largest city in the county and is the county seat. The City of Cortez is located in the center of the county and the Towns of Dolores and Mancos are located north and east of Cortez. The county includes many national protected areas including Mesa Verde National Park, Canyons of the Ancients National Monument, Yucca House National Monument, and Hovenweep National Monument.

Montezuma County is the 21st most populous of Colorado's 64 counties, with a 2018 population of 26,155. The county is served by U.S. Highways 160 and 491, and by Cortez Municipal Airport. It has no rail service, although both Mancos and Dolores were established as railroad towns in the 1890s.

Mesa Verde National Park, Canyons of the Ancients National Monument, and Yucca House National Monument preserve hundreds of ancient Native American structures, including the famous cliff-dwellings in Mesa Verde National Park. Montezuma County is also home to most of the Ute Mountain Ute Reservation, which comprises 33% of the county. The remaining area of the county is split between private land (30%) and state and federal land (37%), which is administered by the State of Colorado, National Park Service, the U.S. Forest Service (USFS), and the Bureau of Land Management (BLM). The county has the second largest reservoir in Colorado (McPhee Reservoir) and many other large reservoirs, and hundreds of private lakes and ponds. Much of the county is irrigated cropland, and it produces fruit, cattle, sheep, and beans.

Figure 3-1 Montezuma County Planning Area



3.1 Historical Overview

According to the Cortez Area Chamber of Commerce, Montezuma County has been settled since approximately 600 A.D., and had an estimated population of approximately 100,000, four times its current population, in the 12th century. However, a series of events caused virtually all permanent settlements to be abandoned between 1200 and 1300, and the area to be contested between nomadic Ute and Navajo bands until resettlement occurred in the 1870s. Montezuma County was created out of the western portion of La Plata County by the Colorado Legislature in April 1889. It was named in honor of a famous chief of the Aztec Indians in Mexico, Montezuma II. The building ruins in Mesa Verde National Park were thought to be of Aztec origin at the time.

The City of Cortez was built in 1886 to provide housing for men working on tunnels and irrigation ditches required to divert water out of the Dolores River and into Montezuma Valley. The town was named for Spanish conquistador Hernán Cortés. Cortez was incorporated into Montezuma County in 1902.

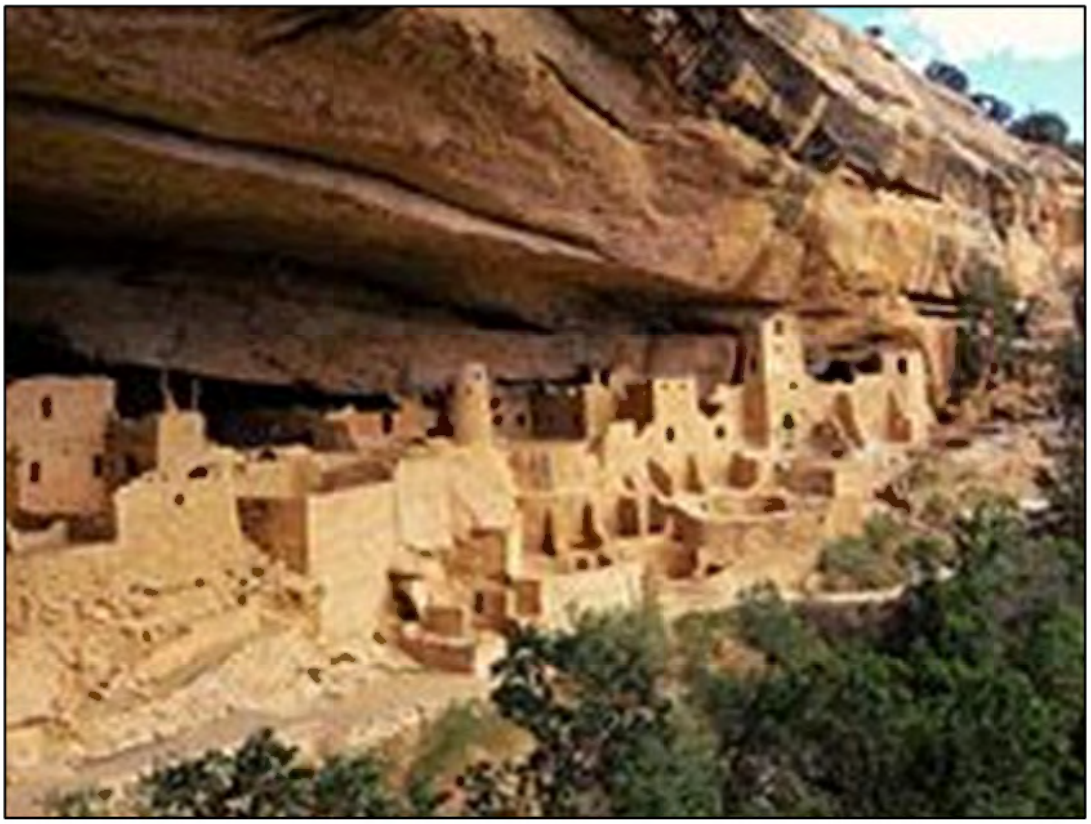
The Town of Dolores (Spanish for "sorrows" and named for the river on which it is located) is located at the mouth of the Dolores Valley and the upper reaches of McPhee Reservoir, approximately 40 miles from the Four Corners Monument. Established as a station on the Rio Grande Southern Railroad, Dolores replaced the earlier town, Big Bend, now covered by McPhee Reservoir. McPhee Reservoir is Colorado's second largest Reservoir.

The Mancos Valley has been settled since at least the 10th century, although various severe conditions in the mid to late 13th century saw the area and its multitude of small villages abandoned by the Ancient Pueblo People (Anasazi). The Mancos area is dotted with inventoried and uninventoried archeological sites, including both isolated houses and shelters and small village complexes. Part of the original Ute Mountain Ute Reservation in 1868, Mancos was part of the San Juan Cession of 1873, and cattle ranchers began settling the Mancos Valley in the 1870s, providing cattle to the mining camps of the San Juan and La Plata ranges. Today, the boundary of the Ute Mountain Ute Reservation is located approximately 6 miles south of town. At the time it was founded, Mancos served as the primary commercial trading center for eastern Montezuma County, rivaling the Town of Dolores to the northwest. At that time, Cortez, now the county seat, was not yet established. In the 1890s, Mancos was platted and built as a stop along the Rio Grande Southern Railway built by Otto Mears - Colorado's southwestern railroad pathfinder, connecting Durango to the east, and the Telluride mining district to the north, via Dolores. Ranchers in the Mancos Valley provided beef, timber, and other agricultural products to the mining camps. Latter-day Saints colonists moved into the area and established farms and small communities such as Weber and Cherry Creek.

Local farmers and ranchers began constructing irrigation canals to bring water from the Mancos River to cropland and pasture in various parts of the Mancos Valley in the late 1870s and 1880s, and by the beginning of the 20th century a large network of irrigation ditches and laterals was operating and continues to operate (with improvements) today.

Mesa Verde National Park was created by President Theodore Roosevelt in 1906. It occupies 52,485 acres near the Four Corners region and with more than 4,000 sites and 600 cliff dwellings. It is the largest archeological preserve in the nation. Mesa Verde (Spanish for "green table") is best known for structures such as Cliff Palace, thought to be the largest cliff dwelling in North America (Figure 3-2).

Figure 3-2 Cliff Palace in Mesa Verde National Park



Source: Uploaded to Wikipedia by Rationalobserver, June 13, 2015

3.2 Climate

Due to its diverse topography, the climate of Montezuma County is highly varied, and conditions can change quickly. There is also a great variation of weather conditions across the seasons. Average temperature tends to decrease with increases in elevation, roughly 4 degrees Fahrenheit (°F) per 1,000 feet, with subzero temperatures common in winter. The majority of snowfall occurs during December, January, February, and March.

The Western Regional Climate Center (WRCC) reports data summaries from a station in the City of Cortez, at the Cortez Municipal Airport. The City of Cortez gets 13 inches of rain annually and an average of 36 inches of snowfall. Typically, Cortez has 71 days per year of any measurable precipitation, and, on average, there are 240 sunny days per year. Table 3-1 contains temperature summaries for the station. Figure 3-3 graphs the daily temperature averages and extremes.

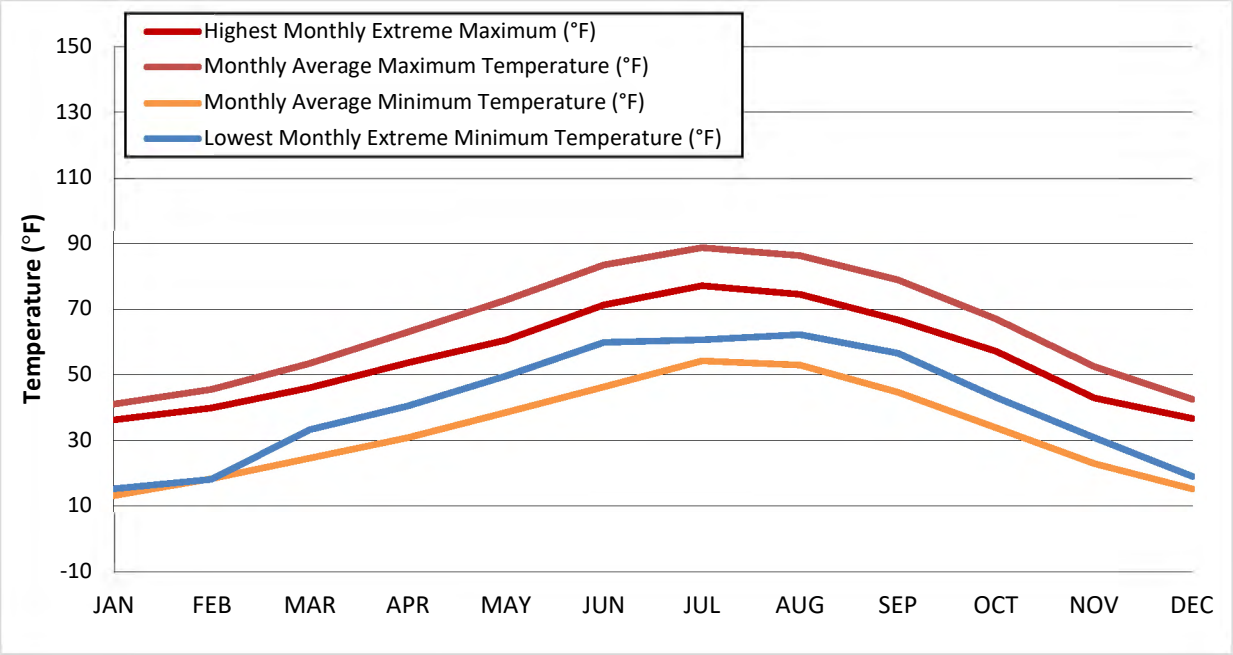
Table 3-1 Montezuma County Temperature Summaries Cortez Station

Period of record	4/1/1911 – 10/31/2012
Winter[a] Average Minimum Temperature[b]	15.6°F
Winter[a] Mean Temperature[b]	29.4°F
Summer[a] Average Maximum Temperature[b]	86.2°F
Summer[a] Mean Temperature[b]	68.7°F
Maximum Temperature	102°F; July 15, 2003
Minimum Temperature	-31°F; February 8, 1933
Average Annual Number of Days >90°F	30.6
Average Annual Number of Days <32°F	190.6

a. Winter: December, January, February; Summer: June, July, August
b. All temperatures are in degrees Fahrenheit (°F)
Source: Western Regional Climate Center, www.wrcc.dri.edu/

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

Figure 3-3 Cortez Station Monthly Temperature Data (4/1/1911-10/31/2012)



3.3 Geology and Soils

Montezuma County varies in elevation from approximately 6,000 feet to more than 14,000 feet above mean sea level and includes climates from the high Colorado Plateau desert to alpine tundra. The county includes the La Plata Mountains and wooded forests in the northeastern portion of the county, prairie, and grassland in the center and west of the county, and Mesa Verde National Park in the south. Much of the topography of the county is defined by the Dolores River in the north and the Mancos River in the central and southern portions of the county. In addition, the county includes several reservoirs and lakes,

including the McPhee Reservoir, Narraguinnep Reservoir, Summit Reservoir, Pruett Reservoir, Bauer Lake, and Totten Lake.

The rock and sandstone formations, including those near cliff dwellings in Mesa Verde National Park, are closely associated with the sandstone of Late Cretaceous age, which weathers to form deep alcoves. Ancient people farmed the thick, red loess (wind-blown dust) deposits on the mesa tops, which because of its particle size distribution has good moisture retention properties. The soil in this loess cover and the seasonal rains allowed these people to grow their crops (corn, beans, and squash) on the broad mesa tops. Today, geology is still an important concern in the Mesa Verde area because the landscape is susceptible to various forms of mass movement (landslides, debris flows, rockfalls), swelling soils, and flash floods that affect the park's archeological sites and its infrastructure (roads, septic systems, utilities, and building sites).

Montezuma County is also made of surficial deposits including: artificial fills, alluvium of small ephemeral streams, alluvium deposited by the Mancos River or Dolores River, residual gravel on high mesas, a combination of alluvial and colluvial deposits, fan deposits, colluvial deposits derived from the Menefee Formation, colluvial deposits derived from the Mancos Shale, rockfall deposits, debris flow deposits, earthflow deposits, translational and rotational landslide deposits, rock rubble deposits, and loess.

3.4 Demographics

Information on population and how it has changed in the past and may change in the future is needed for making informed decisions about the future. Population directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Population changes are useful socio-economic indicators, as a growing population generally indicates a growing economy, and a decreasing population signifies economic decline.

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Select demographic and social characteristics from the U.S. Census Bureau's American Community Survey Five-Year Estimates from 2014 and 2018, for Montezuma County are shown in Table 3-2.

Table 3-2 Montezuma County Demographic and Social Characteristics (2014-2018)

	Montezuma County	Cortez	Dolores	Mancos
Total Population	25,909	8,637	877	1,742
Gender/Age (% of Total Population)				
Male	49.2	50.4	54.8	48
Female	50.8	49.6	46.9	52
Median Age (value)	44.4	35.9	29.9	32.8
Under 5 years	5.9	6.8	9.2	11.3
65 years and over	21	17.1	9.4	15.1

	Montezuma County	Cortez	Dolores	Mancos
Race/Ethnicity (% of Total Population)				
White	83.2	76.9	77.4.4	94.1
American Indian/Alaska Native	13.8	12.7	0	1.3
Asian	0.3	0.4	0	0.5
Black or African American	0.7	0.1	0	0.3
Hawaiian or Pacific Islander	0.1	0	0	0
Other Race	4.0	6.9	2.6	2.5
More Than One Race	2.1	2.9	0.0	1.4
Hispanic or Latinx (of any race)[1]	12.4	17.9	22.6	16.5
Education				
High school graduate or higher (% of Total >25 Population)	89.5	88.3	86.8	92.6

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2014-2018 [1]The 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.

3.4.1 Population Trends

Montezuma County is the 21st most populous of Colorado's 64 counties. Colorado's State Demography Office Affairs estimated Montezuma County's population at 26,155 at the end of 2018. Table 3-3 shows planning area population data from 1990 through 2018.

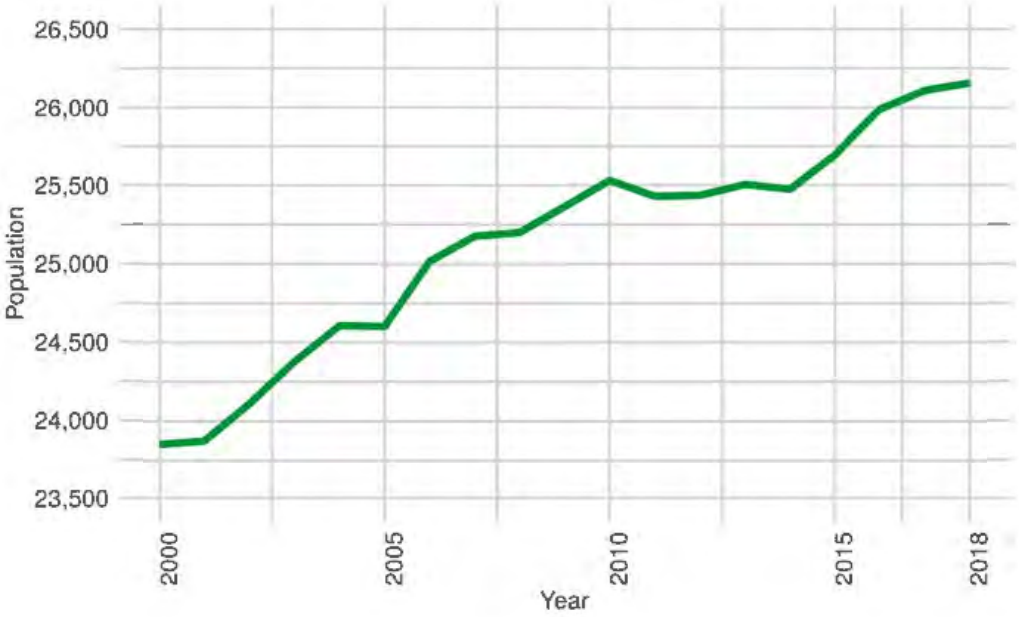
Table 3-3 Montezuma County Population Estimates

	Total Population						
	1990	1995	2000	2005	2010	2013	2018
Cortez	7,284	7,893	8,001	8,273	8,484	8,551	8,765
Dolores	866	914	863	884	936	939	965
Mancos	842	973	1,121	1,188	1,337	1,361	1,421
Unincorporated County	9,680	12,379	13,867	14,258	14,775	14,816	15,004
County Total	**18,672**	**22,159**	**23,852**	**24,603**	**25,532**	**25,667**	**26,155**

Source: Colorado Department of Local Affairs
State Demography Office

Figure 3-4 shows the population change in Montezuma County from 1990 to 2018.

Figure 3-4 Montezuma County Population Growth, 1990-2018



Source: State Demography Office

3.4.2 Age Distribution

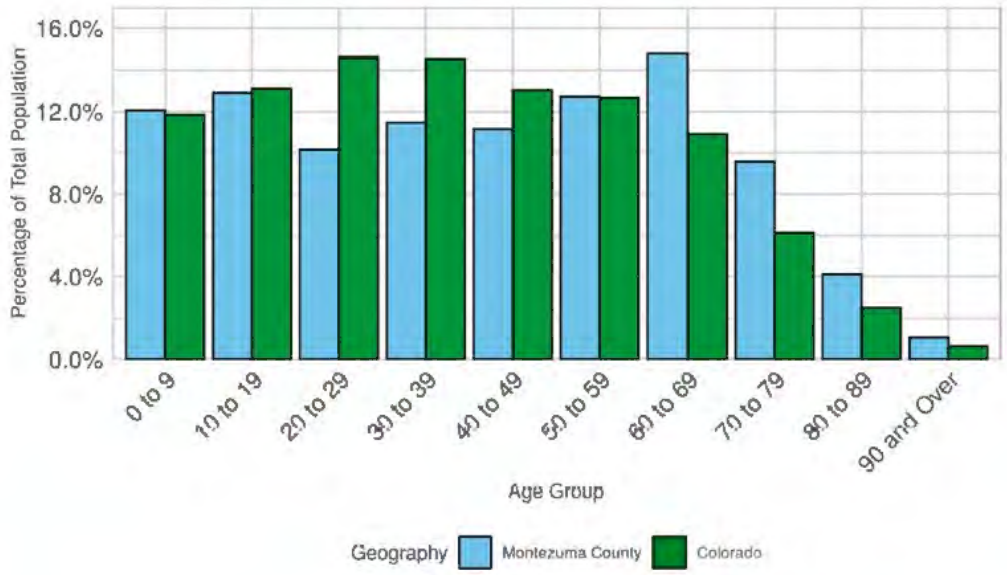
As a group, the elderly are more likely to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

According to the State Demography Office, both men and women in the County are significantly older compared to the state. The median age of Montezuma Count (44.4) is 7.7 years older than the state average. American Community Survey 5-Year estimates, 2014-2018 data estimates, 21% of the planning area's population is 65 or older compared to 15.2% nationwide.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

It is estimated 18.5% of the county's population is 14 years old or younger. American Community Survey 5-year estimates for 2014-2018 indicate that 26% of Montezuma County families have children under 18 and are below the poverty line. The overall age distribution estimates in 2018 for Montezuma County compared to statewide estimates is illustrated in Figure 3-5.

Figure 3-5 State of Colorado and Montezuma County Population Distribution by Age, 2018



Source: State Demography Office, Montezuma County Community Profile, printed 4/28/2020

3.4.3 Disabled Populations

People with disabilities tend to be more vulnerable to a hazard event than the general population. Having access and functional needs can make adapting and dealing with changing and extreme circumstances more challenging and stressful. During an emergency, individuals with disabilities often require a caretaker or family member to provide assistance and support during an emergency event, and depending on the situation assistance may not be available during the event. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Individuals with disabilities represent 12.6% of the population national wide. According to ACS Five-Year estimates for 2014-2018, 17.3% of the population in Montezuma County are individuals with disabilities. Of individuals 65 years and older 36.4% have a disability. Individuals who are 65 years and certain young people with disabilities are eligible for Medicare, the federal health insurance program. In Montezuma County there are 6,319 Medicare Beneficiaries, of which 13% or 842 individuals are electricity-dependent beneficiaries meaning they rely on equipment such as ventilators, at-home dialysis, electric wheelchair or an electric bed in order to live independently in their homes. Long term power outages due to severe weather or other types of emergencies can be life-threatening for this segment of population.

3.4.4 Ethnic Population

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. Proficiency in English can help in the ability to communicate between individuals and allow better access to resources. In Montezuma County, 10.8% of individuals speak a language other than English at home compare to 21.5% in the United States. Spanish is the second most commonly spoken language at home followed by “other languages”. According to the U.S. Census, the racial composition of the planning area is predominantly white, at approximately 81.3%. The largest minority population is American Indian at 12.5%, which is

predominately the Ute Mountain Ute Tribe with 5.6%. The population also is 12.4% Hispanic or Latino (of any race).

3.5 Economy

Select economic characteristics estimated for Montezuma County by the American Community Survey Five-Year estimates for 2014-2018 are shown in Table 3-4.

Table 3-4 Montezuma County Economic Characteristics

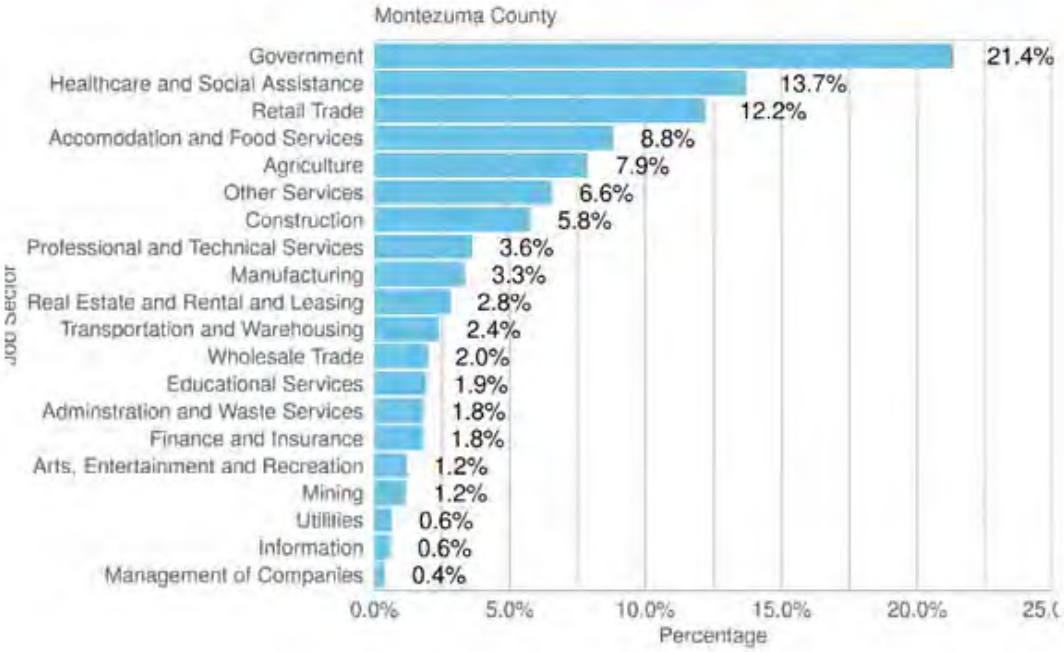
	Montezuma County	Cortez	Dolores	Mancos
% of Families below poverty level	10%	18%	10%	18%
% of Individuals below poverty level	16%	25%	14%	23%
Median home value	$208,300	$168,300	$163,800	$205,800
Median household income	$46,797	$40,048	$44,048	$41,875
Per capita income	$25,161	$21,500	$24,168	$21,589
% of Population >16 years old in the Labor Force	57%	59%	71%	64%
% of Population Employed	54.1	55.4	69.4	60.9

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2014-2018, Colorado State Demography Office

3.5.1 Occupations and Industries

According to the State Demography Office, in 2018 the planning area's economy is based in the government (21.4% of total employment), health care and social assistance industries (13.7% of total employment), and by retail trade (12.2%). Figure 3-6 shows the share of job by of industry types in Montezuma County.

Figure 3-6 2018 Share of Jobs by Industry in Montezuma County



Source: Colorado State Demography Office, Montezuma County Community Profile Report, printed: 4/28/2020

According to the Region 9 Economic Development District of Southwest Colorado, Inc. Economic Snapshot Report (2017), the following as the largest employers in Montezuma County:

- Montezuma Cortez School Dist. RE1
- Ute Mountain Casino Hotel
- Southwest Memorial Hospital
- Ute Mountain Ute Tribe
- Walmart
- Montezuma County
- City of Cortez
- Dolores School Dist. RE 4A
- Pasco SW Inc.
- City Market

The U.S. Census estimates that 81.2% of Montezuma County workers commute alone (by car, truck or van) to work, and mean travel time to work is 20.3 minutes. Twenty-seven percent (27%) of resident's commute to neighboring La Plata County.

3.6 Housing

In the United States, individual households are expected to use private resources to prepare for, respond to, and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. Mobile homes represent 19% of the total housing Montezuma County. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that

residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

The following table show select housing characteristics from the State Demography Office and the ACS Five-Year estimates for the planning area:

Table 3-5 Montezuma County Select Housing Characteristics

	Montezuma County	Cortez	Dolores	Mancos
Total Housing Units	12,277	3,980	512	643
# Occupied Housing Units	10,803	3,712	444	583
Vacancy Rate	12.0	6.7	13.3	9.3
% Owner-Occupied	71.1	56.4	49.7	53.3
% Renter-Occupied	28.9	43.6	50.3	46.7
Median Year of Construction	1983	1974	1956	1982
Average # of Persons per Household	2.42	2.34	2.28	2.56
% of Rental Households paying 50% or more of income on housing	14.6	16.0	8.8	12.3

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2014-2015, Colorado State Demography Office http://www.census.gov/

3.7 Government

3.7.1 Montezuma County

The Montezuma County government is made up of the following offices and departments:

- Administration
- Assessor
- Attorney
- Auditor
- Clerk and Recorder
- Colorado State University Cooperative Extension
- Commissioners
- Coroner
- Detention Center
- District Attorney
- Elections Office
- Emergency Management
- Fairgrounds
- GIS/Mapping
- Landfill
- Public Trustee
- Natural Resources/Public Lands
- Information Technology
- Planning and Zoning
- Public Health
- Public Transportation
- Road and Bridge
- Sheriff
- Senior Services
- Treasurer
- Social Services
- Surveyor
- Veteran Services
- Weed Control

3.7.2 City of Cortez

The City of Cortez is governed by a mayor and city council and includes the following departments:

- Airport
- City Clerk
- City Manager
- Colorado Welcome Center
- Dispatch Center
- Finance
- General Services
- Human Resources
- Library
- Marketing
- Municipal Court
- Parks and Recreation
- Planning and Building
- Police
- Public Works

3.7.3 Town of Dolores

The Town of Dolores is governed by a mayor and town board of trustees. The town government is made up of the following offices and departments:

- Planning and Zoning
- Town Manager
- Town Clerk/Treasurer
- Town Attorney
- Municipal Court Judge
- Maintenance Supervisor and Staff
- Administrative Clerk

3.7.4 Town of Mancos

The Town of Mancos is governed by a mayor and a board of six trustees. Elected officials serve four year terms. The town has the following departments:

- Administration
- Boards and Committees (including the Planning and Zoning Commission, Tree Board, and Design Review Board)
- Marshal's Office
- Parks and Recreation
- Development Services
- Public Works

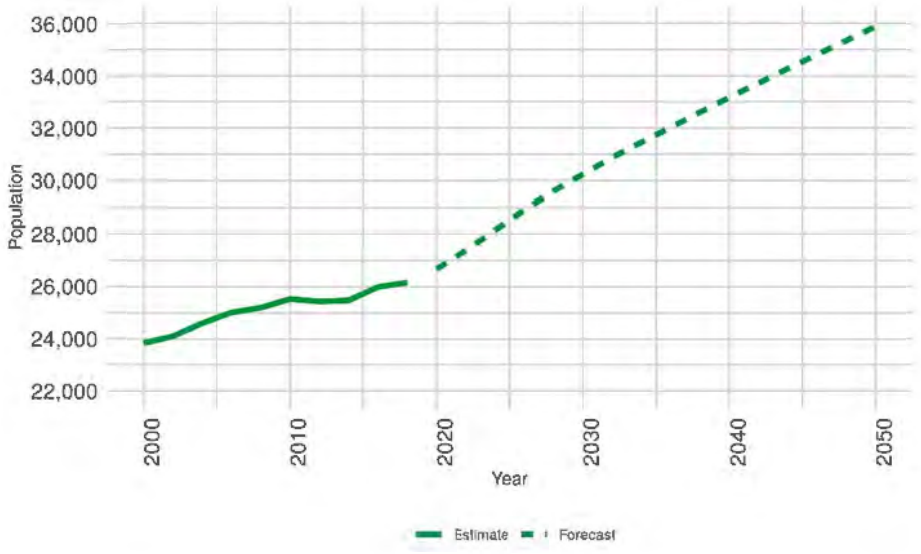
3.7.5 Cortez Fire Protection District

The Cortez Fire Protection District (CFPD) is a combination department evolved from the Cortez Volunteer Fire Department, formed in 1886, the first fire service for the Cortez area. The Fire Protection District was established in 1986. Today the Cortez Fire Protection District covers 162 square miles within Montezuma County. The District is governed by a Board of Directors comprising of five elected members that are residents or property owners of taxable real or personal property within the District. The Board works closely with the Fire Chief and District Management to meet long term goals. The District provides both firefighting services and emergency medical assistance within the District boundaries. In 2020, the Cortez Fire Protection District is comprised of 24 paid personnel including Business and Administration, 3 full-time shifts of 4 firefighters, 6 volunteer firefighters and EMT, a Wildland Lieutenant/Coordinator and Community Risk Reduction Lieutenant. The District implemented a Wildland Program to assist in fire protection and mitigation needs within the District boundaries as well as to work seasonally with the U.S. Forest Service if needed.

3.8 Future Trends in Development

According to the State Demography Office projects the County's population to continue to grow through 2040. The Office forecasts the population to reach 33,157 by the year 2040. The following figure shows the population forecast from 2000 to 2050, from the State Demography Office.

Figure 3-7 Population Forecast, 2000 to 2050



Source: Colorado State Demography Office, Montezuma County Community Profile Report, printed: 4/28/2020

The municipal planning partners have adopted comprehensive plans that govern land use decision and policy making in their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area.

All municipal planning partners will incorporate this hazard mitigation plan update in their comprehensive plans by reference. This will help ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

3.9 Capability Assessment

This section presents Montezuma County's mitigation capabilities, as well as the capabilities of the participating jurisdictions 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.

3.9.1 Montezuma County

Planning and Regulatory Mitigation Capabilities

Table 3-6 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Montezuma County. Excerpts from applicable policies, regulations, plans, and programs descriptions follow to provide more detail on existing mitigation capabilities.

Table 3-6 Montezuma County Regulatory Mitigation Capabilities Matrix

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive Land Use Plan	Yes	The most fundamental issues addressed by the *Montezuma County Comprehensive Plan* involve protection of private property rights and the protection of private property values.
Zoning ordinance	Yes	Chapter 3, Montezuma Land Use Code
Subdivision ordinance	Yes	Chapter 5, Montezuma Land Use Code. Includes subdivision wildfire mitigation plan regulation
Growth management	Yes	Growth in Montezuma County is directed by the Comprehensive Plan and provisions in the Land Use Code.
Floodplain ordinance	Yes	Flood Damage Prevention Resolution (2-2014)
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	Resolution 7-2020: A resolution restricting open fires and use of fireworks. Open fires and use of fireworks are prohibited in the unincorporated areas of Montezuma County except as provided on amendment.
Building code	Yes	New construction and remodeling for commercial and industrial buildings or structures requires compliance with Uniform Building Code 1997 standards.
Erosion or sediment control program	No	General design guidelines address erosion in Chapter 5, Section 5101.3 of the Montezuma County Subdivision Regulations, however, no overall County Erosion Management Program has been identified.
Stormwater management	Yes	Stormwater drainage plans are required for all developments through the Montezuma County Subdivision Regulations.
Site plan review requirements	Yes	The County Planning and Zoning Department administers a "Subdivision and/or Planned Unit Development Review" process.
Capital improvement plan	Yes	
Economic development plan	No	
Local emergency operations plan	Yes	*Montezuma County Emergency Operations Plan,* adopted December 4, 2017; *Montezuma County Wildfire Risk Assessment*
Other special plans	Yes	*Montezuma County Community Wildfire Protection Plan* (2011); *Noxious Weed Plan* (Updated September 26, 2016)
Flood insurance study or other engineering study for streams	Yes	*Flood Insurance Study for Montezuma County*, September 26, 2008. Study includes flood insurance rate maps and/or flood boundary floodway maps. These were adopted by the Montezuma County resolution, Flood Damage Prevention
Elevation certificates	Yes	The Montezuma County floodplain management and regulations requires structures and other developments to have an elevation certificate.

Comprehensive Land Use Plan, 1997 (as amended)

The Montezuma County Comprehensive Land Use Plan is the official document for guiding both the public and private sector in land use decision for the county. The original plan was adopted by the Planning Commission in 1997. The plan was amended in 2004 to update demographics and reflect changes in land use issues brought on by county growth.

The Montezuma County Comprehensive Land Use Plan includes goals and policy recommendations–many of which integrate and complement the hazard mitigation plan initiatives. The plan includes the following goals:

1. To provide reasonable protection of private property rights.
2. To provide reasonable protection of private property values.
3. To develop a Comprehensive Plan that protects the right of landowners to divide, sell and change the use of their land.
4. To develop a Comprehensive Plan that provides reasonable protection of property values from incompatible uses.
5. To develop a Comprehensive Plan that does not resort to mandates or regulations intended to "take" open space and does not lock landowners into agricultural uses as a means of locking in open space.
6. To develop a Comprehensive Plan that utilizes voluntary incentives to address open space needs, before the long-term effects of rural development narrow the options for voluntary solutions.
7. To develop a Comprehensive Plan with a strong "right to farm" policy, that protects conventional agricultural operations from "nuisance liability" suits.
8. To develop a Comprehensive Plan with a land owner education policy, aimed at informing rural landowners about the tolerances (spraying, night baling, etc.) to the "right to farm" guarantee, as well as, the courtesies that are essential in making residential and agricultural land use compatible.
9. To protect existing property taxpayers from undue burden in financing the costs of new development.
10. To avoid placing such a heavy burden on new development, that the opportunity for future residents to become part of the community becomes cost prohibitive.

The plan included policy recommendations in the following areas:

1. Landowner initiated zoning (expired in 1999)
2. Industrial and commercial development
3. Junk trash and visual blight
4. Agricultural viability
5. Residential development
6. Open space and wildlife
7. Residential density
8. Rural sprawl
9. Infrastructure, services, and cost of growth
10. Federal lands in Montezuma County
11. Intergovernmental relations

Flood Damage Prevention Resolution, 2008 (as amended)

The Legislature of the State of Colorado has, in Title 29, Article 20 of the Colorado Revised Statutes, delegated the responsibility of local governmental units to adopt regulations designed to minimize flood losses. The requirements are based on standards of Paragraph 60.3(c) of the NFIP regulations. Montezuma County passed Resolution 2-2014 to amend previous resolutions to address flood damage prevention.

The purpose of the resolution was to promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health.
2. Minimize expenditure of public money for costly flood control projects.
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public.
4. Minimize prolonged business interruptions.
5. Minimize damage to critical facilities, infrastructure and other public facilities such as water, sewer and gas mains, electric and communication stations, and streets and bridges located in floodplains.
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas.
7. Ensure that potential buyers are notified that property is located in a flood hazard area.
8. To ensure that those who occupy the areas of special flood hazard assume the responsibilities of their own actions.

In order to accomplish its purposes, the resolution uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood height or velocities.
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction.
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters.
4. Control filling, grading, dredging, and other development which may increase flood damage.
5. Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or may increase flood hazards to other lands.

Emergency Operations Plan, 2017

The Montezuma County Emergency Operations Plan (EOP) outlines how county public safety agencies and organizations will implement life and property saving action when a major disaster or emergency challenges the county's ability and resources to respond effectively. The purpose of the EOP is to:

- Describe the Emergency Management process to be utilized by Montezuma County during response and recovery activities for emergencies or disasters.
- Identify the roles, responsibilities, guidelines and principles for effective coordination during emergencies/disasters within the county resulting from a natural or human-caused event.
- Identify actions required of county departments and other agencies in preparing for and responding to major emergencies and disasters.
- Ensure a coordinated response by local, state, and federal governments by the use of National Incident Management System (NIMS) in managing emergencies or disasters; to save lives, prevent injuries, protect property and the environment, and to return the affected area to a state of normalcy as quickly as possible.
- Provide a framework for coordinating, integrating, and administering the emergency operations plans and related programs of local, state, and federal governments.

- Provide for the integration and coordination of volunteer agencies and private organizations involved in emergency response and relief efforts.

The EOP uses the all-hazard approach addressing a full range of complex and constantly changing requirements in anticipation of or in response to threats or acts of major disasters (natural or technological), terrorism, and other emergencies. The EOP does not specifically address long-term reconstruction, redevelopment, and mitigation measures. The EOP details the specific incident management roles and responsibilities of departments and agencies involved in emergency management. This plan also helps establish coordination roles of the county departments and agencies. The EOP was designed to address hazards such as flooding, tornadoes, wildfires, severe weather, landslide, drought, earthquake, dam failure, hazardous materials, and terrorism.

The EOP includes emergency support functions (ESFs) to provide a concise overview of the incident command structure for each type of incident. The ESFs provide functions and identify responsibilities for each time of incident and the necessary support elements that may be required.

Community Wildfire Protection Plan (CWPP), revised 2011

The Montezuma County CWPP is a direct extension of the National Fire Plan authorized by the U.S. Congress, as a response to the tragic summer wildfires of 2000. In 2003, the Healthy Forest Restoration Act was signed into law. This act focused on restoring forests and rangeland into healthy fire-adapted ecosystems while reducing the threat of wildfire to the communities. The Healthy Forest Restoration Act established four key planning concepts, including:

- Collaborative planning amongst stakeholders
- Identifying and prioritizing hazardous fuel reduction projects
- Assessment of community firefighting capacity
- Reducing structural ignitability

The CWPP was prepared to assist Montezuma County residents, local governments, and land management agencies to support the following overarching goals:

- Protect the lives of residents and emergency personnel
- Protect property and critical infrastructure in the wildland-urban interface (WUI)
- Protect key environmental values and quality of life.

Montezuma County has five Fire Protection Districts: Lewis-Arriola, Pleasant View, Cortez, Dolores, and Mancos. Fire suppression on Mesa Verde National Park is provided by the National Park Service. Wildfire management on tribal lands is provided by the Bureau of Indian Affairs (BIA) and the Towaoc Fire Protection District. Fire suppression on National Forest and BLM lands is provided by the Dolores District of the San Juan Forest and BLM. Mutual-aid between fire protection districts as well as for federally managed lands is well coordinated and used effectively when necessary.

Dolores River Emergency Alert and Notification Plan, 2016

This local early warning and notification plan prioritizes and focuses on information sharing between local, state, and federal stakeholders within Montezuma County concerning the Dolores River Watershed within Montezuma County. This plan contains guidance for sharing information as situations develop on the Dolores River Watershed concerning annual spring run-off/high water, mud, land and rock-slides, flash flooding and other manmade or naturally occurring events. The plan provides information on the steps to take when emergencies arise. This document also describes how best to coordinate, communicate and

share information with other jurisdictions to include local emergency managers, responding agencies, and jurisdictions downstream of Montezuma County.

This plan is meant to serve as the basis for effective response to any hazard that threatens the Dolores River and the jurisdictions it serves. General information and instructions are included in this plan as they relate to information collection and sharing, communication, and notification. It was developed in with Montezuma County Office of Emergency Management, Montezuma County Sheriff's Office, Montezuma County Public Health Department, Colorado State Division of Water Resources, City of Cortez, Town of Dolores, the Dolores Water Conservancy District and the Ute Mountain Ute Tribe.

Dolores River Valley Plan, 2004 (as amended)

Montezuma County established a Dolores River Valley Plan to limit the growth in the Dolores River Valley to greater than 10 acre lots. The plan was developed to ensure the quality of water in the Dolores River, while allowing for development. Recommendations from this plan were incorporated into the Montezuma Land Use Code, but many provisions were rescinded by the Board of County Commissioners on July 7, 2014.

Land Use Code, 1998 (as amended)

The Montezuma County Land Use Code applies to all the land in the unincorporated areas of the county. Montezuma County has adopted resolutions and ordinances that directly or indirectly mitigate hazards identified in this plan. The code includes the following chapters:

- Chapter 1: General Provisions, Application and Threshold Standards
- Chapter 2: High Impact Commercial or Industrial Permitting
- Chapter 3: Zoning
- Chapter 4: Planned Unit Development
- Chapter 5: Montezuma County Subdivision Regulations
- Chapter 6: Review Procedure for Subdivisions and Planned Unit Developments
- Chapter 7: Public Notice Procedure
- Chapter 9: Administration

Montezuma County flood hazard preparedness includes participation in the FEMA National Flood Insurance Program (NFIP). Montezuma County regulates floodplain development through the Montezuma County Land Use Code, which establishes minimum NFIP standards for floodplain development. Montezuma County requires new or substantially improved, habitable structures and accessory structures, and engineered septic systems, to be permitted and approved by a licensed engineer and or surveyor. Proposed structures within the floodway or jurisdictional wetlands also require U.S. Army Corps of Engineers (USACE) permitting before Montezuma County permits are issued.

Emergency Declaration Resolution, 2014

Resolution 11-2014 allows the BOCC to declare a State of Emergency to provide for the safety of the public, protect critical infrastructure, protect private property, and protect the environment. When an Emergency Disaster Declaration is adopted, the EOP will be implemented in part or whole based on the need of the county. This resolution provides further guidance, clarification, authority, and policy changes during the period of the Emergency Disaster Declaration.

Amended Fire Ban Ordinance, amended 2015

Ordinance 2-2015 amended previously adopted Ordinance No. 1-2008 and 2-2014 regarding a fire ban. The ordinance prohibits open fires and the use of fireworks in the unincorporated areas of Montezuma County except as detailed in the ordinance. The ordinance also sets penalties for violations of the fire ban.

Noxious Weed Program

The Weed Management Plan was developed because noxious weeds have become a threat to the natural resources of Colorado and an organized and coordinated effort must be made to stop the spread of noxious weeds. The plan, adopted as Resolution 3-2014, established a Noxious Weed Program. The objectives and goals of the program are education, mapping, and support of private enterprise.

The mission of the Montezuma County Noxious Weed Program is to educate county residents, property owners, and managers to be responsible stewards of the land and resources of Montezuma County by protecting and preserving all lands and natural resources of the county from the degrading impact of invasive noxious weeds.

Administrative and Technical Mitigation Capabilities

Table 3-7 identifies the County personnel responsible for activities related to mitigation and loss prevention in Montezuma County.

Table 3-7 Montezuma County Administrative/Technical Mitigation Capabilities Matrix

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Department of Planning and Zoning
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	Yes	Department of Planning and Zoning
Personnel skilled in GIS	Yes	GIS & Mapping
Full-time building official	No	
Floodplain manager	Yes	Public Lands Coordinator
Emergency manager	Yes	Office of Emergency Management; New Manager as of March 20, 2020
Grant writer	No	
Other personnel	Yes	Montezuma County Landfill
GIS data: Hazard areas	Yes	GIS & Mapping
GIS data: Critical facilities	Yes	GIS & Mapping
GIS data: Building footprints	Yes	GIS & Mapping
GIS data: Land use	Yes	GIS & Mapping
GIS data: Links to Assessor's data	Yes	GIS & Mapping
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Nixle 360
Other	Yes	Implementing Social Media: New PIO hired March 18, 2020

Notes:
GIS Geographic Information System

Office of Emergency Management

The Office of Emergency Management coordinates with all county fire and emergency medical services, as well as the Sheriff's Office, to prepare and plan for emergencies in Montezuma County. This is

accomplished by maintaining a county EOP, participating in local and regional workgroups, planning and coordinating emergency training and exercises, and supporting public education in emergency preparedness. In addition, communication is maintained with state and federal agencies for coordination in the event of large disasters, natural or human-caused. After the disaster, the Office of Emergency Management coordinates and assists with the recovery efforts to restore the community.

Planning and Zoning

The mission of the Department of Planning and Zoning is to guide and assist landowners and businesses in complying with the Montezuma County Land Use Code. New construction and remodeling for commercial and industrial buildings or structures requires compliance with Uniform Building Code 1997 standards. The county does not license contractors or have a building department.

Department of Public Health

The mission of the Department of Public Health is to protect and improve the health of the communities in Montezuma County. Public health staff provide a variety of services including immunizations, preventive assessments of children and the elderly and a full range of services designed to assist individuals and groups to attain and maintain good health and to cope with illnesses. The department also oversees state health orders and inspections in the county including for restaurants, septic systems, smoke, and more.

Health Department Emergency Preparedness and Response

The Health Department Emergency Preparedness and Response (EPR) Coordinator works with local agencies to inform, educate, and empower the community about disaster preparedness. EPR personnel provide training and exercises to provide a competent public health work force. The department participates in a Regional Health Care Coalition to work closely with other medical- and health-related agencies. When necessary, the EPR Coordinator responds to local and state disasters to coordinate efforts with other agencies.

Financial Mitigation Capabilities

Table 3-8 identifies the financial capabilities that can be used in the implementation of mitigation and loss prevention activities in Montezuma County.

Table 3-8 Montezuma County Financial Mitigation Capabilities Matrix

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Community Development Block Grants	Yes	Yes
Capital improvements project funding	Yes	Yes
Authority to levy taxes for specific purposes	Yes	No
Fees for water, sewer, gas, or electric services	No	No
Impact fees for new development	Yes	No
Incur debt through general obligation bonds	No	No
Incur debt through special tax bonds	Yes	No
Incur debt through private activities	No	No
Withhold spending in hazard prone areas	No	No
Other	No	No

3.9.2 City of Cortez

Planning and Regulatory Mitigation Capabilities

Table 3-9 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Cortez. Excerpts from applicable policies, regulations, and plans, and descriptions of applicable programs follow to provide more detail on existing mitigation capabilities.

Table 3-9 City of Cortez Regulatory Mitigation Capabilities Matrix

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive plan	Yes	*City of Cortez Comprehensive Plan*
Zoning ordinance	Yes	Chapter 3, Land Use Code
Subdivision ordinance	Yes	Subdivision regulations are included in the *City of Cortez Comprehensive Plan* and Land Use Code (Chapter 4).
Growth management	Yes	Growth management is accomplished through compliance with the *City of Cortez Comprehensive Plan* and Land Use Code.
Floodplain ordinance	Yes	Chapter 7, Land Use Code
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	Some stormwater, erosion control, and slope provisions are included in the City of Cortez Development Review Requirements.
Building code	Yes	2015 International Building Code
Erosion or sediment control program	No	
Stormwater management	No	
Site plan review requirements	Yes	
Capital improvements plan	No	
Economic development plan	Yes	
Local emergency operations plan	Yes	Approved in 2018
Other special plans	Yes	
Flood insurance study or other engineering study for streams	Yes	Flood Insurance Study of Montezuma County and Incorporated Areas (September 26, 2008)
Elevation certificates	Yes	Required but not provided by the City of Cortez.

Comprehensive Plan

The City of Cortez Comprehensive Plan is a guide for the city government to use in making daily decisions, based on the direction that the community intends to go. The plan promotes health, safety, morals, order, convenience, prosperity, general welfare, efficiency, and economy in the process of city wide development. It details the provisions for organized development, growth management, proper and organized transportation routes, promotion of high-quality civic design and arrangement, and adequate

public utilities, facilities, and services. The plan was developed through the combined efforts of city staff members and citizens of the community.

Under Colorado State Statutes (Sections 30-28-106 and 107), a Comprehensive Plan or Master Plan must address, at a minimum, the following issues:

- The general location, character, and extent of the current and desired transportation system
- The general location and extent of public utilities and terminals to all water, light, power, sanitation, transportation, communication, heat, and other purposes and any anticipated expansion of such utilities
- An adequate water supply to serve anticipated demand in terms of both quality and quantity
- Use plans for any dedicated public rights of ways
- Zoning plans for new development
- Inventory of available housing, business, and public space and plans for the projected economic and other needs of the current and anticipated population
- A plan for commercial mineral extraction
- Demographic projections and associated needs
- The general location and extent of delicate and hazardous natural areas

The plan lists the city's principal issues, goals, and recommendations for actions. The following issues, goals, and actions are related to hazard mitigation:

Chapter 5: Land Use Plan

- **Goal 5.1:** Establish land use patterns within the city to provide coordinated and responsible growth.
  - **Ongoing Objective:** To coordinate timing, location, and intensity of growth with provision of adequate public facilities.
  - **Ongoing Objective:** To coordinate with all city departments, utility providers, and other agencies to ensure adequate infrastructure in new developments and public improvements projects.
- **Goal 5.2:** Continually improve the sustainability and efficiency of new and existing land uses.
  - **Ongoing Objective:** Take a position on local, regional, and global environmental issues and shape policies accordingly.
- **Goal 5.5:** Provide joint planning opportunities between the City of Cortez and Montezuma County.
  - **Short-term Objective:** To develop a process for communication between the Cortez Planning and Zoning Commission and the Montezuma County Planning Commission to identify issues that affect both entities and pursue solutions together.
  - **Mid-term Objective:** To establish compatible land use patterns in the One-Mile Urban Services Area.
  - **Long-term Objective:** To seek appropriate and responsible growth within the Three-Mile Potential Growth Area.
- **Goal 5.6:** Maximize economic opportunities within Cortez without sacrificing quality of life.
  - **Ongoing Objective:** To provide adequate land, facilities, and infrastructure for commercial and industrial development.

Chapter 8: Public Facilities and Services

- **Goal 8.3:** Facilitate adequate emergency services, healthcare access, day care, and assisted living to meet the needs of all city residents.

  - **Ongoing Objective:** To improve efficient, quality emergency services within the City of Cortez and be proactive in promoting a healthy, safe community.
  - **Ongoing Objective:** To ensure that the level of fire and police service is adequate to meet the needs of a growing population.

- **Goal 8.5:** Water, wastewater and storm drainage systems are adequate to meet basic and emergency needs of development.
  - **Ongoing Objective:** To maintain a city water supply and distribution system that is adequate to meet the needs of a growing population in terms of both quality and quantity.
  - **Ongoing Objective:** To protect the wastewater system and provide and maintain an adequate stormwater management system that meets the demands of the current and projected population.

Chapter 9: Natural Environment

- **Goal 9.1:** Maintain natural biodiversity and critical lands and preserve and enhance the natural physical environment within the city.
  - **Ongoing Objective:** To mitigate the impacts of growth on valuable natural resources, including those resources that contribute to the economy and quality of life.
  - **Ongoing Objective:** To maintain a healthy urban landscape throughout the community.
- **Goal 9.2:** Help to protect natural biodiversity and critical lands in the natural environment surrounding the City of Cortez through coordinated management, education, legislation, incentives, and requirements.
  - **Ongoing Objective:** To encourage conservation of stream corridors.
- **Goal 9.5:** Carefully manage the air, water, and soil on which city residents depend.
  - **Ongoing Objective:** To ensure that an adequate supply of high quality water is available for residents and the environment.
  - **Mid-term Objective:** To establish a community culture of water conservation.
  - **Ongoing Objective:** To protect the health and productivity of soil from rapid erosion, salination, mineral and nutrient depletion, and contamination.
- **Goal 9.6:** Reduce greenhouse gas emissions as a city and plan for possible impacts of global climate change.
  - **Ongoing Objective:** To prepare for potential local adverse conditions caused by global climate change.

Chapter 11: Economic Development

- **Goal 11.2:** Serve the local economy through the provision of adequate infrastructure, emergency services, and land use designations.
  - **Ongoing Objective:** To maintain adequate emergency services to serve commercial and industrial emergency response needs.
  - **Ongoing Objective:** To keep zoning designations and district regulations current to meet the changing economic needs of the community.

Land Use Code, 2005 (as amended)

The City of Cortez Land Use Code was established in accordance with the city's comprehensive plan for the purpose of promoting the health, safety and general welfare of the city. It has been designed to lessen

the congestion on the streets, to secure safety from fire, panic and other dangers, to provide adequate light and air, to prevent the overcrowding of land, to avoid undue concentration of population, to promote energy conservation and to facilitate the adequate provision of transportation, water, sewage, schools, parks and other public requirements. The code includes the following chapters:

- Chapter 1: General Provisions
- Chapter 2: Rules of Construction, Definitions, and Interpretations
- Chapter 3: Zoning District Regulations
- Chapter 4: Subdivision Standards
- Chapter 5: Site Development Standards
- Chapter 6: Administration and Procedure
- Chapter 7: Flood Damage Prevention

The Land Use Code identifies construction standards for site development and subdivisions. Chapter 7 also identifies special flood hazard areas, outlines permitting requirements, lists use restrictions or special construction requirements for flood hazard reduction, and identifies standards for critical facilities in the floodplain. Chapter 7 identifies the Cortez City Manager or his/her duly-appointed representative as the floodplain administrator.

Code of Ordinances, 1974 (as amended)

The City of Cortez Code of Ordinances includes the following chapters and articles applicable to hazard mitigation:

- **Chapter 6 – Buildings:** The City of Cortez adopted the 2015 version of the following codes: International Fire Code, International Building Code, International Residential Code, International Existing Building Code, International Mechanical Code, International Plumbing Code, International Energy Conservation Code, International Property Maintenance Code, and the International Fuel Gas Code. This chapter also includes supplemental regulations to the international building and residential codes.
- **Chapter 10 – Fire Protection:** The City of Cortez has adopted the 2015 International Fire Code. This chapter also includes amendments to the 1991 Uniform Fire Code.
- **Chapter 11 – Fireworks:** This chapter discusses the use and sale of fireworks as well as the penalties for violations.
- **Chapter 27 – Water:** This chapter discusses the ability of the city to adjust water utility rates and impose emergency or conservation restrictions on water use. This chapter also discusses the laws against use or tampering with fire hydrants or other fire suppression systems and wasting water.
- **Chapter 29 – Zoning:** The City of Cortez adopted the 2009 Construction Design Standards and Specifications, which provide plans, specifications, general construction criteria, permits, excavation, etc. for construction activity in Cortez.

Administrative and Technical Mitigation Capabilities

Table 3-10 identifies the City personnel responsible for activities related to mitigation and loss prevention in the City of Cortez.

Table 3-10 City of Cortez Administrative/Technical Mitigation Capabilities Matrix

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Public Works
Engineer/professional trained in construction practices related to buildings or infrastructure	Yes	Planning and Zoning Representative/Town Building Inspector

Personnel Resources	Yes/No	Department/Position
Planner/engineer/scientist with an understanding of natural hazards	Yes	City Engineer
Personnel skilled in GIS	Yes	Public Works Department
Full-time building official	Yes	Planning and Building, Building Official
Floodplain manager	No	Chapter 7 of the Land Use Code identifies the City Manager or a designated representative as the floodplain administrator; however, there is not a dedicated floodplain manager for the city.
Emergency manager	Yes	Dispatch Supervisor
Grant writer	Yes	Private contracted individual
Other personnel	No	
GIS data: Hazard areas	Yes	
GIS data: Critical facilities	Yes	
GIS data: Building footprints	Yes	
GIS data: Land use	Yes	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Nixle 360 (Everbridge) with IPAWS
Other	Yes	Local TV or radio station

Notes:

GIS Geographic Information System

Planning and Building Department

The Planning and Building Department consists of four divisions:

- The Planning and Zoning Division is dedicated to guiding the development of the City of Cortez, through both short-term and long-term planning activities.
- The Building Division is primarily responsible for inspections of all phases of commercial and residential construction.
- The Fire Division conducts inspections and plan review of commercial projects to ensure that all federal, state, and local fire codes are met and maintained.
- Cross Connection works to keep pollutants and contaminants out of the city's potable water supply.

All of these services work in unison to preserve and enhance quality of life in the City of Cortez.

Public Works Department

The Public Works Department is responsible for street repair and maintenance, water treatment and distribution, trash collection, recycling, engineering, and GIS. The department consists of the following divisions:

- The engineering division performs design and construction management for the city's public works projects and oversees engineering design, construction management inspections to ensure compliance with adopted city codes.
- The GIS division maintains a complete set of geo-spatial data within the city limits and beyond.

- The recycling division consists of weekly curbside recycling collection service and a drop-off station at the city service center in the Industrial Park.
- The refuse division is responsible for weekly trash collection service for residential and commercial accounts.
- The street division is responsible for street repair, signage and traffic markings, sweeping, sanding, and snowplowing city streets.
- The water division is responsible for meter and waterline installation and maintenance, while the water treatment plant delivers high quality water to the citizens of Cortez for household uses, yard irrigation, and business uses.

Financial Mitigation Capabilities

Table 3-11 identifies the financial capabilities that can be used in the implementation of mitigation and loss prevention activities in Montezuma County.

Table 3-11 City of Cortez Financial Mitigation Capabilities Matrix

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Community Development Block Grants	Yes	Yes
Capital improvements project funding	Yes	Yes
Authority to levy taxes for specific purposes	Yes	No
Fees for water, sewer, gas, or electric services	Yes	No
Impact fees for new development	Yes	No
Incur debt through general obligation bonds	Yes	Yes
Incur debt through special tax bonds	Yes	No
Incur debt through private activities	No	No
Withhold spending in hazard prone areas	No	No
Other	No	No

3.9.3 Town of Dolores

Planning and Regulatory Mitigation Capabilities

Table 3-12 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Town of Dolores. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 3-12 Town of Dolores Regulatory Mitigation Capabilities Matrix

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive Plan	Yes	*Town of Dolores Comprehensive Plan*, adopted in 1997
Zoning ordinance	Yes	Title 17, Municipal Code
Subdivision ordinance	Yes	Title 17, Land use code. In Process of updating in 2020.
Growth management	Yes	Growth is governed by the *Town of Dolores Comprehensive Plan* and

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
		Municipal Code.
Floodplain ordinance	Yes	Title 17, Chapter 17.08 of the Municipal Code
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	LUC addresses steep slopes, wildfire and floods. Articles VI-O
Building code	Yes	2006 International Building Code. In Process of updating in 2020 to 2018 ICC Code family
Erosion or sediment control program	No	
Stormwater management	Yes	Discussed in Municipal Code. Updated in 2018
Site plan review requirements	Yes	The Town of Dolores Planning and Zoning Division enforces the building site plan review process as required by the municipal code.
Capital improvements plan	Yes	
Economic development plan	Yes	Community Business District Section of Land Use Code
Local emergency operations plan	Yes	In draft form, pending legal review and adoption.
Other special plans	Yes	*Town of Dolores Trails Master Plan*
Flood insurance study or other engineering study for streams	Yes	*Flood Insurance Study of Montezuma County and Incorporated Areas* (September 26, 2008)
Elevation certificates	Yes	Required for FEMA Zones AO, all new structures.

Notes:
FEMA Federal Emergency Management Agency

Comprehensive Plan, 1997

The Town of Dolores Comprehensive Plan encompasses the Town of Dolores and lands with the Town's 3-mile Dolores Urban Influence Area. The plan is a statement of current community values, is a benchmark against which future changes and needs may be weighed and provides policy direction in matters relating to many aspects of government.

The Town of Dolores is surrounded by a narrow, relatively level valley floor bounded on the north and south by sharply defined canyon walls. Most of the slopes exceed 30%. The area includes hazards such as steep slopes and floodplain hazard areas. The Dolores River has a floodplain boundary with base flood elevations designated by FEMA. Flooding along the river occurs primarily in mid-June. Flooding is attributed to a combination of strong thunderstorms and snowmelt.

The Comprehensive Plan includes the following goals and objects that pertain to hazard mitigation:

- **Goal:** Development in Dolores will respect, conserve, and complement the rural and natural setting.
  - **Objective:** Locate development on land suitable for development (e.g., avoid the river, wetlands, floodplain, steep slopes, ridgelines).
  - **Objective:** Provide environmentally responsive storm drainage systems.

- **Goal:** Dolores' future land use pattern will be characterized by compact, commercial core area; a highway commercial area with well-defined edges; an isolated light industrial area; and residential densities decreasing with distance from the commercial core.
    - **Objective:** Define the term "usable lands," as used herein, to include only lands that are generally free of hazards: 100-year floodplain, steep slopes (>30%), and geologic hazards.

Municipal Code (updated regularly)

Some of the chapters in the Town of Dolores Municipal Code have provisions related, directly or indirectly, to hazard mitigation. These provisions are mentioned below:

- Title 9 (Public Peace, Morals, and Welfare), Chapter 9.32 (Fireworks and Explosives): This chapter includes restrictions on the use or sale of fireworks within the Town of Dolores.
- Title 13 (Public Services), Chapter 13.04 (Water and Sewer System): This chapter prohibits the wasting of water and the use of water for irrigation or sprinkling during town firefighting efforts.
- Title 15 (Buildings and Construction): This title includes the adoption of 2006 editions of the International Building Code, International Residential Code, and International Energy Conservation Code. This title also includes construction design standards and permit requirements for construction.
- Title 17 (Land Use Code and Zoning), Chapter 17.04 (Land Use Code and Zoning): This chapter includes zoning regulations, site development standards, and subdivision standards.
- Title 17 (Land Use Code and Zoning), Chapter 17.08 (Flood Damage Prevention): This chapter includes the identification of land within flood hazard areas, designation of a floodplain administrator and standards for flood hazard reduction.

Land Use Code, 1998 (with amendments)

Provisions from the Town of Dolores Land Use Code apply to the development of all land within the Town of Dolores. The purpose of the Land Use Code is to promote health, safety and general welfare of the citizens of the Town of Dolores. The Land Use Code is in the process of being updated in 2020, with an emphasis on natural hazard mitigation, the update will be finalized in January 2021. It was adopted in accordance with the Town of Dolores Comprehensive Plan. The Land Use Code is intended to do the following:

1. Preserve and enhance the integrity, stability, and livability of residential neighborhoods.
2. Extend greater opportunities for traditional community living, working, housing, and recreation to all citizens and residents of Dolores.
3. Maintain property values by stabilizing expectations and ensuring predictability in development.
4. Preserve the historic, small town character of the community by directing new development in appropriate locations and minimizing the visual impact of development.
5. Prevent overcrowding of buildings and sites to avoid excessive concentrations of population, to promote energy conservation and facilitate the provision of adequate transportation, water, sewage, schools, businesses, parks and other public facilities and services.
6. Reduce development sprawl and the excessive segregation of land uses that cause unnecessary traffic congestion and increase the costs of provided adequate public facilities and services.
7. Encourage a more efficient use of land and public services and to direct new development in a more traditional pattern of mixed- and multiple-use and varied housing types.

8. Provide a procedure which can relate the type, design and layout of residential development to the particular site, the particular need for housing at a particular time, and to the town's goal of encouraging mixed-use development while preserving and protecting existing residential areas.
9. Establish a process that effectively and fairly applies the regulations and standards of this Land Use Code, respects the rights of property owners and the interests of citizens.

Administrative and Technical Mitigation Capabilities

Table 3-13 identifies the City personnel responsible for activities related to mitigation and loss prevention in the Town of Dolores.

Table 3-13 Town of Dolores Administrative/Technical Mitigation Capabilities Matrix

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	No	
Engineer/professional trained in construction practices related to buildings or infrastructure	No	
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	Yes	Building Official/Fire Marshal
Floodplain manager	Yes	Zoning Administrator (part of manager duties)
Emergency manager	Yes	County Emergency Manager
Grant writer	Yes	Town Manager
Other personnel	No	
GIS data: Hazard areas	Yes	Montezuma County GIS flood map
GIS data: Critical facilities	No	
GIS data: Building footprints	Yes	Montezuma County GIS
GIS data: Land use	Yes	Montezuma County GIS
GIS data: Links to Assessor's data	Yes	Montezuma County GIS
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Nixle 360, outdoor signals to be implemented, County reverse 911
Other	Yes	Local television channel (Channel 19 Government Access)

Notes:
GIS Geographic Information System

Financial Mitigation Capabilities

Table 3-14 identifies the financial capabilities that can be used in the implementation of mitigation and loss prevention activities in the Town of Dolores.

Table 3-14 Town of Dolores Financial Mitigation Capabilities Matrix

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Community Development Block Grants	Yes	Yes
Capital improvements project funding	Yes	Yes
Authority to levy taxes for specific purposes	Yes	No
Fees for water, sewer, gas, or electric services	Yes	No
Impact fees for new development	Yes	No
Incur debt through general obligation bonds	Yes	No
Incur debt through special tax bonds	No	No
Incur debt through private activities	No	No
Withhold spending in hazard prone areas	No	No
Other	No	No

3.9.4 Town of Mancos

Planning and Regulatory Mitigation Capabilities

Table 3-15 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the Town of Mancos. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 3-15 Town of Mancos Regulatory Mitigation Capabilities Matrix

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive Plan	Yes	*Town of Mancos Comprehensive Plan*
Zoning ordinance	Yes	Article 3 of Land Use Code (2019)
Subdivision ordinance	Yes	Article 19 of Land Use Code (2019)
Growth management	Yes	Chapter 16 Article 17 Land Use Code (2019)
Floodplain ordinance	Yes	Article 17 of Land Use Code (2019)
Other special purpose ordinance (stormwater, steep slope, wildfire)	No	Article 6 of Land Use Code – Steep Slopes and Ridgeline Development Town of Mancos Ordinance #734 Series 2017
Building code	Yes	2006 editions of the International Residential Code, International Building Code. Will be adopting IBC2018 in January 2021
Erosion or sediment control program	No	
Stormwater management	Yes	Article 9 section 16 of Land Use Code (2019)
Site plan review requirements	Yes	Article 10 of Land Use Code
Capital improvements plan	Yes	5-Year adopted in 2019
Economic development	Yes	Goals, objectives, and strategies were developed in the *Town of Mancos*

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
plan		*Comprehensive Plan* to guide economic development adopted in 2019
Local emergency operations plan	Yes	Adopted Ordinance 715 Series 2016
Other special plans	Yes	*Town of Mancos Trails Master Plan*
Flood insurance study or other engineering study for streams	Yes	*Flood Insurance Study of Montezuma County and Incorporated Areas* (September 26, 2008)
Elevation certificates	No	

Comprehensive Plan, 2011

The Town of Mancos Comprehensive Plan, adopted November 16, 2011, is intended to represent the desires of the Mancos community. The goals and objectives in this plan are ideals, and the actions are recommended strategies that the town can, if it so chooses, implement in order to strive for the goals and objectives. This plan is an advisory document, rather than a legislative one. It includes many but not all goals, objectives, and actions that could be implemented in order to foster Mancos' western small-town character now and into the future. The objectives of this plan are to: identify community goals and objectives that have a broad base of support; balance competing interests and demands; assess current and long-term needs; provide strategies for attaining community goals and objectives; and serve as a "road map" to guide the town in a direction consistent with the community's values.

Municipal Code, 2010 (as amended)

The Mancos Municipal Code was updated effective January 1, 2011. Links to the various sections and chapters are provided on the town website; these include:

- Chapter 1: General Provisions
- Chapter 2: Administration
- Chapter 4: Revenue and Finance
- Chapter 5: Franchises and Communication Systems
- Chapter 6: Business Licenses and Regulations
- Chapter 7: Health, Sanitation and Animals
- Chapter 8: Vehicles and Traffic
- Chapter 10: General Offenses
- Chapter 11: Streets, Sidewalks and Public Property
- Chapter 13: Municipal Utilities
- Chapter 16: Land Use Code
- Chapter 18: Building Regulations

The Mancos Municipal Codes included the adoption of the 2006 editions of the International Building Code, International Residential Code, International Existing Building Code, and International Energy Conservation Code. Chapter 16, Land Use Code, includes zoning regulations, subdivision and site development standards, and floodplain regulations.

Administrative and Technical Mitigation Capabilities

Administrative and Technical Mitigation Capabilities Table 3-16 identifies the City personnel responsible for activities related to mitigation and loss prevention in the Town of Mancos.

Table 3-16 Town of Mancos Administrative/Technical Mitigation Capabilities Matrix

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Contract with SAFEbuilt for all LUC and Building Permit applications
Engineer/professional trained in construction practices related to buildings or infrastructure	Yes	Contract with SAFEbuilt for all LUC and Building Permit applications
Planner/engineer/scientist with an understanding of natural hazards	No	
Personnel skilled in GIS	No	
Full-time building official	Yes	Development Services
Floodplain manager	Yes	
Emergency manager	Yes	County Emergency Manager
Grant writer	Yes	Town Administrator and Administrative Asst. are grant writers for Town.
Other personnel	No	
GIS data: Hazard areas	No	
GIS data: Critical facilities	No	
GIS data: Building footprints	No	
GIS data: Land use	No	
GIS data: Links to Assessor's data	No	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Yes	Nixle 360
Other	Yes	Local television channel (Channel 19 Government Access)

Notes:
GIS Geographic Information System

Financial Mitigation Capabilities

Table 3-17 identifies the financial capabilities that can be used in the implementation of mitigation and loss prevention activities in the Town of Mancos.

Table 3-17 Town of Mancos Financial Mitigation Capabilities Matrix

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Community Development Block Grants	Yes	Yes
Capital improvements project funding	Yes	Yes
Authority to levy taxes for specific purposes	Yes	No
Fees for water, sewer, gas, or electric services	Yes	Yes
Impact fees for new development	Yes	No
Incur debt through general obligation bonds	Yes	No
Incur debt through special tax bonds	Yes	No

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Incur debt through private activities	No	No
Withhold spending in hazard prone areas	No	No
Other (Stormwater Utility Fees)	Yes	Yes

3.9.5 Cortez Fire Protection District

Planning and Regulatory Mitigation Capabilities

Table 3-18 lists planning and regulatory management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place within the Cortez Fire Protection District.

Table 3-18 Cortez Fire Protection District Planning and Regulatory Capabilities

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Comprehensive Land Use Plan	Y	County Comprehensive Plan
Zoning ordinance	NA	
Subdivision ordinance	NA	
Growth management	NA	
Floodplain ordinance	NA	
Other special purpose ordinance (stormwater, steep slope, wildfire)	Y	Resolution 7-2020: An ordinance restricting open fires and use of fireworks. Open fires and use of fireworks are prohibited in the unincorporated areas of Montezuma County except as provided on amendment.
Building code	NA	New construction and remodeling for commercial and industrial buildings or structures requires compliance with Uniform Building Code 1997 standards.
Erosion or sediment control program	NA	
Stormwater management	NA	
Site plan review requirements	NA	
Capital improvement plan	NA	
Economic development plan	NA	
Local emergency operations plan	NA	

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
Other special plans	NA	
Flood insurance study or other engineering study for streams	NA	
Elevation certificates	NA	

Administrative and Technical Mitigation Capabilities

Table 3-19 identifies the District personnel responsible for activities related to mitigation and loss prevention within the Cortez Fire Protection District.

Table 3-19 Cortez Fire Protection District Administrative and Technical Mitigation Capabilities

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	NA	
Engineer/professional trained in construction practices related to buildings or infrastructure	NA	Development Services
Planner/engineer/scientist with an understanding of natural hazards	NA	
Personnel skilled in GIS	NA	
Full-time building official	NA	Development Services
Floodplain manager	NA	
Emergency manager	NA	County Emergency Manager
Grant writer	NA	
Other personnel	NA	
GIS data: Hazard areas	NA	
GIS data: Critical facilities	NA	
GIS data: Building footprints	NA	
GIS data: Land use	NA	
GIS data: Links to Assessor's data	NA	
Warning systems/services (Reverse 911 callback, cable override, outdoor warning signals)	Y	Nixle 360
Other	Y	Local television channel (Channel 19 Government Access)

Notes:
GIS Geographic Information System

Financial Mitigation Capabilities

Table 3-20 identifies the financial capabilities that can be used in the implementation of mitigation and loss prevention activities in the Cortez Fire Protection District. The District has a recently developed (beginning in fall 2019) a Community Risk Reduction budget funded with General funds to complete prescribed burning projects. Donations have also helped, but has not been consistent or nearly enough to

provide significant funding to complete all that is needed. The District is hoping to apply and hopefully obtain grant funding from multiple sources moving forward, and is working to establish impact fees.

Table 3-20 Cortez Fire Protection District Financial Mitigation Capabilities

Financial Resources	Accessible/Eligible to Use	Has Been Used in the Past
Community Development Block Grants	NA	NA
Capital improvements project funding	NA	NA
Authority to levy taxes for specific purposes	NA	NA
Fees for water, sewer, gas, or electric services	NA	NA
Impact fees for new development	potentially (2022)	No
Incur debt through general obligation bonds	NA	NA
Incur debt through special tax bonds	NA	NA
Incur debt through private activities	NA	NA
Withhold spending in hazard prone areas	NA	NA
Other	General Fund, grants, donations	Yes

3.9.6 Public Education and Outreach Mitigation Capabilities

Montezuma County and the participating jurisdictions have several outreach and public education activities in an effort toward informing the public on hazards and hazards mitigation. The following lists the efforts put forth in the County and jurisdictions to educate the public. The City of Cortez and Town of Dolores do not have specific examples of public outreach and education but do utilize state and regional partners for sharing information with the public.

Montezuma County

- CSU Extension with drought and water concerns training
- Wildfire partners with State and federal education
- 20 Youth working hazard mitigations for households
- C.E.R.T training

Town of Mancos

- In the process of adopting Water Wasting restrictions and water conservation ordinances.

Cortez Fire Protection District

- Fire Prevention/Preparedness Month to local schools
- Controlled burning advice given to landowners, developing more in-depth program for fire mitigation on private property
- In process of establishing an impact fee to fund wildfire mitigation efforts

3.9.7 Firewise

Firewise USA® is a voluntary program that provides a framework to help neighbors get organized, find direction, and take action to increase the ignition resistance of their homes and community. The program is co-sponsored by the USDA Forest Service, the U.S. Department of the Interior, and the National Association of State Foresters. The following subdivisions and neighborhoods within Montezuma County participate in the Firewise program.

- Cash Canyon/ Stinking Springs Neighborhood, Mancos
- Cedar Mesa Ranches, Mancos
- Elk Stream Ranch, Mancos
- Kernan Creek Ranch, Mancos
- North Mancos Property Owners Association, Mancos
- Wingspread, Dolores

3.9.8 State and Regional Partnerships

Colorado Division of Homeland Security and Emergency Management

Pursuant to House Bill 12-1283, the former Division of Emergency Management moved from the Department of Local Affairs to the newly created Division of Homeland Security and Emergency Management under the Colorado Department of Public Safety, effective July 1, 2012. The division is now comprised of three offices:

- Office of Emergency Management
- Office of Grants Management
- Colorado Information Analysis Center

The Division of Homeland Security and Emergency Management operates under the following division mission: "The mission to lead and support Colorado's effort to prevent, protect, mitigate, respond to and recover from all-hazards events.." According to the Division: "The vision A prepared, safe and resilient Colorado.""

Colorado Water Conservation Board

The CWCB is an agency of the State of Colorado. The CWCB Flood Protection Program is directed to review and approve statewide floodplain studies and designations prior to adoption by local governments. The CWCB is also responsible for the coordination of the NFIP in Colorado and for providing assistance to local communities in meeting NFIP requirements. This includes CWCB prepared or partnered local floodplain studies.

Colorado Geological Survey

The Colorado Geological Survey is a non-regulatory state government agency within the Colorado School of Mines. The mission of CGS is to help reduce the impact of geologic hazards on the citizens of Colorado, to promote responsible economic development of mineral and energy resources, provide geologic insight into water resources, provide avalanche safety training and forecasting, and to provide geologic advice and information to a variety of constituencies.

Colorado State Forest Service

The mission of the Colorado State Forest Service is to provide for the stewardship of forest resources and to reduce related risks to life, property, and the environment for the benefit of present and future generations. Its fire preparedness and response strategic priority is to provide leadership in wildland fire

protection for state and private lands in Colorado and reduce wildfire-related loss of life, property, and critical resources.

Southwest Colorado Council of Governments

The Southwest Colorado Council of Governments (SWCCOG) promotes regional cooperation and coordination among local governments and between levels of government for the geographic area comprising the Counties of Archuleta, Dolores, La Plata, Montezuma, and San Juan. The need for a SWCCOG is based on the recognition that the people of the region form a single community and are bound together not only physically, but economically and socially. It is the purpose of the SWCCOG through its participating membership, staff and programs, to provide local public officials with the means of responding more effectively to the local and regional problems of the regional community. The SWCCOG officially formed in December 2009, and intergovernmental agreements are currently in effect between 14 governmental jurisdictions across the region, including the City of Cortez and the Town of Dolores.

Wildfire Adapted Partnership

Wildfire Adapted Partnership (formerly FireWise Council of Southwest Colorado) strives to keep lives, homes, and property from being damaged by wildfire. After devastating fires near Durango, Colorado in 2002, Durango Fire and Rescue Authority hosted a national FireWise workshop, which more than 100 residents attended. Out of that workshop, FireWise of Southwest Colorado was born. The Partnership has several objectives including:

- Increasing the number of homeowners undertaking mitigation efforts
- Increasing the number of Neighborhood Ambassadors
- Encouraging and supporting the development of neighborhoods scale Community Wildfire Protection Plans and community wildfire risk assessments
- Getting subdivisions recognized as FireWise Communities USA program
- Reaching more southwest Colorado residents with information about wildfires risk and how residents can reduce that risk
- Participating in Fire Prevention and Education Month

Wildfire Adapted Partnership has part-time coordinators in La Plata, Montezuma, and Archuleta Counties and more than 130 Neighborhood Ambassadors, volunteers who lead wildfire preparedness activities in their high risk neighborhoods.

Fire Adapted Colorado

Fire Adapted Colorado (FACO), a stakeholder in the HMP planning process, is a connecting force whose members and partners strive to implement global best practices and apply scientific knowledge toward a future where homes and lives are never lost to wildfire in Colorado. Wildfire Adapted Partnership and the Dolores Watershed Resilient Forest Collaborative are among the members of this statewide nonprofit. This organization is a statewide resource that is closely affiliated with the Fire Adapted Community Learning Network (FAC Net), a national network to building resiliency and community capacity in wildfire prone communities. This organization brings state and nationally recognized best practices for wildfire mitigation before, during, and after fires, to local leaders.

East Canyon Community Wildfire Protection Plan, 2014

The East Canyon community, located about 4 miles east of the Town of Mancos, includes residents and property owners of the Elk Springs Ranch and Elk Stream Ranch developments and adjacent neighbors in Montezuma and La Plata Counties. The community, as considered in the CWPP, includes 50 private

properties: 13 in Elk Springs Ranch, 35 in Elk Stream Ranch, and 2 adjoining properties. Both Elk Springs Ranch and Elk Stream Ranch are Colorado Common Interest Communities, with homeowners associations and compliant governing documents, including covenants, conditions and restrictions, which provide guidance for FireWise development and property maintenance. Community fire protection is by the volunteer Mancos Valley Fire Protection District.

The community extends about 5 miles south from U.S. Highway 160. The only access to the community is by Montezuma County Road 46. The 2012 Weber Fire burned the canyon to the west of Road 46; however, the east side of the canyon has remaining heavy fuel loads on steep valley slopes. The Montezuma County wildfire risk assessment considered East Canyon to have extreme fire risk. The East Canyon CWPP identified proposed actions to reduce the fire risk, including improved access, defensible space, fuel breaks and safe areas, education and community involvement, and evacuation and emergency response plans.

Cedar Mesa Ranches Community Wildfire Protection Plan, 2011

The Board of the Cedar Mesa Ranches Homeowners Association has recognized that the subdivision is at risk from wildfires moving into or originating within the subdivision. A local effort to educate homeowners has been underway for several years, including development of a CWPP for Cedar Mesa Ranches. Cedar Mesa Ranches is located in Montezuma County, approximately 7 miles west of Mancos and 9 miles east of Cortez on the north side of U.S. Highway 160. The CWPP identified education and community outreach methods, policies for managing vegetation, and wildfire mitigation actions, such as vegetation/fuels management, structure vulnerability, and safety activities.

Cash Canyon/ Stinking Springs Community Wildfire Protection Plan, 2015

This self-defined community of over 3,200 acres organized a planning effort to address wildfire risk in their wildland urban interface area. Several residents in this area plan mitigation projects aligned with this CWPP, plan community work events, and provide ongoing wildfire preparedness education and resources with support of Wildfire Adapted Partnership. Montezuma County has provided past mapping support for emergency response and mitigation planning for the WUI community where the Cortez, Dolores, and Mancos Fire protection Districts come together.

Dolores Watershed Resilient Forest Collaborative

The Dolores Watershed Resilient Forest (DWRF) Collaborative is a network of local government, nonprofits, state and federal agencies, water agencies, wood product industries and community members. The inclusive local group shares knowledge and resources to enhance ecological and community resilience to wildfire and other disturbances in the 666,000+ acre upper Dolores River watershed. Recognizing direct links between social, economic, and ecological conditions, they work to enhance the communities' ability to safely live with fire.

DWRF partners work to:

- Collaboratively implement forest management activities, including mapping and analyses, policy discussions, direct treatments, and adaptive management.
- Use the best available science to inform community preparedness and land management projects and decisions.
- Increase the capacity of the local forest products industry and integrate them into forest treatment initiatives that reduce risk and enhance resilience.
- Better prepare for, respond to, and aid recovery from severe wildfire, post-fire effects, and other disturbances.

DWRF is one of the lead partners in the Southwest Colorado Project chosen in 2019 by the Rocky Mountain Restoration Initiative. The project area encompasses 750,000 acres stretching along Colorado State Highway 160. DWRF has a timeline of projects for the next; some of the efforts are related to hazard mitigation including mitigating 20,000 acres of private lands located in high fire risk areas, treating areas of the San Juan National Forest, protecting water quality and quantity, safeguarding the Dolores River, and maintaining economic viability of these communities.

3.9.9 Opportunities for Enhancement

The 2020 update provided the County and participating jurisdictions an opportunity to review and update the capabilities currently in place to mitigate hazards. This also provided an opportunity to identify where capabilities could be improved or enhanced. Specific opportunities could include the update or development of following plans, which should also cross reference this hazard mitigation plan (see also Section 6.3.5):

- Development and Implementation of a Capital Improvement Plan (Cortez)
- Update the County Community Wildfire Protection Plan (County)
- Update Comprehensive Plans to include linkages to the hazard mitigation plan and consideration of hazards in land use planning (County, Dolores, Cortez, Mancos). Develop an impact fee as a potential source for funding mitigation (Cortez Fire Protection District)
- Become StormReady certified communities (County, Dolores, Cortez, Mancos)

4 Hazard Identification and Risk Assessment

DMA 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 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.

Risk, for the purposes of this plan and as defined by FEMA, 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."

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural 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

In essence, the risk assessment evaluates potential loss from hazards by assessing the vulnerability of the county's population, built environment, critical facilities, and other assets. 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 (Montezuma County) and describes why some hazards have been omitted from further consideration.

Section 4.2: Asset Summary - Describes the methodology for inventorying assets as the basis for determining vulnerability of the Planning Area to the identified hazards.

Sections 4.3-4.13: Hazard Profiles - Discusses the threat each hazard poses to the Planning Area and describes previous occurrences of hazard events and the likelihood of future occurrences (2013 FEMA Local Mitigation Planning Handbook Risk Assessment, Step 1). It also includes a vulnerability assessment for each hazard, considering assets at risk, critical facilities, and future development trends (2013 FEMA Local Mitigation Planning Handbook Risk Assessment, Steps 2, 3 and 4).

4.1 Hazard Identification and Prioritization

DMA 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 first step in developing a risk assessment is identifying the hazards. The Montezuma County Hazard Mitigation Planning Committee (HMPC) conducted a hazard identification study to determine the hazards that threaten the Planning Area and estimates of potential losses or assets that could be affected by those hazards (if/as applicable).

4.1.1 Methodology and Results

For this plan, the Hazard Mitigation Planning Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. Hazards data was obtained from various federal, state, and local sources such as FEMA, the Colorado Geological Survey (CGS), the National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Information (NCEI), the United States Geological Survey (USGS), and others. Local newspaper articles from The Journal, which provides news for Cortez, Mancos, Dolores and surrounding areas, were also used to research historic events. Together, these sources were examined to assess the significance of these hazards to the County. 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 process also incorporated a review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Based on the review, this plan addresses the following hazards of concern:

- Avalanche
- Dam and Levee Failure/Incident
- Drought
- Earthquake
- Erosion and Deposition
- Expansive Soil
- Extreme Heat
- Flood
- Hail
- Landslide, Mud/Debris Flow, Rockfall
- Lightning
- Severe Wind
- Subsidence
- Tornado
- Wildfire
- Winter Storm

Several of these hazards were profiled together because of their common occurrence or damage assessments, such as drought and extreme heat, and hail, lightning, and severe winds. The HMPC did not omit any of the natural hazards that commonly affect the County. The plan is focused on natural hazards, as required by the DMA 2000, and does not include human caused hazards. These may be considered for future updates, but are often included in other planning mechanisms such as the Emergency Operations Plan or public health plans.

Overall Hazard Significance Summary

Members of the HMPC used a hazards worksheet to identify and rate the significance of a variety of possible hazards based on their experience and knowledge of the Planning Area. Overall hazard significance was based on a combination of Probability of Future Occurrence, and Potential Impact to people, property and economy (Magnitude/Severity, e.g. Extent) as defined below.

Probability of Occurrence

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence. The assessment of hazard frequency is generally based on past hazard events in the area.

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor = 2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor = 1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

Impact

Hazard impacts were assessed in three categories: impacts on people, impacts on property, and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total population exposed to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people who live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High – 50% or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium – 25% to 49% of the population is exposed to a hazard (Impact Factor = 2)
  - Low – 24% or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact – None of the population is exposed to a hazard (Impact Factor = 0)
- **Property**—Values were assigned based on the percentage of the total assessed property value exposed to the hazard event:
  - High – 30% or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium – 15% to 29% of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low – 14% or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact – None of the total assessed property value is exposed to a hazard (Impact Factor = 0)
- **Economy**—Values were assigned based on total impact to the economy from the hazard event and activities conducted after the even to restore the community to previous functions. Values were assigned based on the number of days the hazard impacts the community, including impacts on tourism, businesses, road closures, or government response agencies.
  - High – Community impacted for more than 7 days (Impact Factor = 3)
  - Medium – Community impacted for 1 to 7 days (Impact Factor = 2)
  - Low – Community impacted for less than 1 day (Impact Factor = 1)
  - No impact – No community impacts estimated from the hazard event (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1.

The risk rating for each hazard was calculated by multiplying the probability factor by the sum of the weighted impact factors for people, property and operations, as summarized in Table 4-1. Based on these ratings, a priority of high, medium, or low was assigned to each hazard. The hazards ranked as being of highest concern vary by jurisdiction but generally include drought, landslide, mud/debris flow, and rockfall, wildfire, and winter storm. Other hazards ranked as being of high or medium concern include dam/levee failure, extreme heat, flood, hail, lightning, and severe wind. The hazards ranked as being of lowest concern are avalanche, earthquake, erosion and deposition, expansive soils, subsidence, and tornado. Table 4-2 summarizes the hazard risk ranking.

Table 4-1 Hazard Risk Rating Calculations

Hazard	Montezuma County			City of Cortez			Town of Dolores			Town of Mancos			Cortez Fire Protection District		
	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total	Probability Factor	Impact Weighted Sum	Total
Avalanche	3	6	18	0	0	0	1	5	5	0	0	0	0	0	0
Dam/Levee Failure	1	10	10	1	6	6	2	18	36	2	18	36	1	6	6
Drought	3	18	54	3	12	36	3	8	24	3	10	30	3	12	36
Earthquake	1	9	9	1	6	6	1	15	15	1	3	3	1	6	6
Erosion and Deposition	2	6	12	1	6	6	1	5	5	2	6	12	1	6	6
Expansive Soils	2	6	12	2	9	18	0	0	0	0	8	0	2	9	18
Extreme Heat	2	16	32	2	6	12	3	6	18	2	7	14	2	6	12
Flood	2	7	14	1	6	6	3	18	54	3	7	21	1	6	6
Hail	2	8	16	2	9	18	3	5	15	3	8	24	2	9	18
Landslide, Mud/Debris Flow, Rockfall	3	6	18	1	6	6	3	5	15	3	6	18	1	6	6
Lightning	3	6	18	3	9	27	1	5	5	3	6	18	3	9	27
Severe Wind	3	12	36	3	12	36	3	5	15	2	8	16	3	12	36
Subsidence	0	0	0	1	6	6	0	0	0	0	0	0	1	6	6
Tornado	2	6	12	1	12	12	0	0	0	1	9	9	1	12	12
Wildfire	3	15	45	2	9	18	3	18	54	3	18	54	2	6	12
Winter Storm	3	13	39	3	12	36	3	16	48	2	12	24	3	12	36

Notes:
Impact Weighted Sum = Total Impact Factor People + Total Impact Factor Property + Total Impact Factor Economy
Total = Probability x Impact Weighted Sum

Table 4-2 Hazard Significance Summary

Hazard	Montezuma County	City of Cortez	Town of Dolores	Town of Mancos	Cortez Fire Protection District
Avalanche	High	No Exposure	Low	No Exposure	No Exposure
Dam/Levee Failure	Low	Low	Medium	Medium	Low
Drought	High	High	High	High	High
Earthquake	Low	Low	Low	Low	Low
Erosion and Deposition	Medium	Low	Low	Medium	Low
Expansive Soils	Medium	Medium	No Exposure	No Exposure	Medium
Extreme Heat	Medium	High	High	Medium	High
Flood	Low	Low	High	Medium	Low
Hail	Medium	Medium	High	High	Medium
Landslide, Mud/Debris Flow, Rockfall	High	Low	High	High	Low
Lightning	High	High	Low	High	High
Severe Wind	High	High	High	Medium	High
Subsidence	No Exposure	Low	No Exposure	Low	Low
Tornado	Medium	Low	Low	Low	Low
Wildfire	High	Medium	High	High	Low
Winter Storm	High	High	High	Medium	High

Hazard Identification Changes from 2015 Plan

There was no change in the identified hazards from the 2015 Montezuma County HMP and the overall hazard significance ratings have generally remained the same with the exception of landfall, mud/debris flow, rockfall for the Town of Dolores, which changed from medium to high, and wildfire for Cortez which went from low to medium. The hazard profiles have been improved with additional data and analysis. The 2020 planning process showed that recent hazard events have increased awareness of the interconnectedness of many hazards. Another difference of this plan compared to the 2015 HMP is that cultural resources were added to the vulnerability subsection of Historic, Cultural, and Natural Resources in each hazard profile to discuss impacts to the County's numerous cultural resources, where applicable. The maps and GIS analysis were updated with best available data, and the writing was made more concise across most sections.

4.1.2 Disaster Declaration History

One method used to identify hazards applicable for this HMP involved researching past events that triggered federal and state emergency or disaster declarations in Montezuma County. Federal and state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond to such hazard event and have difficulty in recovering. 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 monetary or other assistance. In other words, a presidential disaster declaration puts federal recovery programs in place to help disaster victims, business, and public agencies.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and come without the long-term federal recovery programs of major disaster declarations (Farm Service Agency 2018). The quantity and types of damage are the determining factors behind receiving these assistance sources. The following section focuses on state and federal disaster and emergency declarations.

Montezuma County is among the many communities in Colorado that are susceptible to disasters. Details on federal and state disaster declarations were obtained by the HMPC, FEMA, and the Colorado Divison of Homeland Security and Emergency Management (DHSEM) and compiled in chronological order in Table 4-2. A review of state and federal declared disasters indicates that Montezuma County experienced 8 disaster declarations between 1970 and 2020. The 2020 declarations were related to the Covid-19 pandemic, an ongoing disaster that occurred during the 2020 plan update process.

Since 2003, there have been 27 drought declarations issued by the USDA's Secretary of Agriculture in Montezuma County, 25 of which were Fast Track Secretarial disaster designations. 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 value from the U.S. Drought Monitor for eight consecutive weeks or more. Refer to the Drought hazard profile for more information of Disaster Declarations from the Secretary of Agriculture related to drought events.

Review of these events helps identify hazards for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern. More detailed event tables can be found in the individual hazard profile sections.

Table 4-3 Past Federal Disaster Declarations in Montezuma County

Disaster Declaration	Incident Type	Description	Incident Dates
DR-293	Flood	Heavy Rains and Flooding	9/22/1970
DR-396	Flood	Flooding and Landslides	7/6/1973
EM-3025	Drought	Drought	1/29/1977
DR-1421	Fire	Wildfires	4/23 – 8/6/2002
EM-3224	Coastal Storm	Hurricane Katrina Evacuation	8/29 – 10/1/2005
FM-2985	Fire	Weber Fire	6/23 – 7/6/2012
EM-3436	Biological	COVID-19	3/13/2020 – continuing
DR-4498	Biological	Colorado Covid-19 Pandemic	3/28/2020-continuing

Federal disaster declarations are coded as follows: DR = Major Disaster Declaration; EM = Emergency Declaration; FM = Fire Management Assistance
Source: FEMA Data Visualization: Disaster Declarations for States and Counites
https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

4.1.3 Overview of Hazard Identification and Risk Assessment

Section 4.3 contains detailed hazard profiles for the identified hazards. Each hazard profiled includes the following subsections:

- Hazard Profile—This section gives a description of the hazard in question and associated issues followed by details on the hazard specific to the Montezuma County Planning Area.
- Past Events—This section contains information on historical incidents, including impacts where known.
- Location– This section gives a spatial description of the potential location or areas of Montezuma County where the hazard is expected to have an impact or generally occur.
- Frequency and Severity (Extent)– The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. This section also gives a description of the potential strength or magnitude of the hazard as it pertains to Montezuma County.
- Warning Time – This section takes into consideration the speed of onset of the hazard event.
- Climate Change Considerations—Descriptions of the potential for climate change to affect the frequency and intensity of the hazard in the future.
- Vulnerability —Following the hazard profiles is a vulnerability assessment for each identified hazard. The assessment was conducted through the study of potential impacts to the following specific sectors:
    - Population
    - Property
    - Critical Facilities and Infrastructure
    - Economy
    - Historic, Cultural, and Natural Resources
- Development Trends – This section reviews current trends in land use development in the county and how that might impact the vulnerability to specific hazards in the County.
- Risk Summary —Summary of the key issues/problems based on threat, vulnerability and consequence to the Planning Area and jurisdictions from the specific hazard.

4.2 Assets Summary

4.2.1 Methodology

This vulnerability assessment is an attempt to quantify assets at risk, by jurisdiction where possible, to further define populations, properties, and critical facilities at risk to hazards identified in this plan. The methods of analysis vary by hazard type and data available.

Data to support the vulnerability assessment was collected and compiled from the following sources:

- GIS data (spatial data such as hazard threats, base layers like hydrology, boundaries, roads, etc. assessor's data)
- Written descriptions of inventory and risks provided by participating jurisdictions and the HMPC
- Existing plans, studies, and reports with relevant information
- Plan update guides shared with planning team members and Montezuma County, City of Cortez, Town of Dolores and Town of Mancos, and the Cortez Fire Protection District.

This section assesses the population, structures, critical facilities and infrastructure, and other important assets in the Planning Areas as an initial consideration of risk to hazards identified in this plan. It begins with an inventory of people and buildings (total exposure) in the County to provide a baseline for evaluating vulnerability by hazard.

Limitations

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate, but considered sufficient for mitigation planning purposes. The results do not predict precise results and should be used only to understand relative risk. Over the long term, Montezuma County and its planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

4.2.2 Assets Exposure

As a starting point for analyzing the Planning Area's vulnerability to identified hazards, the HMPC used a variety of data to define a baseline of property exposure against which disaster impacts could be compared. If a catastrophic disaster was to occur in the Planning Area, this section describes significant assets exposed or at risk in the Planning Area. Data used in this baseline assessment included:

- Total property assets at risk based on County Assessor's Office parcel values and a digital database of building address points;
- Critical facility inventory;
- Cultural, historical, and natural resources; and
- Population growth and land use/development trends.

Total Assets at Risk

Montezuma County Assessor data was used to inventory the total number and types of parcels with improvements, defined as parcels with an improvement value greater than zero, in the County. Building content values were estimated based on the following formulas based on FEMA methods: a) Residential properties received content values worth 50% of the improved values; b) Commercial, Agricultural, and Government related properties (including State Assessed and Exempt parcels) received content values worth 100% of the improved values; and, c) Industrial properties received content values worth 150% of the improved values. Adding up these content and original improved values yields the Total Value of Improved Parcels, which is an estimation of the total property exposure within the County. Building counts were based on an address point database to further refine the number of structures, as one parcel may have multiple buildings. The summary does not include inventory for the Ute Mountain Ute Tribe, which has a separate hazard mitigation plan.

Table 4-4 Property Exposure Summaries by Jurisdiction and Parcel Type

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
City of Cortez	Commercial	321	463	$85,164,926	$85,164,926	$170,329,852
	Exempt	56	209	$21,697,743	$21,697,743	$213,725,338
	Industrial	12	14	$3,413,194	$5,119,791	$51,928,471
	Mixed Use	41	122	$13,463,737	$13,463,737	$35,460,459
	Residential	2,756	3,676	$370,908,176	$185,454,088	$583,289,738

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
	Vacant Land	76	77	$18,623,831	$18,623,831	$593,609,926
	Total	**3,262**	**4,561**	**$513,271,607**	**$329,524,116**	**$1,648,343,784**
Town of Dolores	Commercial	33	35	$4,581,882	$4,581,882	$9,163,764
	Exempt	6	25	$1,382,127	$1,382,127	$11,928,018
	Mixed Use	19	47	$3,780,218	$3,780,218	$10,324,690
	Residential	335	404	$44,978,038	$22,489,019	$75,027,493
	Vacant Land	8	9	$872,223	$872,223	$69,211,503
	Total	**401**	**520**	**$55,594,488**	**$33,105,469**	**$175,655,468**
Town of Mancos	Commercial	30	35	$5,876,227	$5,876,227	$11,752,454
	Exempt	14	53	$3,221,324	$3,221,324	$18,195,102
	Industrial	5	5	$756,818	$756,818	$7,956,284
	Mixed Use	15	44	$2,046,356	$2,046,356	$5,606,348
	Residential	420	488	$53,684,310	$26,842,155	$84,619,177
	Vacant Land	15	15	$2,778,987	$2,778,987	$86,084,439
	Total	**499**	**640**	**$68,364,022**	**$41,521,867**	**$214,213,804**
Unincorporated County	Agricultural	1,022	1,165	$156,649,563	$156,649,563	$313,299,126
	Commercial	107	125	$25,120,286	$25,120,286	$363,539,698
	Exempt	25	28	$2,954,006	$2,954,006	$56,148,584
	Industrial	18	19	$11,649,558	$17,474,337	$35,031,907
	Mixed Use	264	372	$71,571,909	$71,571,909	$172,267,713
	Residential	4,513	4,974	$720,717,894	$360,358,947	$1,224,220,659
	Vacant Land	136	141	$41,222,535	$41,222,535	$1,163,521,911
	Total	**6,085**	**6,824**	**$1,029,885,751**	**$675,351,583**	**$3,328,029,598**
Grand Total		**10,247**	**12,545**	**$1,667,115,868**	**$1,079,503,035**	**$5,366,242,654**

Source: Montezuma County Assessor. Wood GIS analysis

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. As defined for this hazard mitigation plan update, critical facilities include but are not limited to the following (as defined by the CWCB):

- Essential services facilities:
  - Public safety (police stations, fire and rescue stations, emergency vehicle and equipment storage, and emergency operation centers)
  - Emergency medical (hospitals, ambulance service centers, urgent care centers having emergency treatment functions, and non-ambulatory surgical structures but excluding clinics, doctors' offices, and non-urgent care medical structures that do not provide these functions)
  - Designated emergency shelters
  - Communications (main hubs for telephone, broadcasting equipment for cable systems, satellite dish systems, cellular systems, television, radio, and other emergency warning systems, but excluding towers, poles, lines, cables, and conduits)
  - Public utility plant facilities for generation and distribution (hubs, treatment plants, substations and pumping stations for water, power and gas, but not including towers, poles, power lines, buried pipelines, transmission lines, distribution lines, and service lines)
  - Air transportation lifelines (airports [municipal and larger], helicopter pads and structures serving emergency functions, and associated infrastructure [aviation control towers, air traffic control centers, and emergency equipment aircraft hangars]).

- Hazardous materials facilities:
  - Chemical and pharmaceutical plants
  - Laboratories containing highly volatile, flammable, explosive, toxic, or water-reactive materials
  - Refineries
  - Hazardous waste storage and disposal sites
  - Aboveground gasoline or propane storage or sales centers
- At-risk population facilities:
  - Elder care (nursing homes)
  - Congregate care serving 12 or more individuals (day care and assisted living)
  - Public and private schools (pre-schools, K-12 schools, before-school and after-school care serving 12 or more children)
- Facilities vital to restoring normal services:
  - Essential government operations (public records, courts, jails, building permitting and inspection services, community administration and management, maintenance and equipment centers)
  - Essential structures for public colleges and universities (dormitories, offices, and classrooms only)

Table 4-5 through Table 4-9 summarizes the general types of critical facilities and infrastructure in each municipality and unincorporated county areas. Figure 4-1 through Figure 4-4 show the location of critical facilities infrastructure in the planning area. Due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. The risk assessment for each hazard discusses critical facilities with regard to that hazard.

Table 4-5 Unincorporated Montezuma County

CWCB Type	Facility Type	Count
At-Risk Population	Nursing Home/ Assisted Living	1
	School	9
	Total	10
Essential Services	Airport	1
	Communications	16
	Compressor Station	7
	Fire Station	11
	Helicopter Pad	3
	Emergency Medical	2
	Park or Rec. Facility	1
	Police Station	1
	Power	25
	Search and Rescue	1
	Substation	5
	Water Tank	73
	Water Treatment	1
	Total	16
	City Offices	1
	County Offices	3
	Maintenance Yard	4
	Total	8
Grand Total		**91**

Source: Montezuma County Assessor. Wood GIS analysis

Table 4-6 Critical Infrastructure in City of Cortez

CWCB Type	Facility Type	Count
At-Risk Population	Nursing Home/ Assisted Living	6
	School	18
	Total	24
Essential Services	Communications	7
	Fire Station	2
	Helicopter Pad	1
	Emergency Medical	6
	Police Station	1
	Sewage Treatment	1
	Total	18
Vital to Restoring Service	Child Advocacy Center	1
	City Offices	4
	County Offices	10
	Court House	2
	Food Bank	1
	Jail	1
	Library	1
	Total	20
Grand Total		**62**

Source: Montezuma County Assessor. Wood GIS analysis

Table 4-7 Critical Infrastructure in Town of Dolores

CWCB Type	Facility Type	Count
At-Risk Population	Nursing Home/ Assisted Living	2
	School	5
	Total	7
Essential Services	Fire Station	1
	Park or Rec. Facility	1
	Police Station	1
	Sewage Treatment	1
	Water Treatment	1
	Total	5
Vital to Restoring Service	City Offices	1
	Library	1
	Total	2
Grand Total		**14**

Source: Montezuma County Assessor. Wood GIS analysis

Table 4-8 Critical Infrastructure in Town of Mancos

CWCB Type	Facility Type	Count
At-Risk Population	Nursing Home/ Assisted Living	2
	School	8
	Total	10
Essential Services	Fire Station	2
	Park or Rec. Facility	2

CWCB Type	Facility Type	Count
	Police Station	1
	Sewage Treatment	1
	Substation	1
	Total	7
Vital to Restoring Service	City Offices	1
	County Offices	1
	Library	1
	Total	3
Grand Total		**20**

Source: Montezuma County Assessor. Wood GIS analysis

Table 4-9 Critical Infrastructure in the Cortez Fire Protection District

CWCB Type	Facility Type	Count
At-Risk Population	Nursing Home/ Assisted Living	7
	School	22
	Total	29
Essential Services	Airport	1
	Communications	7
	Emergency Medical	6
	Fire Station	3
	Helicopter Pad	4
	Police Station	1
	Power	1
	Search and Rescue	1
	Sewage Treatment	1
	Substation	4
	Water Treatment	1
	Total	30
Vital to Restoring Service	Child Advocacy Center	1
	City Offices	4
	County Offices	10
	Court House	2
	Food Bank	1
	Jail	1
	Library	1
	Maintenance Yard	1
	Total	21
Grand Total		**80**

Source: Montezuma County Assessor. Wood GIS analysis

Figure 4-1 Critical Facilities in Montezuma County

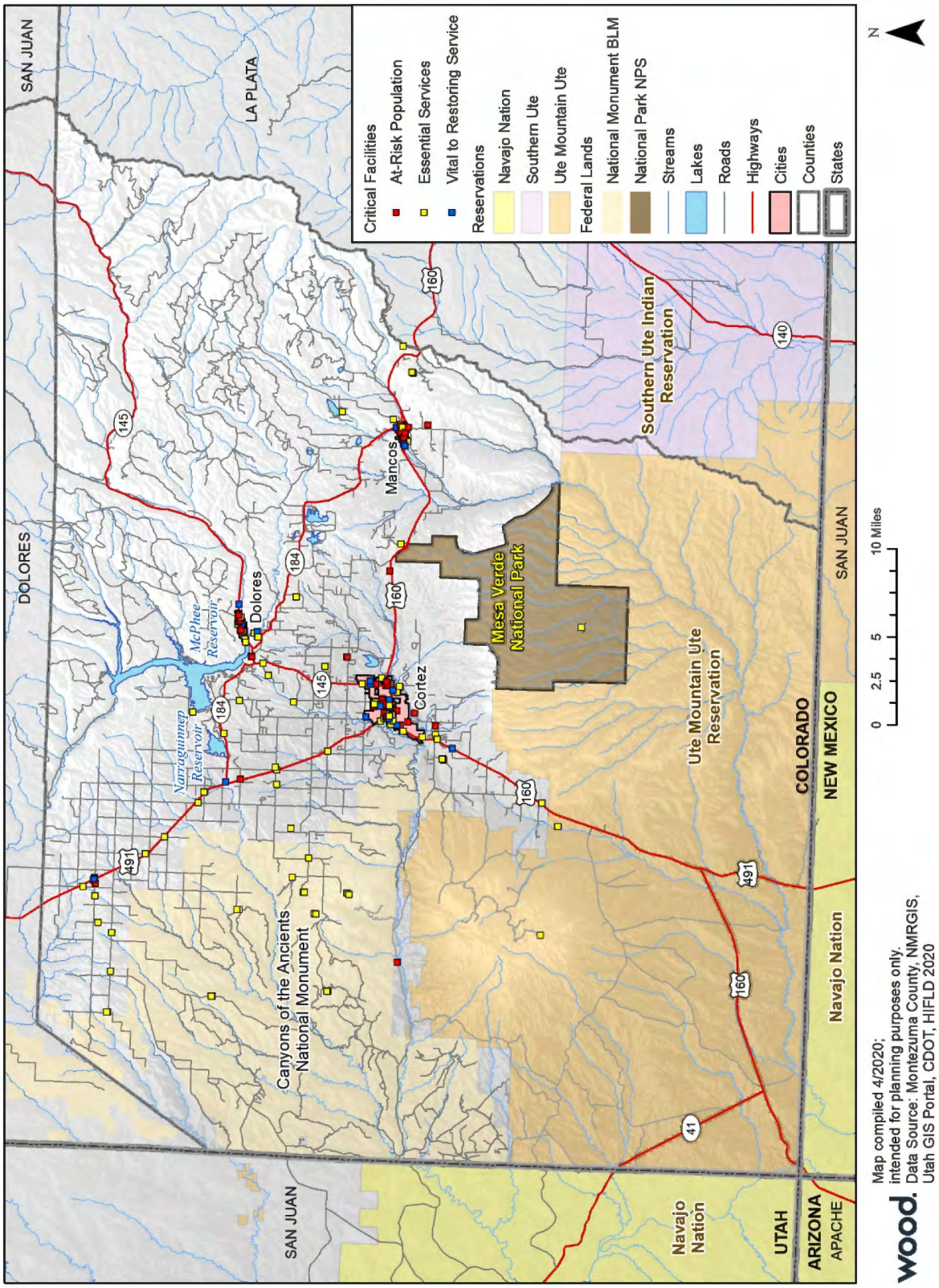


Figure 4-2 Critical Facilities in the City of Cortez

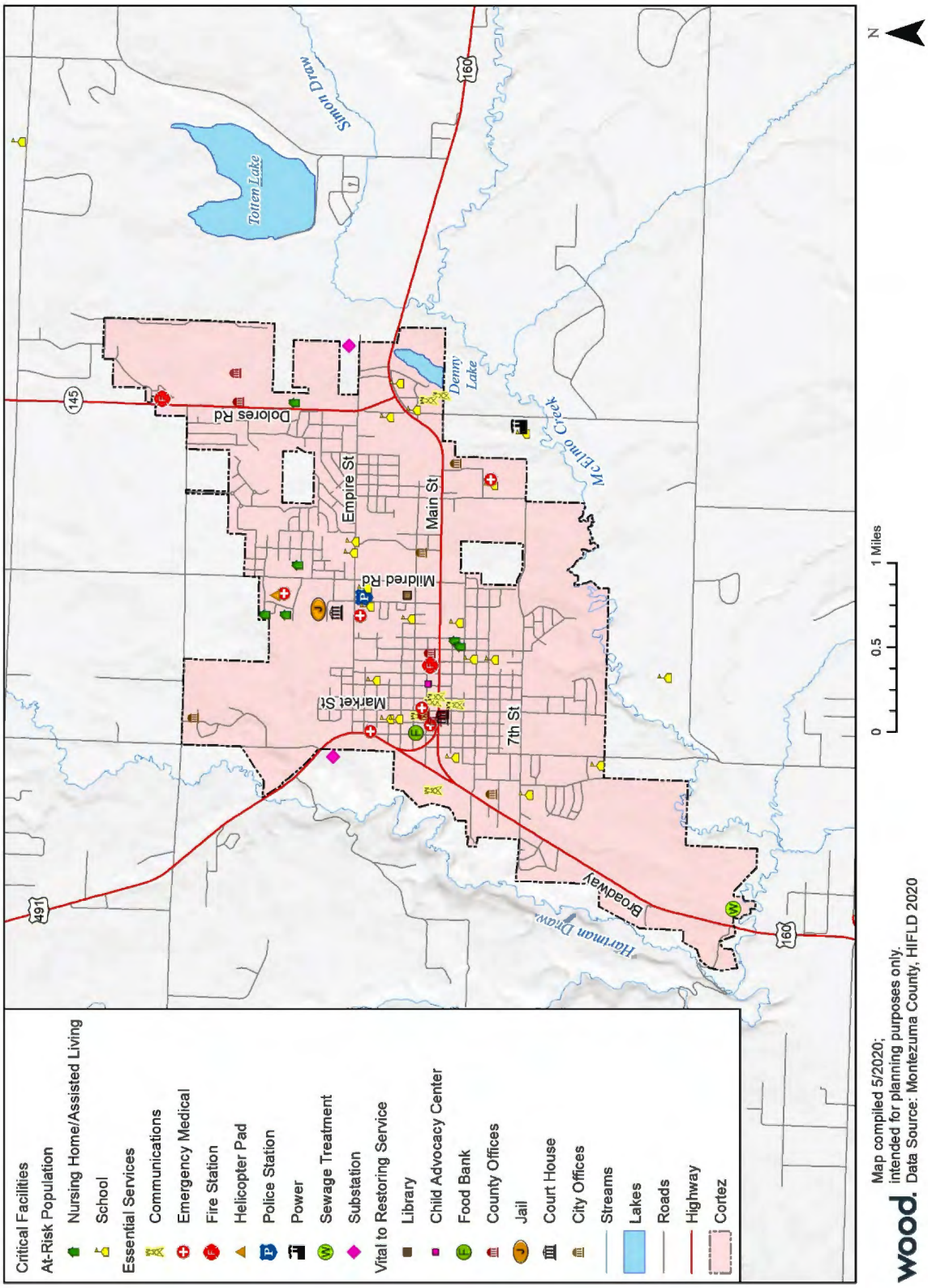


Figure 4-3 Critical Facilities in the Town of Dolores

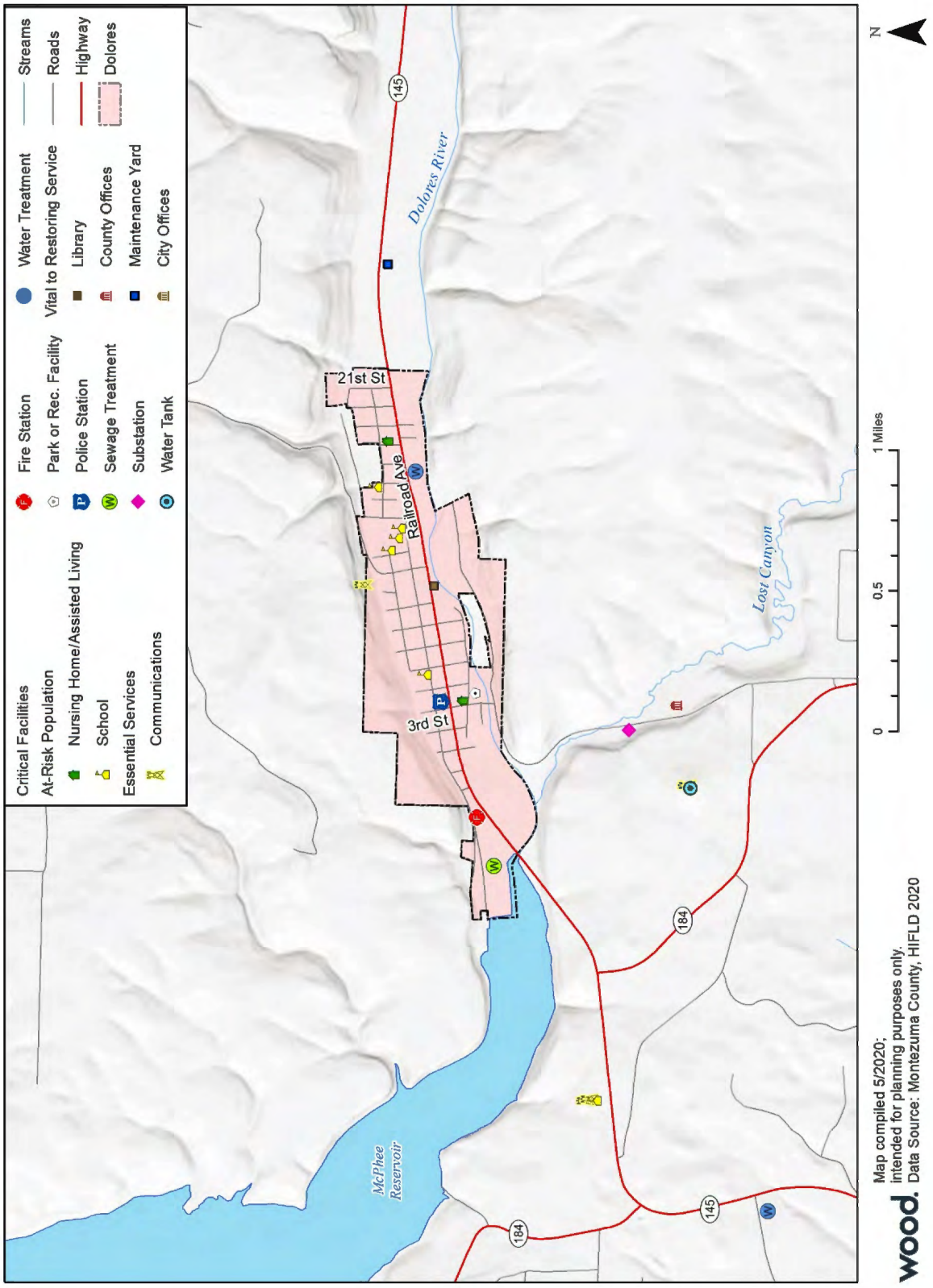
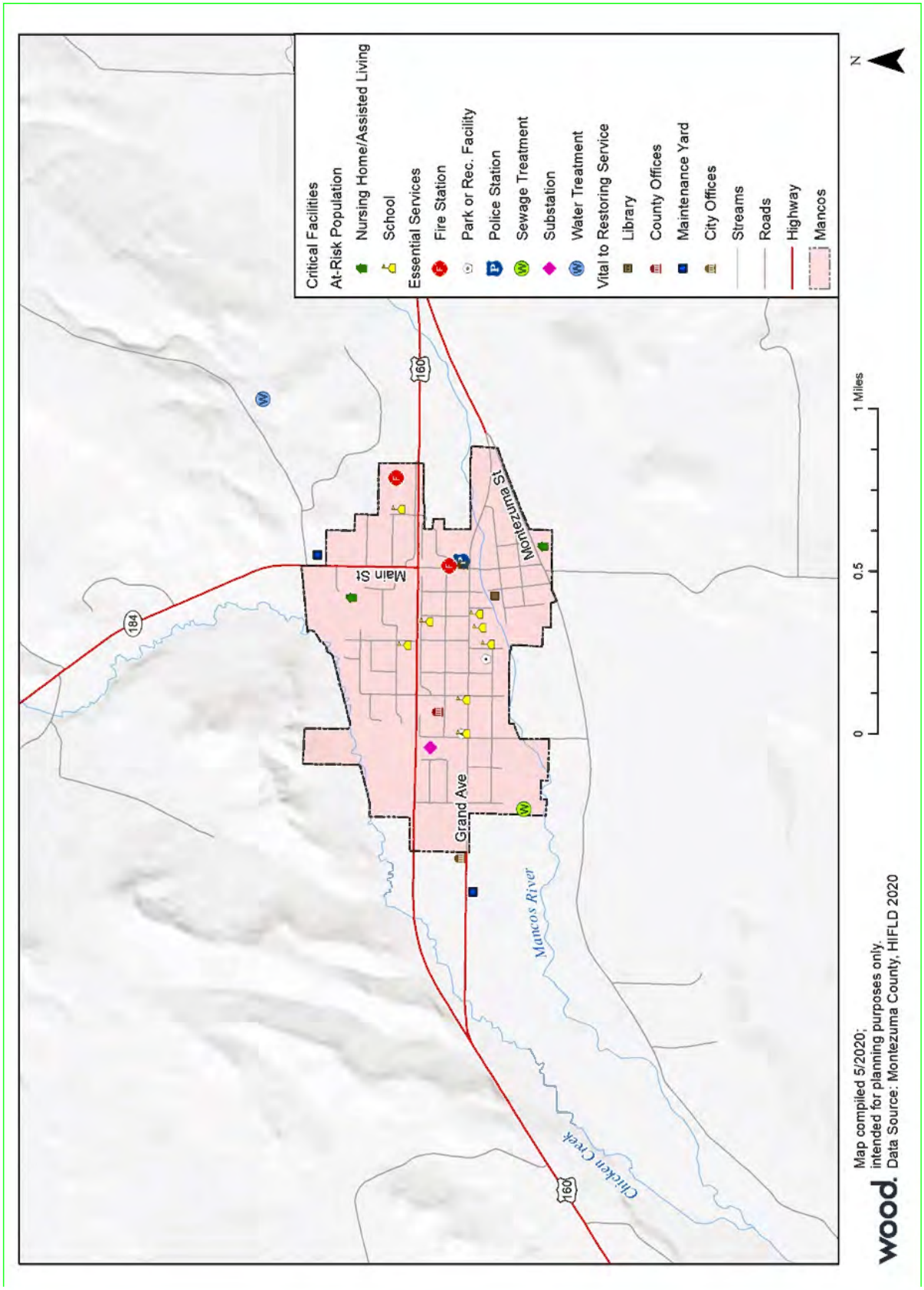


Figure 4-4 Critical Facilities in the Town of Mancos



Natural Assets, Historic and Cultural Resources

Natural resources are important for protection from hazards, and they also can help mitigate hazards. For instance, protecting wetlands areas protects sensitive habitat as well as attenuates and stores floodwaters. Montezuma County's fauna, flora, spectacular views, natural environmental assets and historic and cultural resources draw visitors from around the world every year.

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 take into account identified at-risk species (threatened and endangered species) in the planning area. 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. An endangered species is any species of plant life or wildlife (birds, fish, mammals, etc.) that is in danger of extinction throughout all or most 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.

According to the U.S. Fish and Wildlife Service there are 14 Federal endangered, threatened, recovering, or candidate species in Montezuma County. These species are listed in Table 4-10 along with state listed species. State special concern is not a statutory category but suggests a species may be in danger.

Table 4-10 Sensitive Species Occurring in the Planning Area

Group	Name	Status
Birds	Yellow-billed Cuckoo (*Coccyzus americanus*)	Candidate
Birds	Mexican spotted owl (*Strix occidentalis lucida*)	Threatened
Birds	Southwestern willow flycatcher (*Empidonax traillii extimus*)	Endangered
Fishes	Colorado pikeminnow (=squawfish) (*Ptychochuciuslucius*)	Endangered
Fishes	Greenback Cutthroat trout (*Oncorhynchus clarki stomias*)	Threatened
Fishes	Razorback sucker (*Xyrauchen texanus*)	Endangered
Flowering Plants	Schmoll milk-vetch (*Astragalus schmolliae*)	Candidate
Flowering Plants	Mancos milk-vetch (*Astragalus humillimus*)	Endangered
Flowering Plants	Mesa Verde cactus (*Sclerocactus mesae-verdae*)	Threatened
Flowering Plants	Sleeping Ute milk-vetch (*Astragalus tortipes*)	Candidate
Mammals	Black-footed ferret (*Mustela nigripes*)	Experimental Population, Non-Essential
Mammals	Canada Lynx (*Lynx canadensis*)	Threatened
Mammals	New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)	Candidate
Mammals	North American wolverine (*Gulo luscus*)	Candidate

Source: US Fish and Wildlife Service Species by County Report

Historic and Cultural Resources

There are many important historic resources within Montezuma County. A historic property not only includes buildings or other types of structures such as bridges and dams but can also refer to prehistoric or Native American sites, roads, byways, historic landscapes, and such other features. Given the history of the County, these types of historic properties exist; some are inventoried and listed in this plan.

Historic properties and cultural resources are also valuable economic assets that increase property values and attract businesses and tourists. Far from being at odds with economic development, preservation of these assets is often an important catalyst for economic development (e.g., historic downtown revitalization programs leading to growth in heritage tourism).

Information about historic assets in Montezuma County came from local sources, the HMPC, and the following two historic inventories:

- National Register of Historic Places. 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.
- Colorado State Register of Historic Properties. A listing of the state's significant cultural resources worthy of preservation for the future education and enjoyment of Colorado's residents and visitors. Properties listed in the Colorado State Register include individual buildings, structures, objects, districts, and historic and archaeological sites. The Colorado State Register program is administered by the Office of Archaeology and Historic Preservation within the Colorado Historical Society. Properties listed in the National Register of Historic Places are automatically placed in the Colorado State Register.

Table 4-11 below lists the properties and districts in Montezuma County that are on the Colorado State Register of Historic Properties and the National Register of Historic Places. All listed historic properties in the Planning Area are on both the State and National registers. The area contains significant Native American cultural sites including Mesa Verde National Park, Canyons of The Ancients National Monument, and the Ute Mountain Ute Reservation and Tribal Park.

Table 4-11 Montezuma County Historic Properties on State and National Registers

Property Name	Register	Location	Date Listed
Albert Porter Pueblo	National	Yellow Jacket vicinity	March 18, 1999
Anasazi Archaeological District	National	Northwest of Dolores	July 19, 1984
Bass Site	National	Yellow Jacket vicinity	June 11, 1999
Bauer Bank Building	National/State	107 W. Grand Ave., Mancos	Oct. 11, 2003
Bauer House	State	102 Bauer Ave., Mancos	Sep. 11, 1996
Baxstrom Upper Place Homestead House	State	Cortez vicinity	Aug. 31, 2006
Bement Site	State	Mancos vicinity	March 2, 2013
Cannonball Ruins	National	Cortez vicinity	April 30, 1997
Cortez High School	National	121 E. First Street, Cortez	March 22, 2016
Ertel Funeral Home	National	42 N. Market St., Cortez	Nov. 7, 1995
Escalante Ruin	National	West of Dolores	Nov. 20, 1975
Far View Visitor Center	State	Park Entrance Road, Mesa Verde National Park, Cortez Vicinity	Sep. 26, 2018
Galloping Goose Engine No. 5	State	421 Railroad Ave., Dolores	March 9, 1994
Great Pueblo Period of the McElmo Drainage Unit, AD 1075-1300 (multiple properties)	National	Yellow Jacket vicinity	June 11, 1999
Haynie Site	National	Mancos vicinity	Nov. 13, 2017
Hovenweep National Monument	National	Cortez vicinity	Oct. 15, 1996

Property Name	Register	Location	Date Listed
Indian Camp Ranch Archaeological District	National	Cortez vicinity	March 28, 2012
James A. Lancaster Site/Clawson Ruin	National	Pleasant View vicinity	April 14,1980
Joe Ben Wheat Site Complex	National	Yellow Jacket vicinity	Jan. 16, 2004
Lebanon School	National	24925 County Rd. T, Dolores vicinity	May 29, 1996
Lost Canyon Archaeological District	National	Mancos vicinity	Oct. 18, 1988
Lowry Ruin	National	30 miles northwest of Cortez	Oct. 15, 1966 *National Historic Landmark: July 19,1964
Mancos High School	National	350 Grand Ave., Mancos	Dec. 23, 1991
Mancos Opera House	National	136 W. Grand Ave., Mancos	Jan. 7, 1988
Maxwell Community	State	Southwest of Cortez	Sep. 9, 1998
Mesa Verde Administration District	National	Mesa Verde National Park, Cortez	May 28, 1987 * National Historic Landmark: Feb. 28, 1987
Mesa Verde National Park Archaeological District	National/World Heritage Site	US Hwy. 160, 8 miles east of Cortez	Oct. 15, 1966
Mitchell Springs Ruin Group	National/State	Cortez vicinity	March 8, 2000
Montezuma Valley Irrigation Company Flume No. 6	National	Cortez vicinity	March 27, 2012
Montezuma Valley National Bank and Store	National	2-8 Main St., Cortez	Jan. 15, 2009
Mud Springs Pueblo	National	Cortez vicinity	Oct. 29, 1982
O'Brien Site	State	Dolores vicinity	March 2, 2013
Pigge Site	National	Pleasant View vicinity	April 7, 1980
Puzzle House	State	Pleasant View vicinity	Sep. 9, 1998
Puzzle House Archaeological District	State	Pleasant View vicinity	Nov. 20, 2008
R.S.S. Fox House	State	214 S. 8th St., Dolores	May 5, 2018
Roy's Ruin	National	Cortez vicinity	Jan. 31, 1992
Sand Canyon	National	Cortez vicinity	March 5, 2015
Seven Towers Pueblo	National	Yellow Jacket vicinity	June 11, 1999
The Southern Hotel/Rio Grande Southern Hotel	National	101 S. 5th St., Dolores	Feb. 23, 1989
Ute Mountain Ute Mancos Canyon Historic District	National	Southeast of Towac	May 2, 1972
Wallace Ruin	State	Cortez vicinity	March 3, 2012
Woods Canyon Pueblo	National	Yellow Jacket vicinity	June 11, 1999
Wrightsman House	National	208 Bauer Ave., Mancos	Feb. 14, 1997
Yellowjacket Pueblo/Surouaro	National	Yellow Jacket vicinity	Sep. 28, 1985
Yucca House National Monument	National	Via US Hwy. 666, 12 miles south of Cortez	Oct. 15, 1966

Source: History Colorado, National & State Register Listed Properties

Climate Change

Climate includes patterns of temperature, precipitation, humidity, wind, and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. "Climate change" refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase.
- More extreme precipitation is likely, increasing the risk of flooding.
- The world's average temperature is expected to increase.

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding, and wildfires; and more heat-related stress. In many cases, communities are already facing these problems to some degree. Climate change influences the frequency, intensity, extent, or magnitude of the problems.

This hazard mitigation plan addresses climate change considerations for each identified hazard of concern. Each hazard profile includes a section with a qualitative discussion on the probable impacts of climate change for that hazard.

4.3 Avalanche

AVALANCHE HAZARD RANKING	
Montezuma County	High
City of Cortez	No Exposure
Town of Dolores	Low
Town of Mancos	No Exposure
Cortez Fire Protection District	No Exposure

DEFINITIONS

Avalanche—Any mass of loosened snow or ice and/or earth that suddenly and rapidly breaks loose from a snowfield and slides down a mountain slope, often growing and accumulating additional material as it descends.

Slab avalanches—The most dangerous type of avalanche, occurring when a layer of coherent snow ruptures over a large area of a mountainside as a single mass. Like other avalanches, slab avalanches can be triggered by the wind, by vibration, or even by a loud noise, and will pull in surrounding rock, debris, and even trees.

Climax avalanches—An avalanche involving multiple layers of snow, usually with the ground as a bed surface.

Loose snow avalanches—An avalanche that occurs when loose, dry snow on a slope becomes unstable and slides. Loose snow avalanches start from a point and gather more snow as they descend, fanning out to fill the topography.

Powder snow avalanches—An avalanche that occurs when sliding snow has been pulverized into powder, either by rapid motion of low-density snow or by vigorous movement over rugged terrain.

Surface avalanches—An avalanche that occurs only in the uppermost snow layers.

4.3.1 Hazard Profile

Avalanches can occur whenever a sufficient depth of snow is deposited on slopes steeper than approximately 20 degrees, with the most dangerous coming from slopes in the 35- to 40-degree range. Avalanche-prone areas can be identified with some accuracy, since they typically follow the same paths year after year, leaving scarring on the paths. However, unusual weather conditions can produce new paths or cause avalanches to extend beyond their normal paths.

In the spring, warming of the snowpack occurs from below (from the warmer ground) and above (from warm air, rain, etc.). Warming can be enhanced near rocks or trees that transfer heat to the snowpack. The effects of a snowpack becoming weak may be enhanced in steeper terrain where the snowpack is shallow, and over smooth rock faces that may focus meltwater and produce "glide cracks." Such slopes may fail during conditions that encourage melt.

Wind can affect the transfer of heat into the snowpack and associated melt rates of near-surface snow. During moderate to strong winds, the moistening near-surface air in contact with the snow is constantly mixed with drier air above through turbulence. As a result, the air is continually drying out, which enhances evaporation from the snow surface rather than melt. Heat loss from the snow necessary to drive the evaporation process cools off near-surface snow and results in substantially less melt than otherwise might occur, even if temperatures are well above freezing.

When the snow surface becomes uneven in spring, air flow favors evaporation at the peaks, while calmer air in the valleys favors condensation there. Once the snow surface is wet, its ability to reflect solar energy drops dramatically; this becomes a self-perpetuating process, so that the valleys deepen (favoring calmer air and more heat transfer), while more evaporation occurs near the peaks, increasing the differential between peaks and valleys. However, a warm wet storm can quickly flatten the peaks as their larger surface area exposed to warm air, rain or condensation hastens their melt over the sheltered valleys.

Avalanches can reach speeds of up to 200 miles per hour (mph) and can exert forces great enough to destroy structures and uproot or snap off large trees. Avalanche paths consist of a starting zone, a track, and a runout zone. The runout zone is often an attractive setting for development.

Avalanche hazards occur predominantly in the mountainous regions of Colorado above 8,000 feet. The clear majority of avalanches occur during and shortly after winter storms, during the winter and spring months between November and April. The most avalanche-prone months are, in order, February, March, and January. Avalanches caused by thaw occur most often in April (Colorado Avalanche Information Center). The avalanche danger increases with major snowstorms and periods of thaw. About 2,300 avalanches are reported to the Colorado Avalanche Information Center (CAIC) in an average winter. More than 80 percent of these occur during or just after large snowstorms.

According to the CAIC, avalanches have killed more people in Colorado than any other natural hazard since 1950, and Colorado accounts for one-third of all avalanche deaths in the United States (CAIC no date). Avalanche forecasts were first issued by the Colorado Avalanche Warning Center in 1973. The program was originally part of a federal research program but has been a part of the Colorado State government since 1983. The CAIC is now a program within the Colorado Department of Natural Resources (DNR), Executive Director's Office. The program is a partnership between the DNR, Colorado Department of Transportation (CDOT), and the Friends of the CAIC (FoCAIC) a 501(c)3 group. The mission of the CAIC is to provide avalanche information and education and to promote research for the protection of life, property, and the enhancement of the state's economy (CAIC no date).

4.3.2 Past Events

Although infrequent, avalanches do occur periodically in this region. Generally, avalanches in Montezuma County are relatively minor. There have been two recorded deaths attributable to avalanches in Montezuma County since 1950. The fatalities occurred in the San Juan Mountains in 2013 and 2014 and both victims were snowmobilers.

According to the HMPC, the 2014 event was a slide north of Sharkstooth mountains trigged by a snowmobile and resulted in five individuals being trapped and one being killed. While this area is remote and tends to see less skiers, if a rescue was needed the response time could be very long and communication capabilities difficult. A representative for the County's Search and Rescue (SAR) noted the team was less prepared back in 2014 compared to 2020. The SAR now uses their social media pages to post avalanche warnings from the CAIC.

4.3.3 Location

The greatest impact from an avalanche is in the southern San Juan Mountains in the northeastern portion of Montezuma County. The Town of Dolores is located on the southern portion of the mountains and has a moderately higher risk of avalanche compared to the City of Cortez and Town of Mancos.

There is no mapped avalanche risk zone information available for Montezuma County. A 2017 avalanche path layer used for the Colorado Hazard Mitigation Plan 2018 update was referenced; there is a small path that touches the edge of northeastern Montezuma County affecting Highway 145, primarily in Dolores County.

4.3.4 Frequency and Severity

The probability of a damaging avalanche occurring in the future is low and was considered as such by the planning committee.

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.

According to the CAIC an average of 27 people have died each year in avalanches in the United States over the past 10 winters. Most fatal incidents are investigated and reported; however, non-fatal incidents are likely to go unreported (CAIC). Colorado has recorded the greatest number of fatalities due to avalanches of all states in the United States, total of 287 fatalities in the state since 1951.

Avalanches can result in injury, death and limited property damage in the County. A road closed due to avalanche activity can result in serious transportation disruptions as well as limited emergency response capabilities due to the limited number of roads in the County and minimal personnel. While the small mapped path on the northeastern portion of the county along State Highway 145 is primarily located in Dolores County, impacts to the highways could obstruct access into the County causing an interruption in the flow of goods and services, largely having an economic impact on the County. Backcountry avalanche incidents involve search and rescue teams and resources, which can put these personnel in areas of risk.

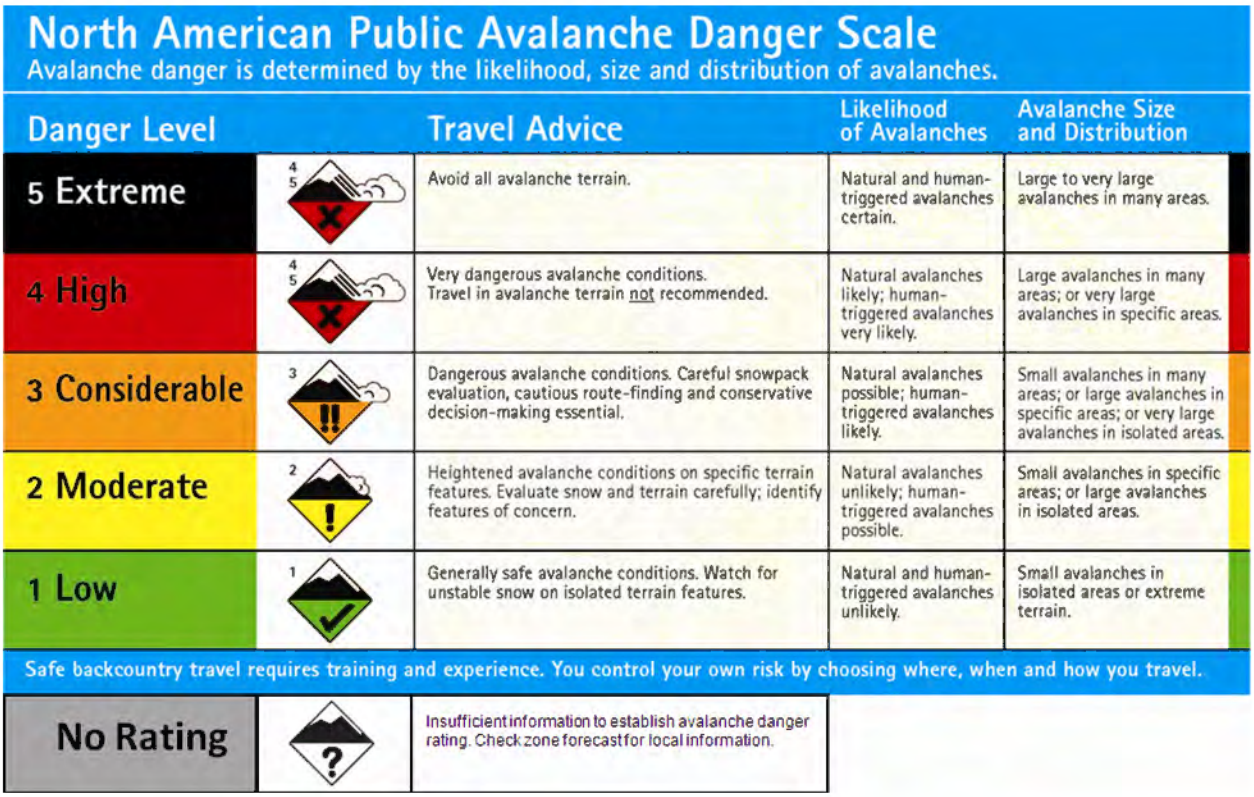
The severity of the avalanche hazard in the county is considered to be moderate to limited with isolated deaths and injuries; minimal property damage that does not threaten structural stability; and or interruption of essential facilities and services for less than 24 hours. Based on the information in this hazard profile, including two recent fatalities, the magnitude/severity of an avalanche, its overall significance is considered to have a moderate potential impact for the county. The magnitude/severity of an avalanche for the Town of Dolores is also minimal. The City of Cortez and Town of Mancos are not exposed to potential avalanches.

4.3.5 Warning Time

The time of an avalanche release depends on the condition of the snowpack; which can change rapidly during a day and particularly during rainfall. Although forecasts can provide information regarding when avalanches are more likely to occur, an avalanche can occur with little or no warning time.

CAIC issues watches and warnings by zone to communicate avalanche danger levels to those recreating in backcountry areas. The North American Danger Scale, which ranges from low to extreme danger is shown in Figure 4-5.

Figure 4-5 Avalanche Danger Scale



North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size and distribution of avalanches.

Danger Level	Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High	Very dangerous avalanche conditions. Travel in avalanche terrain not recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

No Rating	Insufficient information to establish avalanche danger rating. Check zone forecast for local information.

Source: Colorado Avalanche Information Center Website (http://avalanche.state.co.us/wp-content/uploads/2013/09/ads.jpg.)
Source: Colorado Avalanche Information Center Website (http://avalanche.state.co.us/forecasts/backcountry-avalanche/front-range/)

4.3.6 Related Hazards

Avalanches are often caused by heavy snowfall and can also be triggered by a blizzard event with severe wind as well increased temperatures. Severe avalanches also can also temporarily dam rivers or streams with woody debris and might pose a subsequent flood risk.

4.3.7 Climate Change Considerations

The likelihood and nature of future avalanches may be affected by climate change. Winters are becoming shorter, which means there is potential for weaker snow accumulations at the very bottom of the snowpack. As more snow piles on top of the weak layer, and temperatures remain warm, the upper, moisture-laden layers became vulnerable to sliding. More extreme precipitation events that deposit large amounts of snow in a short period of time as well increased temperatures could also periodically increase the potential for large avalanches. The extent of avalanche activity and debris in parts of the southwestern and central mountains during the 2019 winter in Colorado was unprecedented from CAIC's perspective. The CAIC is studying the age of trees felled by the avalanches in 2019 to gain a better understanding of the recurrence interval of the extreme event; some trees were more than 250 years old (Purtell 2019).

4.3.8 Vulnerability

Overall, public safety is the primary concern regarding avalanche hazards and vulnerability. Building impacts are negligible. Backcountry recreationalists, road crews, and motorists along Highway 145 are the most at risk to avalanche dangers. Rising numbers of outdoor enthusiasts may lead to an increase in fatal avalanche occurrences. Beyond backcountry skiing, there has been a growing interest in other forms of recreation, and an introduction of new toys that are bigger, heavier, and intensify avalanche susceptibility.

There is no effective way to keep the public out of avalanche-prone recreational areas, even during times of highest risk, but education and hazard awareness can help to reduce impacts on life safety in combination with self-rescue tools such as locater beacons, shovels, and probes.

Population

Mountain communities are exposed to avalanche risk; however, the greatest exposure to the avalanche hazard is to persons participating in outdoor recreation in backcountry areas. The greatest impact from an avalanche is to mountain communities in the southern San Juan Mountains as well as U.S. Highway 145. Avalanches are also a danger to backcountry skiers, snowmobilers, and others involved in outdoor sports in these areas. The populations of Cortez, Mancos, and Dolores are unlikely to be affected by avalanches.

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.

Property

Avalanche exposure in the county is minimal. The City of Cortez and Town of Mancos are not in avalanches exposure areas. The Town of Dolores has a slightly higher potential for property damage, but damage is still likely to be insignificant.

Critical Facilities and Infrastructure

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. 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. There is a small amount of road infrastructure that could be blocked by avalanches, such as Colorado State Highway 145. This highway may be temporarily closed due to avalanches. CDOT and the CAIC monitors and controls 278 of 522 known avalanche paths in Colorado. According to the CDOT Avalanche Control website “When there is a high risk of avalanche danger, CDOT will close highways at the location of the avalanche path in order to conduct avalanche control. Once all the unstable snow has been brought down, CDOT crews have to clear all of the snow and debris from the roadway before reopening the highway to traffic. Since it is impossible to predict how much snow will be brought down during a control mission, CDOT cannot estimate how long a highway closure will be in place. CDOT will open the highway as soon as it is safe for the traveling public” (CDOT).

Economy

Avalanche activity inside or outside the county (along connecting roadways) can disrupt transportation in and out of the local communities, which could result in temporary economic impacts. Closures of Highway 145 could prevent the import and export of goods and services into the county.

Historic, Cultural and Natural 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. None of the mapped avalanche paths are shown to impact the historic or cultural resources in the County.

4.3.9 Development Trends

Future trends in development cannot be determined until the avalanche hazard areas are accurately mapped. The population of Montezuma County is increasing and some of this new development may be occurring in avalanche hazard areas, but this is suspected to be low.

4.3.10 Risk Summary

- Since 1950 there have been 2 fatalities in the County.
- Backcountry recreationalists, road crews, and motorists along the main roadways are the most at risk to avalanche dangers. Human-caused avalanches are most common cause of events.
- Closure of Highway 145 due to an avalanche could impact the local economy by preventing the import and export of good and services.
- The City of Cortez and Town of Mancos are not in avalanche exposure areas. The Town of Dolores has a slightly higher potential for property damage, but damage is still likely to be insignificant.
- Related hazards: Winter Storm, Severe Wind.

4.4 Dam and Levee Failure

DAM/LEVEE FAILURE HAZARD RANKING	
Montezuma County	Low
City of Cortez	Low
Town of Dolores	Medium
Town of Mancos	Medium
Cortez Fire Protection District	Low

4.4.1 Hazard Profile

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

Causes of Dam Failure

A dam failure is the collapse, breach, or other failure of a dam that causes downstream flooding. Dam failures may result from natural events, human-caused events, or a combination thereof. Due to the lack of advance warning, failures resulting from natural events, such as hurricanes, earthquakes, or landslides, may be particularly severe. Prolonged rainfall that produces flooding is the most common cause of dam failure.

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

- Overtopping of the primary dam structure, which accounts for 34% of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30% of all dam failures.
- Failure due to piping and seepage accounts for 20% of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.

DEFINITIONS

Dam—A man-made barrier, together with appurtenant structures, constructed above the natural surface of the ground for the purpose of impounding water. Flood control and storm runoff detention dams are included (2-CCR 402-1, Rule 4, Section 4.2.5).

Dam Failure—An uncontrolled release of impounded water due to structural deficiencies in dam.

Emergency Action Plan—A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

High Hazard Dam—Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Significant Hazard Dam—Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10% of all failures.
- The remaining 6% of U.S. dam failures are due to miscellaneous causes.

Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

In general, there are three types of dams: concrete arch or hydraulic fill, earth-rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously: the flood wave builds up rapidly to a peak then gradually declines. An earth-rockfill dam fails gradually due to erosion of the breach: a flood wave will build gradually to a peak and then decline until the reservoir is empty. Lastly, a concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

The Colorado Division of Water Resources Dam Safety Branch assigns hazard ratings to dams within the State. Two factors are considered when assigning hazard ratings: existing land use, and land use controls (zoning) downstream of the dam. Dams are classified in three categories that identify the potential hazard to life and property:

- High hazard indicates that a failure would most probably result in the loss of life
- Significant hazard indicates a failure could result in appreciable property damage
- Low hazard exists where failure would result in only minimal property damage and loss of life is very unlikely

It is important to keep in mind that the hazard classification of a dam is a measure of the consequences if the dam were to fail, not a measure of how likely the dam is to fail.

Privately owned high and significant hazard dams are required by Colorado regulations to have Emergency Action Plans (EAPs) in place. High hazard dams are also required to have inundation maps. Federally-owned high hazard dams are also required to have EAPs by federal regulations. Based on the National Inventory of Dams (NID) database (current as of 2019), all high-hazard dams in Colorado have EAPs in place, which provide for the emergency response procedures in the event of a dam emergency. According to this NID database, there are 386 high hazard dams in Colorado. Summaries from the NID indicate there are 16 dams in the County, 11 of which that pose a risk to people or property of in Montezuma County.

Causes of Levee Failure

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.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If

severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure. 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. In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the amount of water.

The complicated nature of levee protection was made evident by events such as Hurricane Katrina. Flooding can be exacerbated by levees that are breached or overtopped. As a result, the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (USACE) are re-evaluating their policies regarding enforcement of levee maintenance and post-flood rebuilding. Both agencies are also conducting stricter inspections to determine how much protection individual levees actually provide. The Colorado Water Conservation Board (CWCB) is committed to aiding local governments with the increased levels of compliance with federal regulations. CWCB will assist qualifying entities who are in good standing with the National Flood Insurance Program (NFIP) through technical and financial assistance. CWCB assistance may include grant funding, participation in levee inspections, assistance in developing Maintenance Deficiency Correction Plans, site visits, and participation in public hearings. In addition, the CWCB will also discourage the construction of new levees to protect new developments, and instead encourage other types of flood mitigation projects.

4.4.2 Past Events

Colorado has a history of dam failure, with more than 130 known dam failures since 1890. Dam safety incidents are defined as situations at dams that require an immediate response by dam safety engineers. There were a number of incidents that occurred following the September 2013 flooding on the Front Range, but many of these were related to high outflows or spillway flows and not related to structural issues. Incidents also included on the water year 2011-2012 list were associated with the large and damaging wildfires that occurred, particularly the High Park Fire and the Waldo Canyon Fire. These fires were tracked to ensure no damage would occur on dams within or near the fire areas.

According to the Association of State Dam Safety Officials, there have been no reported dam failures in Montezuma County. There are, however, two high hazard dams (Summit Main and Summit South) within the county which are listed with an unsatisfactory rating by the State Engineer, meaning they have storage restrictions due to structural concerns. The Totten Dam was listed as conditionally satisfactory and also had a storage restriction as of June 2020. There have been no levee failure events in Montezuma County.

4.4.3 Location

Dams

According to the National Inventory of Dams (NID) database, updated as of 2019, there are 17 dams of concern to Montezuma County which could cause impacts if they were to fail. Of these dams, 11 are considered high hazard, 6 others are rated as significant hazard dams to the county. There are 8 others classified as posing low hazards to the county. Note that the hazard class for the Bauer Lake #2 dam

changed from Significant to High sometime between 2015-2019. These dams are listed in Table 4-12. Figure 4-6 through Figure 4-10 show locations of the high-potential-loss dams in the county and the locations of dam inundation areas. The Groundhog Dam in adjacent Dolores County is also included, as it is located on a tributary to the Dolores River and could ultimately impact the Town of Dolores. Dam inundation areas were provided by the county and include significant portions of the Towns of Dolores and Mancos. All of the dams noted below have Emergency Action Plans.

Table 4-12 High- and Significant-Hazard Dams in Montezuma County

Name	River	Near City	Owner	Max Storage (Acre-Feet)	Hazard Class
Groundhog (in Dolores County)	Groundhog Creek	Dolores	Montezuma Valley Irrigation Company	32,450	High
Bauer Lake #2 - Main Dam	Chicken Creek-TR	Mancos	Bauer Lake Reservoir Company	2,284	High
Jackson Gulch	West Mancos River OS	Mancos	Reclamation	9,980	High
Mcphee	Dolores River	Slide Rock	Reclamation	399,200	High
Mcphee - Great Cut Dike		Aneth, UT	Reclamation	399,200	High
Narraguinnep - Dam 2	Yellowjacket Canyon-OS	Bluff, UT	Montezuma Valley Irrigation Company	22,700	High
Narraguinnep - Dam 3	Yellowjacket Canyon-OS	Bluff, UT	Montezuma Valley Irrigation Company	22,700	High
Narraguinnep - Main Dam	Narraguinnep Canyon	Bluff, UT	Montezuma Valley Irrigation Company	22,700	High
Summit - Main Dam	Lost Canyon Creek-TR	Dolores	Summit Reservoir & Irrigation Company	7,050	High
Summit - South Dam	East Fork Mud Creek-OS	Bluff, UT	Summit Reservoir & Irrigation Company	3,840	High
Totten	Simon Draw-TR	Cortez	Dolores Water Conservancy District	4,530	High
A. M. Pruett	Cash Canyon-TR	Cortez	Summit Reservoir & Irrigation Company	3,209	Significant
Bauer Lake #1	Chicken Creek-OS	Mancos	Bauer Lake Water Company	510	Significant
Bauer Lake #2 - West Dam	Chicken Creek-TR	Mancos	Bauer Lake Reservoir Co.	2,284	Significant
Big Pine	Lost Canyon-TR	Dolores	Summit Reservoir & Irrigation Company	608	Significant
Cortez #1	McElmo Creek-TR	Cortez	City of Cortez	145	Significant
Mcgechie	Hartman Draw-TR	Cortez	Michael Mcgechie,	40	Significant

Source: National Inventory of Dams 2019

There are an uncounted number of 'non-jurisdictional' dams on public and private lands in the county. These are small dams that normally do not store water but may impound water during heavy precipitation events. Because they are not monitored or maintained, there is potential for them to overtop or fail and cause flooding and property damage during a significant rainfall event. The extent and risk associated with these dams is not known.

The areas of the county most likely to be impacted by a dam failure are along the Dolores River. Seven high- and significant-hazard dams could impact the Town of Dolores, including Groundhog Dam, located outside of Montezuma County.

In 2017, Colorado Division of Water Resources (DWR) Dam Safety set out to systematically evaluate all high hazard dams related to operational and flood releases. The analysis produced the "Colorado High Hazard Dam Release- Downstream Floodplain Impacts Database and Ranking Tool", containing information for both private and publicly owned high hazard dams across the state. The ranking of the dams identifies the dams with the highest threat of downstream flooding associated with releases of excess water during high runoff or heavy rain. DWR Dam Safety screened the state's dam database using information from USGS (Streamstats), FEMA Flood Insurance Studies (FIS), and the National Flood Hazard Layer (NFHL). The data was used to compare natural flows versus natural flows in combination with dam release flows. The resulting ranks were developed based on the severity of the conditions, estimated safe channel capacity of the downstream channel, and maximum controlled discharge. The report assesses 415 dams in the State of Colorado and provides a ranking for 366 dams where there is either a high, moderate, or low likelihood of dangerous conditions created by dam and reservoir release operations simultaneously with naturally occurring flood conditions. The high, moderate, or low designations were assigned by DWR by dividing the total number of ranked dams into thirds. Based on this database the following dams are considered high or moderate risk for flooding due to operational and flood releases: Groundhog, McPhee and Jackson Gulch.

Levees

According to the FEMA Flood Insurance Study (FIS) (FEMA 2008) there are limited levees in the county. In 1985 the U.S. Bureau of Reclamation completed construction of the Dolores landfill and protective dike. This project, which was built in conjunction with the Bureau's construction of the McPhee Dam, involved construction of 2,100 feet of levee and landfill between the State Route 145 embankment and the Fourth Street Bridge, along the right bank of the Dolores River. In addition, the project included the rehabilitation of two segments of existing levee along the right bank of the Dolores River upstream of the Fourth Street Bridge. These levees were constructed to prevent flooding resulting from the maximum pool elevation of the McPhee Reservoir. The levees upstream of Fourth Street do not have sufficient freeboard to be recognized as providing protection from 100-year overbank flooding. In addition, these levees as of 2008 were not federal certified levees as they do not meet the FEMA's National Flood Insurance Program (NFIP) regulations.

Figure 4-6 Dams Within and Upstream of Montezuma County

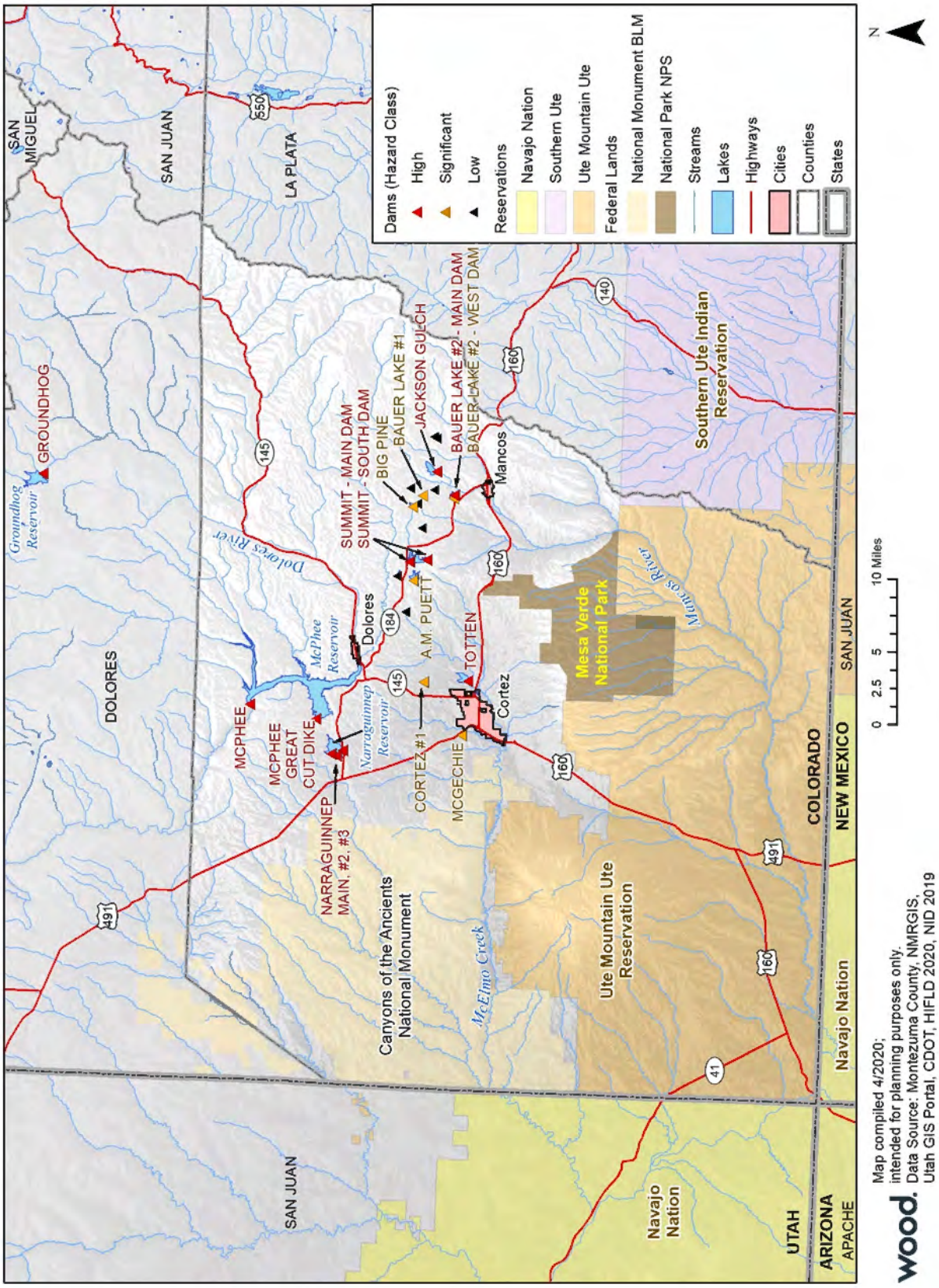


Figure 4-7 High Hazard Dam Inundation

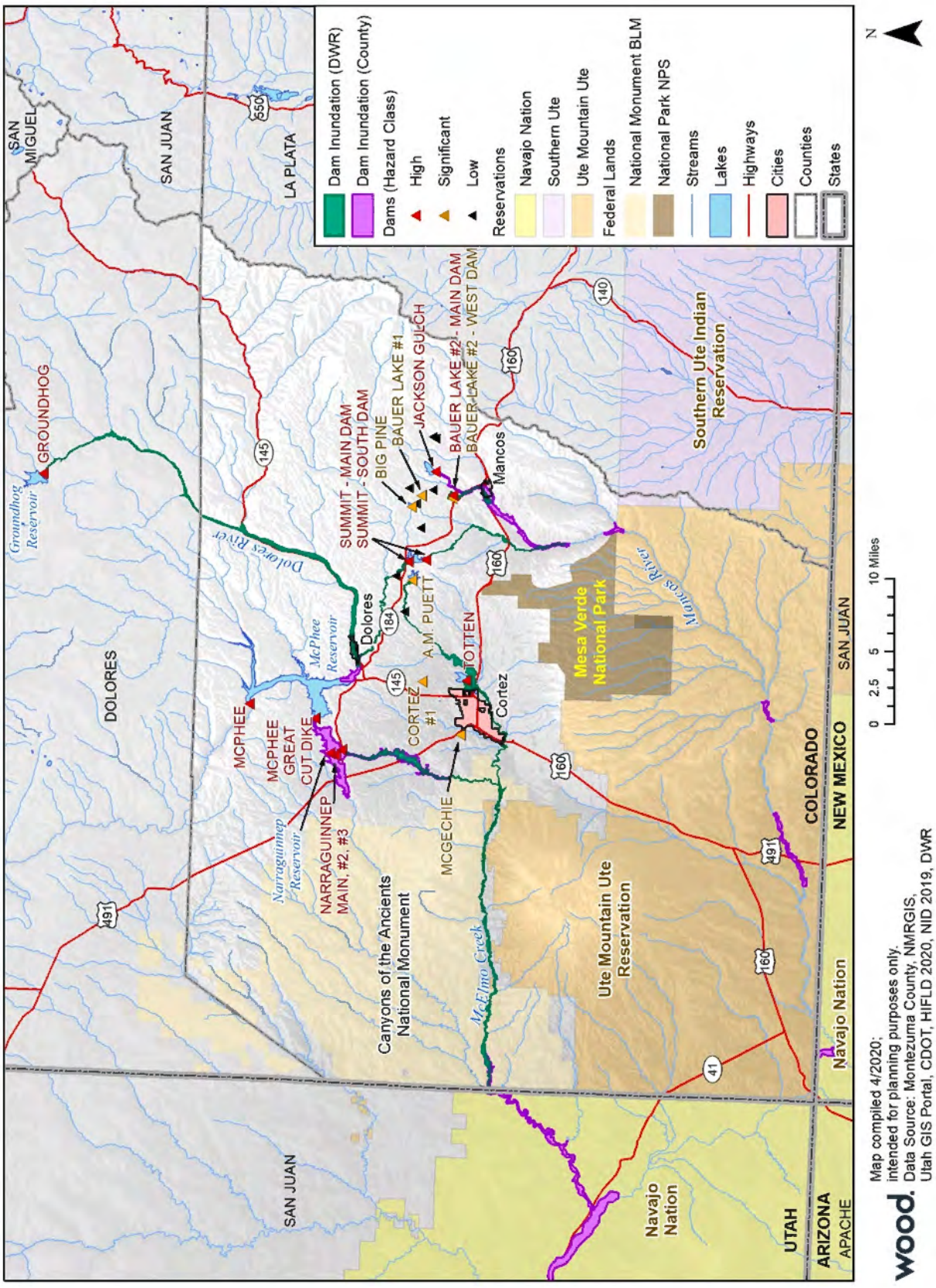


Figure 4-8 Potential Dam Inundation for the Town of Dolores

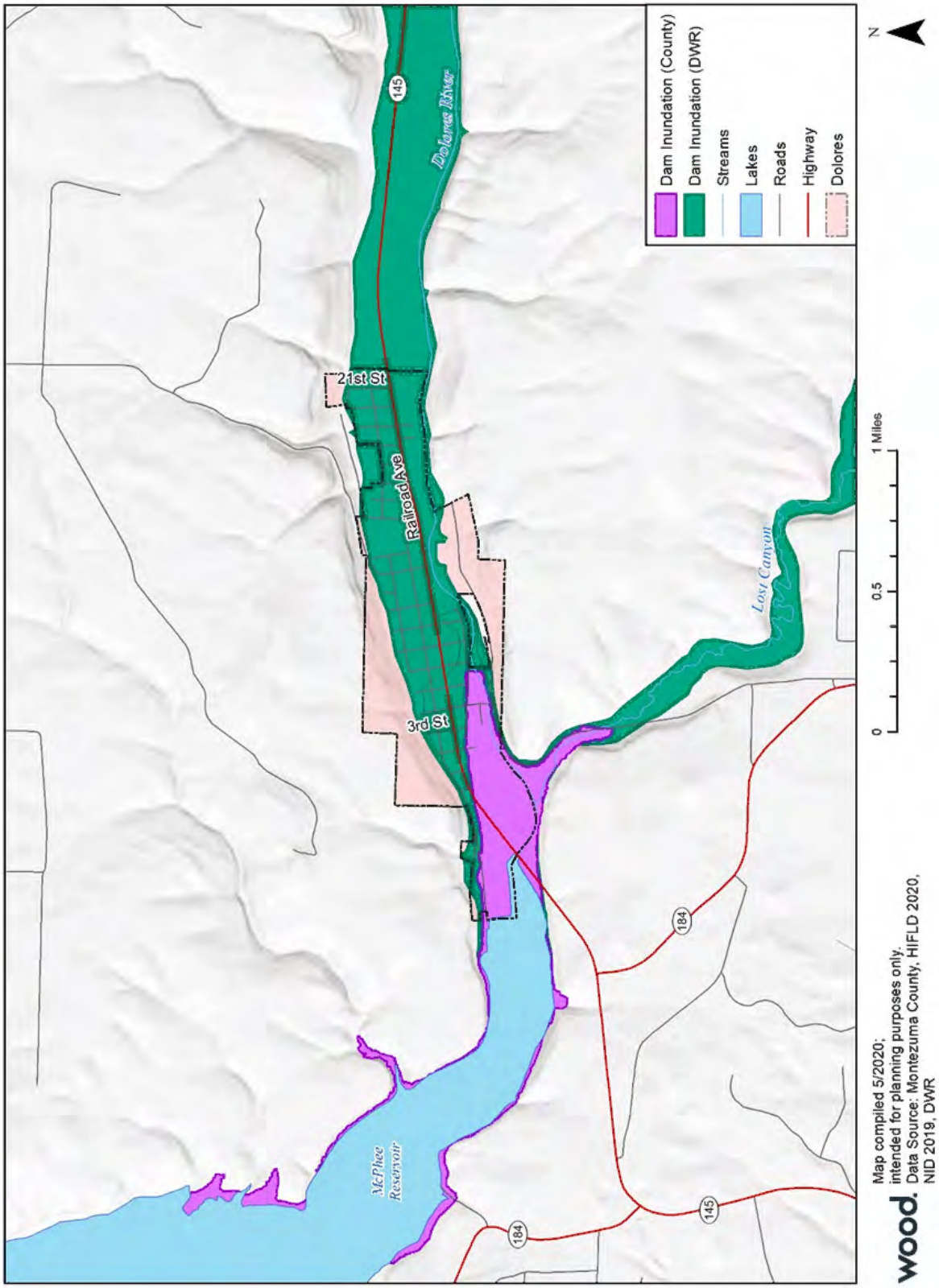


Figure 4-9 Potential Dam Inundation for Town of Mancos

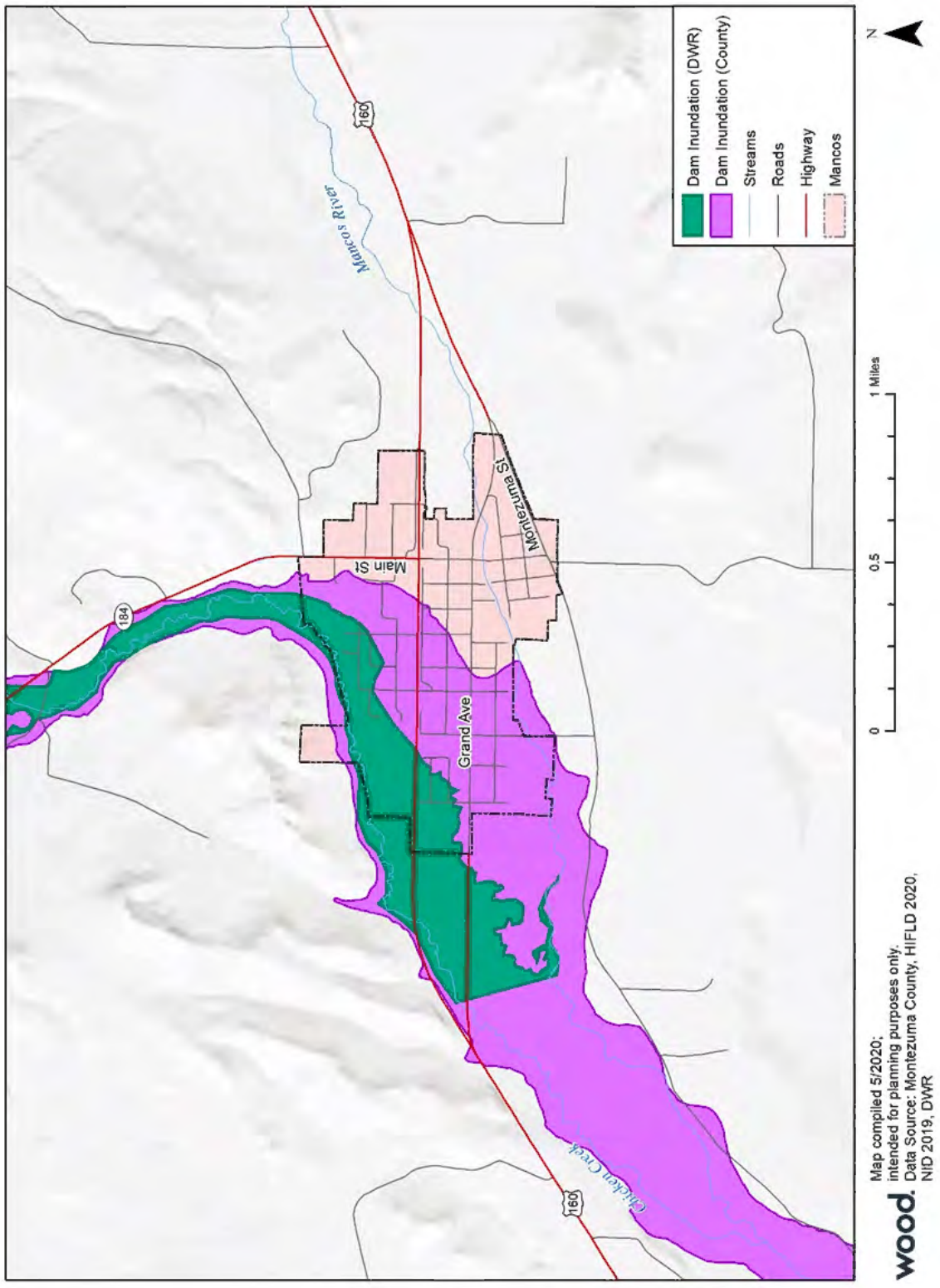
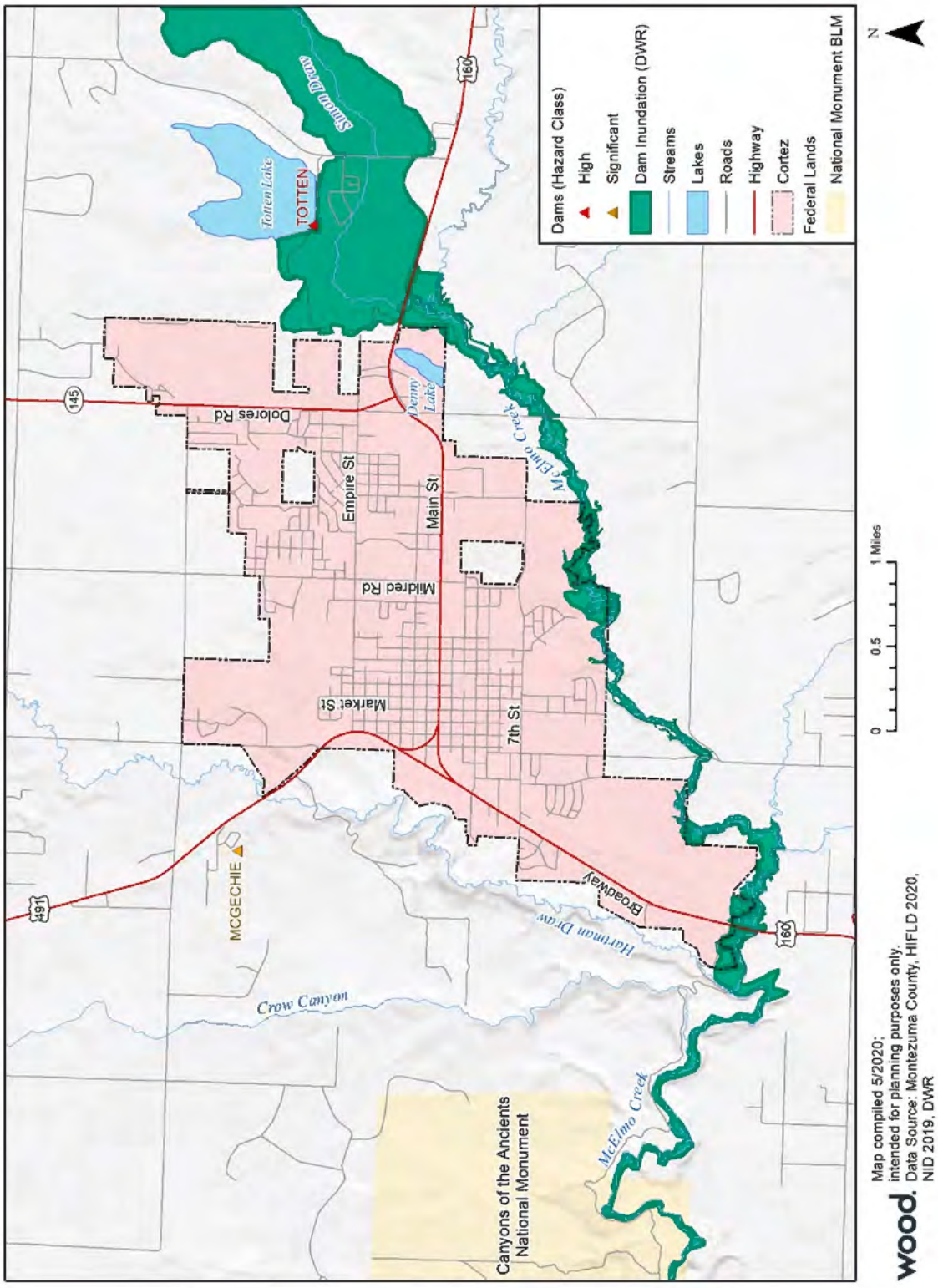


Figure 4-10 Potential Dam Inundation in the Town of Cortez



4.4.4 Frequency and Severity

There have been no recorded occurrences of dam or levee failures in or near Montezuma County in the past 80 years. Therefore, the probability of a failure in the future is Low (hazard event is not likely to occur within 100 years likely to be greater than once in 100 years).

The USACE developed the classification system shown in Table 4-13 for the hazard potential of dam failures. The USACE hazard rating system is based only on the potential consequences of a dam failure and does not take into account the probability of such failures. The County, Dolores and Mancos all have potential inundation from high hazard dams that could lead to loss of life and extensive property losses.

Table 4-13 U.S. Army Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.

b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.

c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.

d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.

e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

f. Source: U.S. Army Corps of Engineers 1995

4.4.5 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, there is generally more time for evacuations. In the event of a structural failure due to earthquake, there may be no warning time, though this is an unlikely failure mode in Montezuma County. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (USACE 1997).

4.4.6 Related Hazards

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential related hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam that impacts the planning area. While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs with historical record. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding.

4.4.7 Climate Change Considerations

With a potential for increase in extreme precipitation events due to climate change, 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 hygrograph 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.

Dams are constructed with safety features known as spillways. Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to non-dam failure flood events result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of non-dam failure flooding.

4.4.8 Vulnerability

A dam failure can range from a small, uncontrolled release to a catastrophic failure. Structures, aboveground infrastructure, critical facilities, and natural environments are all vulnerable to dam failure, but this is tempered by the low probability of this hazard.

Information for the exposure analysis provided in the sections below is based off a GIS analysis of dam inundation areas provided by the County and the Colorado Division of Water Resources. These areas are indicated in Figure 4-7 through Figure 4-10.

The most significant issue associated with dam failure involves the properties and populations in the inundation areas. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard.

Population

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 value of 2.4 persons per household for Montezuma County. These estimates are shown in Table 4-14. A significant portion of the Towns of Dolores and Mancos are within dam inundation areas, particularly portions of the Town of Mancos that lie below the Jackson Gulch Dam.

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable timeframe. This population includes those with access and functional needs including, 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, radio emergency warning system or wireless emergency alerts.

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. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads, and bridges in the path of the dam inundation. 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.

In general, communities located below a high or significant hazard dam and along a waterway are potentially exposed to the impacts of a dam failure. For reference, high hazard dams threaten lives and property, significant hazard dams threaten property only. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) are produced for many high hazard dams. Six of the high or significant hazard dams contained dam inundation extents in spatial form that were analyzed to quantify risk across the planning area. Table 4-14 displays the number of structures in dam inundation areas within the county and their values. Total building value and exposure numbers were based off 2019 county tax assessor data.

Table 4-14 Montezuma County Exposure and Value of Structures within Dam Inundation Areas

Jurisdiction	Building Count	Improved Value	Content Value	Total Value	Population
Dolores	503	$52,316,863	$31,466,657	$83,783,520	832
Mancos	364	$38,681,573	$22,682,032	$61,363,605	735
Unincorporated County	341	$53,244,733	$33,878,119	$87,122,852	629
Grand Total	1,208	$144,243,169	$88,026,808	$232,269,977	2,196

Source: Montezuma County Assessor. National Inventory of Dams 2019 Wood GIS analysis

Critical Facilities and Infrastructure

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. 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. Based on the critical facility inventory considered in the updating of this plan, 30 critical facilities were found to intersect with the dam inundation extents obtained in GIS form from the Colorado Dam Safety Program. Every participating jurisdiction has at least one critical facility located a risk to dam inundation. A majority are

located in Dolores (14) and Mancos (9). Facilities for at-risk populations such as schools and nursing homes/assisted living facilities were most commonly found to be at risk at inundation. The following table shows the results of the GIS analysis.

Table 4-15 Montezuma County Critical Facilities Exposure within Dam Inundation Areas

Jurisdiction	Facility Type	Count
Cortez	Sewage Treatment	1
	Total	**1**
Dolores	Nursing Home/Assisted Living	2
	School	5
	Fire Station	1
	Park or Rec. Facility	1
	Police Station	1
	Sewage Treatment	1
	Water Treatment	1
	City Offices	1
	Library	1
	Total	**14**
Mancos	Nursing Home/Assisted Living	1
	School	4
	Park or Rec. Facility	1
	Sewage Treatment	1
	Substation	1
	County Offices	1
	Total	**9**
Unincorporated County	Substation	1
	City Offices	1
	County Offices	1
	Maintenance Yard	2
	Total	**5**
Grand Total		**29**

Source: Montezuma County Assessor. National Inventory of Dams 2019 Wood GIS analysis

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.

Historic, Cultural and Natural 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 impacts in the event of dam failure. The inundation could introduce many foreign elements into local waterways, potentially causing the destruction of

downstream habitats. Cultural resource impacts would be limited but could result in loss of historic structures.

According to the 2019 Ute Mountain Ute Tribal Hazard Mitigation Plan, Tribal areas such as the Ute Mountain Ute Tribal Park, Mesa Verde, Sleeping Ute Mountain, and White Mesa could be affected by debris flow and sedimentation-driven degradation (on trails or structures) within the tribal lands as a result of a dam failure or incident event. The Tribal Park specifically could potentially be affected upstream on the Mancos River, as there are some areas in the valley bottom of cultural significance, although potential for dam failure is again generally low.

4.4.9 Development Trends

The vulnerability to dam failure could increase if development occurs in inundation areas downstream of dams. Often these inundation areas are not shown on plat or planning maps or NFIP maps and thus are not regulated. This type of development can change the designation of a dam from low to high hazard. As noted previously, that the hazard class for the Bauer Lake #2 dam changed from significant to high sometime between 2015-2019, likely due to development downstream.

4.4.10 Risk Summary

- While a low probability, the presence of 11 high hazard and 6 significant hazard dams in the county present the possibility of dam failure and non-dam failure flooding below them.
- A total of 2,196 people are potentially at risk of dam failure or incident events based on the dam inundation analysis.
- A total of 1,208 buildings are potentially at risk of dam failure incident events, with over $232 Million in total values at risk.
- The Town of Dolores has the most people, buildings and critical facilities at risk of dam failure or incident events.
- A total of 29 critical facilities are at risk of dam failure or incident events. Schools are the most noted in the dam inundation analysis.
- A dam failure and loss of water from a critical reservoir or structure could include direct and indirect business and industry damages or disruption of the local economy and key county resources (e.g. potable water).
- Related hazards: Flooding, Earthquake, Landslide

4.5 Drought and Extreme Heat

DROUGHT AND EXTREME HEAT HAZARD RANKING		
	Drought	Extreme Heat
Montezuma County	High	Medium
City of Cortez	High	Medium
Town of Dolores	High	High
Town of Mancos	High	Medium
Cortez Fire Protection District	High	Medium

4.5.1 Hazard Profile

Drought

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Drought is a complex issue involving many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Due to Colorado's semiarid conditions, drought is a natural but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Colorado to be deficient in moisture at the same time. Single season droughts over some portion of the state are quite common.

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

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well-being, and quality of life.
Meteorological Drought— An expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.
Agricultural Drought — Occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.
Hydrological Drought — Deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels. Water supply is controlled not only by precipitation, but also by other factors, including evaporation (which is increased by higher than normal heat and winds), transpiration (the use of water by plants), and human use.
Socioeconomic Drought— a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.
Extreme Heat— Period of high heat and humidity with temperatures above 90 degrees for at least two to three days. In extreme heat your body works extra hard to maintain a normal temperature, which can lead to death.

a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline.

The onset of drought in western Colorado mountainous counties is usually signaled by a lack of significant winter snowfall. Hot and dry conditions that persist into spring, summer, and fall can aggravate drought conditions, making the effects of drought more pronounced as water demands increase during the growing season and summer months.

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Precipitation is the main source of Colorado's water supply. Annual precipitation in the populated areas of the planning area is approximately 11 to 15 inches per year. According to the 2018 Colorado State Drought Mitigation and Response Plan, "there are no major rivers that flow into Colorado (McKee et al. 1999). There are several major river basins originating in the Colorado Rockies, which flow out of the state, providing water to much of the southwestern United States, and contributing to the Missouri and Mississippi Rivers as well. Thus, Colorado earns its title as "the Mother of Rivers" (CWCB 2013). This supply is stored in five forms throughout the state: snowpack, streamflow, reservoir water, soil moisture, and groundwater (McKee and others 2000).

Extreme Heat

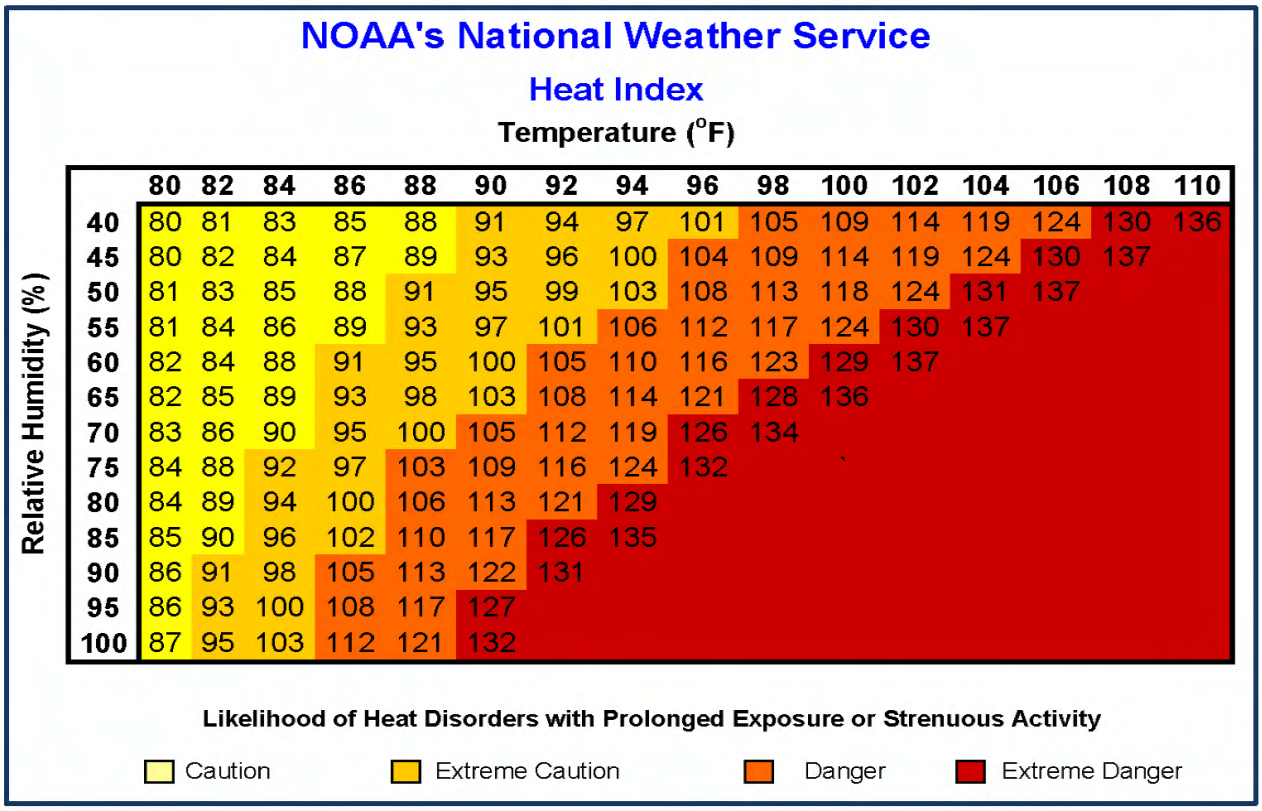
Excessive heat events are defined by the U.S. Environmental Protection Agency (EPA) as "summertime weather that is substantially hotter or more humid than average for a location at that time of year" (EPA 2006). Criteria that define an excessive heat event may differ among jurisdictions and in the same jurisdiction depending on the time of year. Excessive heat events are often a result of more than just ambient air temperature. Heat index tables (see Figure 4-11) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15 degrees Fahrenheit (°F). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous. In the future consider this plan may consider effects of extreme heat on increased energy usage, overloading distribution/transmission system. While it may not be a problem now, but with load growth due to electric vehicles the planning area may someday have that challenge.

Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. According to the National Weather Service (NWS), among natural hazards, only the cold of winter—not lightning, hurricanes, tornados, floods, or earthquakes—takes a greater toll. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died.

Heat disorders are related to a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise, and heat-related illness may develop. Elderly persons, small children, people with pre-existing medical conditions , those on certain

medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves in areas where moderate climate usually prevails.

Figure 4-11 Heat Index Table



*Note: Since HI values were devised for shady, light wind conditions, exposure to full sunshine can increase HI values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

The National Weather Service (NWS) has in place a system to initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for the issuance of excessive heat alerts is when the maximum daytime high is expected to equal or exceed 105°F and a nighttime minimum high of 80°F or above is expected for two or more consecutive days.

4.5.2 Past Events

Drought

Colorado has experienced multiple severe droughts. Colorado has experienced drought in 2018, 2011-2013, 2006-2004, 1996, 1994, 1990, 1989, 1975-1979, 1963-1965, 1951-1957, 1931-1941, and 1893-1905 (Colorado Drought Mitigation and Response Plan, 2018). The most significant are listed in Table 4-16. Although drought conditions can vary across the state, it is likely that Montezuma County suffered during these dry periods.

Table 4-16 Historical Dry and Wet Periods in Colorado

Date	Dry	Wet	Duration (years)
1893-1905	X		12
1905-1931		X	26

Date	Dry	Wet	Duration (years)
1931-1941	X		10
1941-1951		X	10
1951-1957	X		6
1957-1959		X	2
1963-1965	X		2
1965-1975		X	10
1975-1978	X		3
1979-1999*		X	20
2000-2006*	X		6
2007-2010*		X	3
2011-2013*	X		2
2018-2019**	X		2

Notes:
Source: McKee, et al. 1999
*modified for 2018 State of Colorado Drought Mitigation and Response Plan Update based on input from the Colorado Climate Center
**Modified for 2020 Montezuma HMP update

There have been several (27) USDA Secretarial Disaster Declarations for the County in the last 16 years. The following table summarizes the USDA Disaster Declarations related to drought from 2003 to 2019, in which Montezuma County was included.

Table 4-17 USDA Secretarial Disasters (2003-2013)

Year	Type	Declaration Number
2003	Drought, Insects	S1843
2005-2006	Drought, Fire, High Wind, Heat	S2327
2009	Drought	S2996
2011	Drought	S3149
2012	Drought	S3260
2012	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insects	S3267, S3282, S3289
2013	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insect	S3455, S3461, S3466, S3539
2014	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insect	S3634, S3651, S3653, S3715
2015	Drought, Wind/High Winds, Fire/Wildfire, Heat/Excessive Heat, Insect	S3783, S3788, S3792
2018	Drought	S4279, S4300, S4308, S4320, S4347
2019	Drought	S4466, S4469, S4481

Notes:
USDA U.S. Department of Agriculture

Montezuma County has experienced below-normal precipitation and unseasonably dry air masses in the past several decades. Drought conditions continued and the forests throughout the region became drier with each passing season. The largest wildfire in the past several decades occurred in July 2000. The Bircher Fire burned more than 23,000 acres south of Mesa Verde National Park. The years 2000, 2012, and

2013 were active years for drought conditions. Conditions began improving in 2015. Drought returned in 2018, with southwest/four corners area being a bullseye for the most severe Drought Monitor ratings for the summer months.

The Storm Events Database from the National Centers for Environmental Information (NCEI) lists all the drought events for the Four Corner/Upper Dolores River Basin Zone and the Southwestern San Juan Mountain Zone. According to the Database there have been 236 events between 2007 and 2019 that have impacted these areas. However, there are no identified associated economic losses (property damage or crop damage). A review of USDA Risk Management Agency Crop Indemnity Reports shows in the past 12 years, the county has lost 16,248 acres of insured crop due to drought and $425,240 in indemnity payments. When the estimated county yield for an insured crop, as determined by National Agricultural Statistics Service, falls below the trigger yield level chosen by the producer, an indemnity is paid.

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies. The database is being populated beginning with the most recent impacts and working backward in time. The Drought Impact Reporter contains information on 823 impacts from droughts that affected Montezuma County between 2000 and April 2020. Most of the impacts (354) were classified as "agriculture." Other impacts include "energy" (3), "plants and wildlife" (258), "society and public health" (101), "business & industry" (22), "fire" (196), "tourism and recreation" (65), "relief, response, and restrictions" (196) and "water supply and quality" (234). These categories are described as follows:

- **Agriculture (354)** —Drought effects associated with agriculture, farming, aquaculture, horticulture, forestry, or ranching. Examples of drought-induced agricultural impacts include damage to crop quality; income loss for farmers due to reduced crop yields; reduced productivity of cropland; insect infestation; plant disease; increased irrigation costs; cost of new or supplemental water resource development (wells, dams, pipelines) for agriculture; reduced productivity of rangeland; forced reduction of foundation stock; closure/limitation of public lands to grazing; high cost or unavailability of water for livestock, Christmas tree farms, forestry, raising domesticated horses, bees, fish, shellfish, or horticulture.
- **Energy (3)**—This category concerns drought's effects on power production, rates and revenue. Examples include production changes for both hydropower and non-hydropower providers, changes in electricity rates, revenue shortfalls and/or windfall profits, and purchase of electricity when hydropower generation is down.
- **Plants and Wildlife (258)**—Drought effects associated with unmanaged plants and wildlife, both aquatic and terrestrial, include: loss of biodiversity of plants or wildlife; loss of trees from rural or urban landscapes, shelterbelts, or wooded conservation areas; reduction and degradation of fish and wildlife habitat; lack of feed and drinking water; greater mortality due to increased contact with agricultural producers (as predators seek food from farms and producers are less tolerant of the intrusion); disease; increased vulnerability to predation (from species concentrated near water); migration and concentration (loss of wildlife in some areas and too much wildlife in others); increased stress on endangered species; salinity levels affecting wildlife; wildlife encroaching into urban areas; and loss of wetlands.
- **Society and Public Health (101)** —Drought effects associated with human, public and social health include: health-related problems related to reduced water quantity or quality, such as increased concentration of contaminants; loss of human life (e.g., from heat stress, suicide); increased respiratory ailments; increased disease caused by wildlife concentrations; increased human disease caused by changes in insect carrier populations; population migration (rural to urban areas, migrants into the

United States); loss of aesthetic values; change in daily activities (non-recreational, like putting a bucket in the shower to catch water); elevated stress levels; meetings to discuss drought; communities creating drought plans; lawmakers altering penalties for violation of water restrictions; demand for higher water rates; cultural/historical discoveries from low water levels; cancellation of fundraising events; cancellation/alteration of festivals or holiday traditions; stockpiling water; public service announcements and drought information websites; protests; and conflicts within the community due to competition for water.

- **Business and Industry (22)** —This category tracks drought's effects on non-agriculture and non-tourism businesses, such as lawn care, recreational vehicles, or gear dealers, and plant nurseries. Typical impacts include reduction or loss of demand for goods or services, reduction in employment, variation in number of calls for service, late opening or early closure for the season, bankruptcy, permanent store closure, and other economic impacts.
- **Fire (196)**—Drought often contributes to forest, range, rural, or urban fires, fire danger, and burning restrictions. Specific impacts include enacting or increasing burning restrictions, fireworks bans, increased fire risk, occurrence of fire (number of acres burned, number of wildfires compared to average, people displaced, etc.), state of emergency during periods of high fire danger, closure of roads or land due to fire occurrence or risk, and expenses to state and county governments of paying firefighters overtime and paying equipment (helicopter) costs.
- **Tourism and Recreation (65)** —Drought effects associated with recreational activities and tourism include closure of state hiking trails and hunting areas due to fire danger; water access or navigation problems for recreation; bans on recreational activities; reduced license, permit, or ticket sales (e.g., hunting, fishing, ski lifts, etc.); losses related to curtailed activities (e.g., bird watching, hunting and fishing, boating, etc.); reduced park visitation; and cancellation or postponement of sporting events.
- **Relief, Response, and Restrictions (196)** —This category refers to drought effects associated with disaster declarations, aid programs, requests for disaster declaration or aid, water restrictions, or fire restrictions. Examples include disaster declarations, aid programs, U.S. Department of Agriculture (USDA) Secretarial Disaster Declarations, Small Business Association Disaster Declarations, government relief and response programs, state-level water shortage or water emergency declarations, county-level declarations, a declared "state of emergency," requests for declarations or aid, non-profit organization-based relief, water restrictions, fire restrictions, National Weather Service (NWS) Red Flag Warnings, and declaration of drought watches or warnings.
- **Water Supply and Quality (234)** —Drought effects associated with water supply and water quality include dry wells, voluntary and mandatory water restrictions, changes in water rates, increasing of water restrictions, increases in requests for new well permits, changes in water use due to water restrictions, greater water demand, decreases in water allocation or allotments, installation or alteration of water pumps or water intakes, changes to allowable water contaminants, water line damage or repairs due to drought stress, drinking water turbidity, change in water color or odor, declaration of drought watches or warnings, and mitigation activities.

Extreme Heat

Montezuma County on average experiences 28 days over 90°F and 5 days over 95°F (Colorado State Hazard Mitigation Plan, 2018). In August and September 2019, the City of Cortez broke 5 heat records, with two 97°F records that were the highest September temperature ever recorded in the City (Mimiaga 2019).

The Western Regional Climate Center reports data summaries from a station in the City of Cortez, at the Cortez Municipal Airport, the county seat in Montezuma County. Table 4-18 contains temperature summaries related to extreme heat for the station.

Table 4-18 Temperature Data from Cortez Municipal Airport (1911-2016)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (degrees Fahrenheit)												
Average Maximum Temperature	41.1	45.6	53.5	63.1	72.8	83.5	88.8	86.4	79.0	67.1	52.5	42.6
Average Minimum Temperature	13.2	18.4	24.6	30.9	38.6	46.4	54.3	53.0	44.7	33.9	23.0	15.3
Average Temperature	27.2	32.0	39.0	47.0	55.7	64.9	71.5	69.7	61.8	50.5	37.7	28.9
Extreme Temperatures (degrees Fahrenheit)												
Extreme Maximum Temperature	63	79	80	88	95	102	102	99	97	88	75	65
Average Number of Days												
Maximum Temperature above 90 degrees Fahrenheit	0.0	0.0	0.0	0.0	0.2	5.8	14.8	8.9	1.0	0.0	0.0	0.0

Source: Western Regional Climate Center

According to USDA Risk Management Agency Crop Indemnity Reports, 541 acres of crop were lost in Montezuma County due to heat. The crop loss resulted in $19,011 in crop indemnity payments.

4.5.3 Location

Drought

Due to Colorado's semiarid conditions, drought is a natural but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Colorado to be deficient in moisture at the same time. Single season droughts over some portion of the state are quite common.

The entire county is at risk to drought conditions. Drought is one of the few hazards that has the potential to directly or indirectly impact every person in the county as well as adversely affect the local economy.

Extreme Heat

The entire county is at risk to extreme heat events; however, these events may be exacerbated in urban areas, such as the City of Cortez, where reduced air flow, reduced vegetation and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding rural or less urbanized areas. This phenomenon is known as urban heat island effect. Conversely, extreme heat events are unlikely to occur at higher elevations in Montezuma County. Average temperatures tend to decrease with increases in elevation, roughly 4°F per 1,000 feet above mean sea level.

4.5.4 Frequency and Severity (Extent)

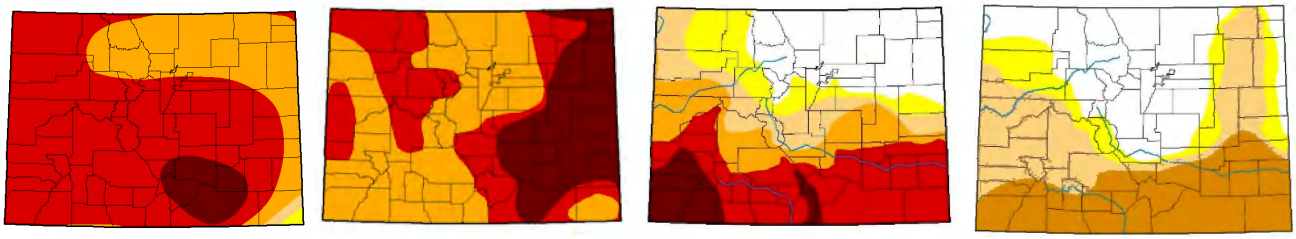
Drought

The U.S. Drought Monitor is an accepted and widely used site for obtaining and summarizing drought information, as it integrates data from several other sources including the Palmer Drought Index, Soil Moisture Models, U.S. Geological Survey Weekly Stream Flows, Standardized Precipitation Index, and the Satellite Vegetation Health Index. It includes drought intensity categories for measuring dry conditions across counties, states, and regions of the U.S., so that drought can be quantified. These categories range from "abnormally dry" to "exceptional drought." Figure 4-12 compares the severity of the drought in Colorado in December 2002, with the severity of the drought in February 2013 compared to drought conditions in June 2015 and as of April 2020. The maps illustrate significantly improved conditions in

Colorado and Montezuma County in 2015 over the 2002 conditions. The snapshots selected are instrumental in depicting both the historic and potential change in drought's geographic range and severity in the County.

Note: The Drought Monitor maps integrate data from several sources including the Palmer Drought Index, Soil Moisture Models, U.S. Geological Survey Weekly Stream flows, Standardized Precipitation Index, and Satellite Vegetation Health Index.

Figure 4-12 U.S. Drought Monitor for the State of Colorado from 2002 Compared to 2020



12/31/2002 **2/5/2013** **6/5/2018** **4/21/2020**

State Drought Conditions

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
12/31/2002	0	100	99.66	98.98	72.73	7.06
2/5/2013	0	100	100	100	54.29	24.92
6/23/2018	24.69	75.31	63.91	50.80	35.13	7.79
4/21/2020	33.26	66.74	53.58	28.51	0	0

Source: National Drought Mitigation Center

The probability of a future drought in Montezuma County is likely, with a recurrence interval of 10 years or less. According to information from the 2018 Colorado State Drought Mitigation and Response Plan, over 119 years (1893 to 2012) there were 7 recorded drought incidents that totaled 41 dry years. Short duration droughts occur much more frequently. According to a study cited in the 2018 Colorado Drought Mitigation and Response Plan, they occur somewhere in Colorado in nearly 9 out of every 10 years. (McKee and others 2000).

Drought impacts are wide-reaching and may be economic, environmental, or societal. The most significant impacts associated with drought in Colorado are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in streams and groundwater decline. Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced

replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly.

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. A drought directly or indirectly impacts all people in affected areas. All people could pay more for water if utilities increase their rates due to shortages. Agricultural impacts can result in loss of work for farm workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

Based on the information in this hazard profile, the magnitude/severity of drought is considered to have a significant potential impact for the county. The City of Cortez is considered to have a moderate potential impact for drought, while the Towns of Dolores and Mancos are considered to have minimal potential impacts for drought. The City of Cortez is expected to have a higher potential impact for drought than the Towns of Dolores and Mancos because Cortez has higher annual maximum and minimum temperatures, with lower overall rainfall.

Extreme Heat

There are no recorded instances of extreme heat or heat events in Montezuma County from 1950 to 2019 in the National Center for Environmental Impact's Storm Events Database. However, there are approximately 28 days per year on average where temperatures exceed 90°F and an average of 5 days per year that temperatures exceed 95ºF. When temperatures reach 90ºF and above, people are vulnerable to sunstroke, heat cramps, and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. As shown in the RMA data under the Past Events section, crops can be vulnerable to extreme heat as well.

Based on the information in this hazard profile, the magnitude/severity of extreme heat is considered to have a moderate potential impact for the county. The City of Cortez is considered to have a moderate potential impact for extreme heat, while the Towns of Dolores and Mancos are considered to have minimal potential impacts for extreme heat.

4.5.5 Warning Time

Drought

Droughts are climatic patterns that occur over long periods of time. Only generalized warnings can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last

depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

Colorado is semiarid; thus, drought is a regular and natural occurrence in the State. The main source of water supply in the state is precipitation and much of this occurs in the winter as snowfall. Although drought conditions are difficult to predict, low levels of winter snowpack may act as an indicator that drought conditions are occurring.

Extreme Heat

NOAA issues watch, warning and advisory information for extreme heat. Meteorologists can often predict extreme heat days in advance.

4.5.6 Related Hazards

Drought

The hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Millions of board feet of timber have been lost, and in many cases, erosion occurred, which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers. An ongoing drought may leave an area more prone to beetle kill and associated wildfires. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wind and erosion. An ongoing drought that severely inhibits natural plant growth cycles may impact critical wildlife habitats. Drought can affect soil shrinking and swelling cycles

According to the Colorado State Drought Mitigation and Response Plan, economic impacts may also occur for industries that are water intensive such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation and wildfire preservation. A reduction of electric power generation and water quality deterioration are also potential effects.

Extreme Heat

Extreme heat can exacerbate wildfire conditions. Excessive heat events can cause failure of motorized systems such as ventilation systems used to control temperatures inside buildings. It can lead to public health issues such as heat stroke in both the elderly and the young and healthy.

4.5.7 Climate Change Considerations

The Intergovernmental Panel on Climate has projected dramatic changes in regional climate characteristics between present-day and if global temperatures rise between 1.5 degrees Celsius and 2 degrees Celsius. Climate change can have impacts both in terms of inter-annual droughts and intra-annual runoff patterns (CWCB 2018). Temperatures increased and resulting changes in evaporation and soil moistures will also add to the trend of decreasing runoff in a majority of Colorado Basins. The following table shows the challenges water managers may face with the projected changes in climate.

Table 4-19 Future Drought Vulnerability Due to Climate Change and Challenges Faced by Colorado Water Managers

Challenge	Observed and/or Projected Change
Water demands for agriculture and outdoor watering	Increasing temperatures raise evapotranspiration by plants, lower soil moisture, alter growing seasons, and thus increase water demand.
Water supply infrastructure	Changes in snowpack, streamflow timing, and hydrograph evolution may affect reservoir operations including flood control and storage. Changes in the timing and magnitude of runoff may affect functioning of diversion, storage, and conveyance structures.
Legal water systems	Earlier runoff may complicate prior appropriation systems and interstate water compacts, affecting which rights holders receive water and operations plans for reservoirs
Water quality	Although other factors have a large impact, "water quality is sensitive both to increased water temperatures and changes in patterns of precipitation" (CCSP SAP 4.3, p. 149). For example, changes in the timing and hydrograph may affect sediment load and pollution, impacting human health.
Energy demand and operating costs	Warmer air temperatures may place higher demands on hydropower reservoirs for peaking power and increased energy usage, potentially overloading distribution/transmission system Warmer lake and stream temperatures may affect water use by cooling power plants and other industries.
Mountain habitats	Increasing temperature and soil moisture changes may shift mountain habitats toward higher elevation.
Interplay among forests, hydrology, wildfires, and pests	Changes in air, water, and soil temperatures may affect the relationships between forests, surface and groundwater, wildfire, and insect pests. Water-stressed trees, for example, may be more vulnerable to pests.
Riparian habitats and fisheries	Stream temperatures are expected to increase as the climate warms, which could have direct and indirect effects on aquatic ecosystems (CCSP SAP 43.), including the spread of instream non-native species and diseases to higher elevation and the potential for nonnative plant species to invade riparian areas. Changes in streamflow intensity and timing may also affect riparian ecosystems.
Water – and snow – based recreation	Changes in reservoir storage affect lake and river recreation activities; changes in streamflow intensity and timing will continue to affect rafting directly and trout fishing indirectly. Changes in the character and timing of snowpack and the ratio of snowfall to rainfall will continue to influence winter recreational activities and tourism.
Groundwater resources	Changes in long-term precipitation and soil moisture can affect groundwater recharge rates; coupled with demand issues, this may mean greater pressure on groundwater resources.

Source: State of Colorado Drought Mitigation and Response Plan 2018

4.5.8 Vulnerability

All people, property, and environments in the planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions. Populations living in densely populated urban areas are likely to be more exposed to extreme heat events. People who live at higher elevations would be less susceptible to heat events.

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. Extreme heat can exacerbate the effects of drought.

Population

Drought

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.

Extreme Heat

According to the EPA, the individuals with the following combinations or characteristics are typically at greater risk to the adverse effects of excessive heat events: individuals with physical or mobility constraints, cognitive impairments, economic constraints, and social isolation. Twenty (20) percent of the County's population is over 65 years old and would be considered more vulnerable to extreme heat events. According to the Colorado Department of Public Health and Environment, 14.7% of individuals admitted to an emergency department at a county hospital in 2017 were for heat-related illnesses, compared to 6% statewide.

Property

Drought

Direct structural damage from drought is rare, though it can happen. Drought can affect soil shrinking and swelling cycles and can result in cracked foundations and infrastructure damage. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Extreme Heat

Typically, the only impact extreme heat has on general building stock is increased demand on air conditioning equipment, which in turn may cause strain on electrical systems.

Critical Facilities and Infrastructure

Drought

Due to the long-lasting nature of the hazard, the biggest impact of drought is on water supply. As a result, critical facilities that rely on a steady supply of water could see the greatest impacts if a long-term drought occurred. Drought can also directly impact water storage, treatment and distribution systems. The McPhee Reservoir on the Dolores River depends on precipitation and snowpack runoff. After the 2002

drought, it took the Reservoir several years to reach full levels (Barnett 2019). The low levels in the McPhee Reservoir has downstream impacts on the Ute Mountain Ute's farm and ranching enterprises.

Extreme Heat

Power outages may occur as a result of extreme heat events, and can affect the supporting mechanisms or systems of a community's infrastructure. For example, when high amounts of utilization are imposed on the power system it can cause an interruption in the transmission of that power shutting down air conditioning capabilities or refrigeration that can lead to spoiled foods, etc.

Additionally, transportation systems may experience disruption in services. According to the State of Colorado Hazard Mitigation Plan, road systems have experienced "blowouts or heaves" both on local highway and the higher volume parkway and interstate systems. Blowouts occur when pavements expand and cannot function properly within their allotted spaces. Pavement sections may rise up several inches during such events. These conditions can cause motor vehicle accidents in their initial stages and can shut down traffic lanes or roadways entirely until such times as the conditions are mitigated.

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. If such conditions persisted for several years, the economy of Montezuma County could experience setbacks, especially in water dependent industries.

Historic, Cultural and Natural 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. According to the 2018 Ute Mountain Ute Tribal Hazard Mitigation Plan, the vegetation on and around the Sleeping Ute Mountain, a significant landmark and scenic viewshed, is at risk of being affected by heat stress. 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.

4.5.9 Development Trends

Each municipal planning partner in this effort has an established comprehensive plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their comprehensive plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation initiatives to increase the capability to deal with future trends in development. Vulnerability to drought will increase as population growth increases, putting more demands on existing water supplies. Future water use planning should consider increases in population as well as potential impacts of climate change.

4.5.10 Risk Summary

- There have been 28 USDA Disaster Declaration specifics to Drought in the County since 2007.
- Montezuma County on average experiences 28 days per year over 90°F and 5 days over 95°F.
- In the past 12 years (2007-2019) 16,248 acres of insured crops were lost due to drought resulting in $425,240 indemnity payments. 541 acres were lost due to heat stress resulting in $19,011 indemnity payment due to crops being lost because of heat.
- Drought can lead to cascading hazards such as wildfires and flooding.
- Vegetation around the Sleeping Ute Mountain are at risk of being affected by heat stress and drought.
- The effects of climate change may result in an increase in frequency of extreme heat events.

4.6 Earthquake

EARTHQUAKE HAZARD RANKING	
Montezuma County	Low
City of Cortez	Low
Town of Dolores	Low
Town of Mancos	Low
Cortez Fire Protection District	Low

4.6.1 Hazard Profiles

How Earthquakes Happen

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 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.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates.

Liquefaction—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

Earthquake Classifications

Earthquakes are typically classified in one of two ways: by the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (Mw) scale, with the follow classifications of magnitude:

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

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

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (U.S. Geological Survey [USGS] 1989):

I. Not felt except by a very few under especially favorable conditions.
II. Felt only by a few persons at rest, especially on upper floors of buildings.
III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (e.g., single-family dwellings). Longer period response components create the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). The following table lists damage potential and perceived shaking by PGA factors, compared to the modified Mercalli scale.

Table 4-20 Mercalli Scale and Peak Ground Acceleration Comparison

Modified		Potential Structure Damage		Estimated PGA[a]
Mercalli Scale	Perceived Shaking	Resistant Buildings	Vulnerable Buildings	(%g)
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X - XII	Extreme	Very Heavy	Very Heavy	>124%

PGA Peak Ground Acceleration
a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: USGS 2008; USGS 2010

Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the earthquake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 4-21 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E, and F. In general, these areas are also most susceptible to liquefaction.

Table 4-21 NEHRP Soil Classification System

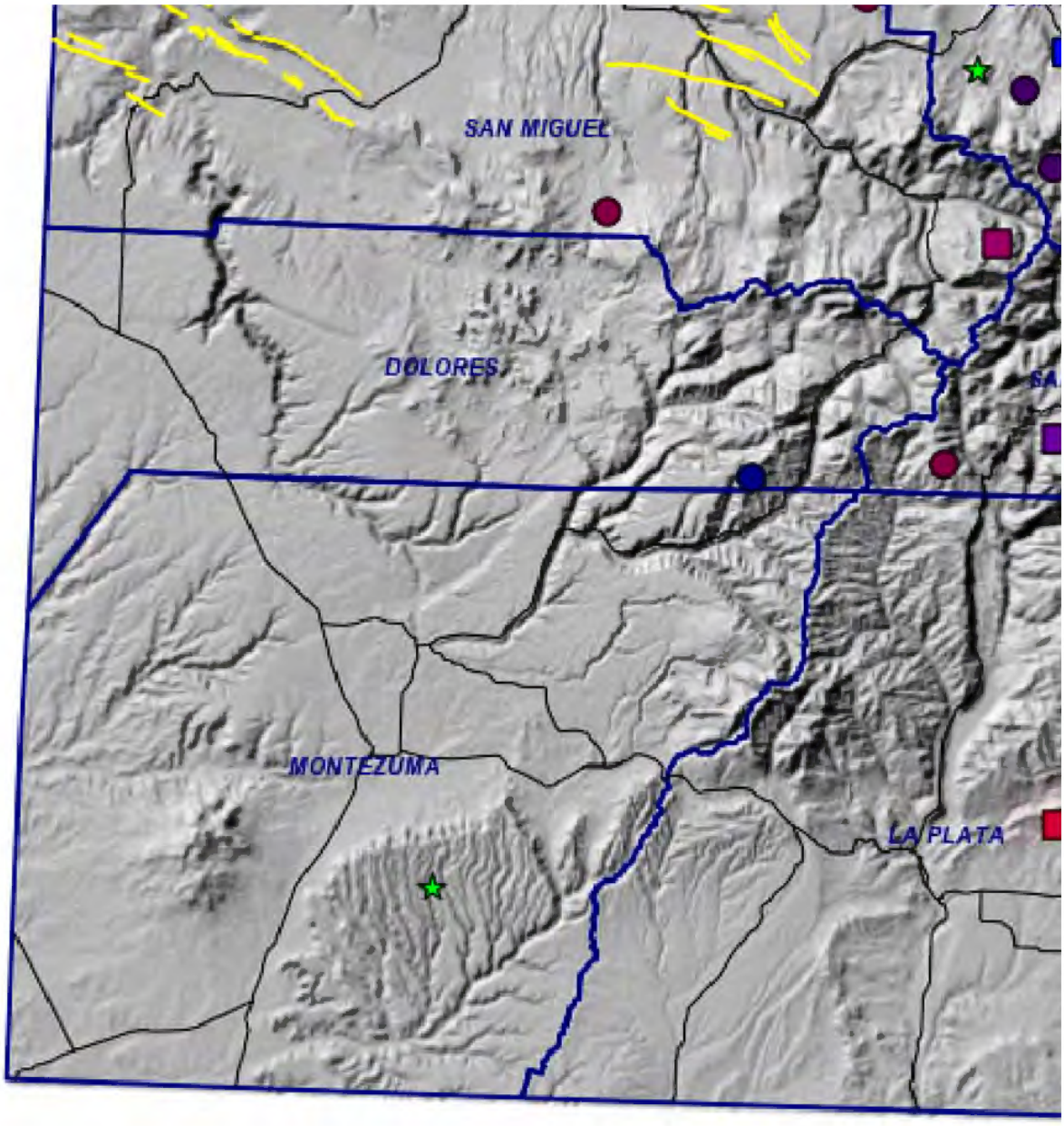
NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

Notes:
m Meters
m/s Meters per second

4.6.2 Past Events

Colorado has a relatively short period of historical records for earthquakes. An earthquake and fault map developed by the Colorado Geological Survey depicts the location of historical epicenters and potentially active faults in that state. Figure 4-13 shows the faults and recorded earthquakes for Montezuma County and vicinity. The figure is a collection of all known and catalogued earthquakes in the area. The map indicates that no recorded earthquake events occurred in Montezuma County. However, a 2.5 magnitude earthquake did occur just north of the county line in 1987.

Figure 4-13 Earthquake Faults and Recorded Epicenters Map for Montezuma County and Vicinity

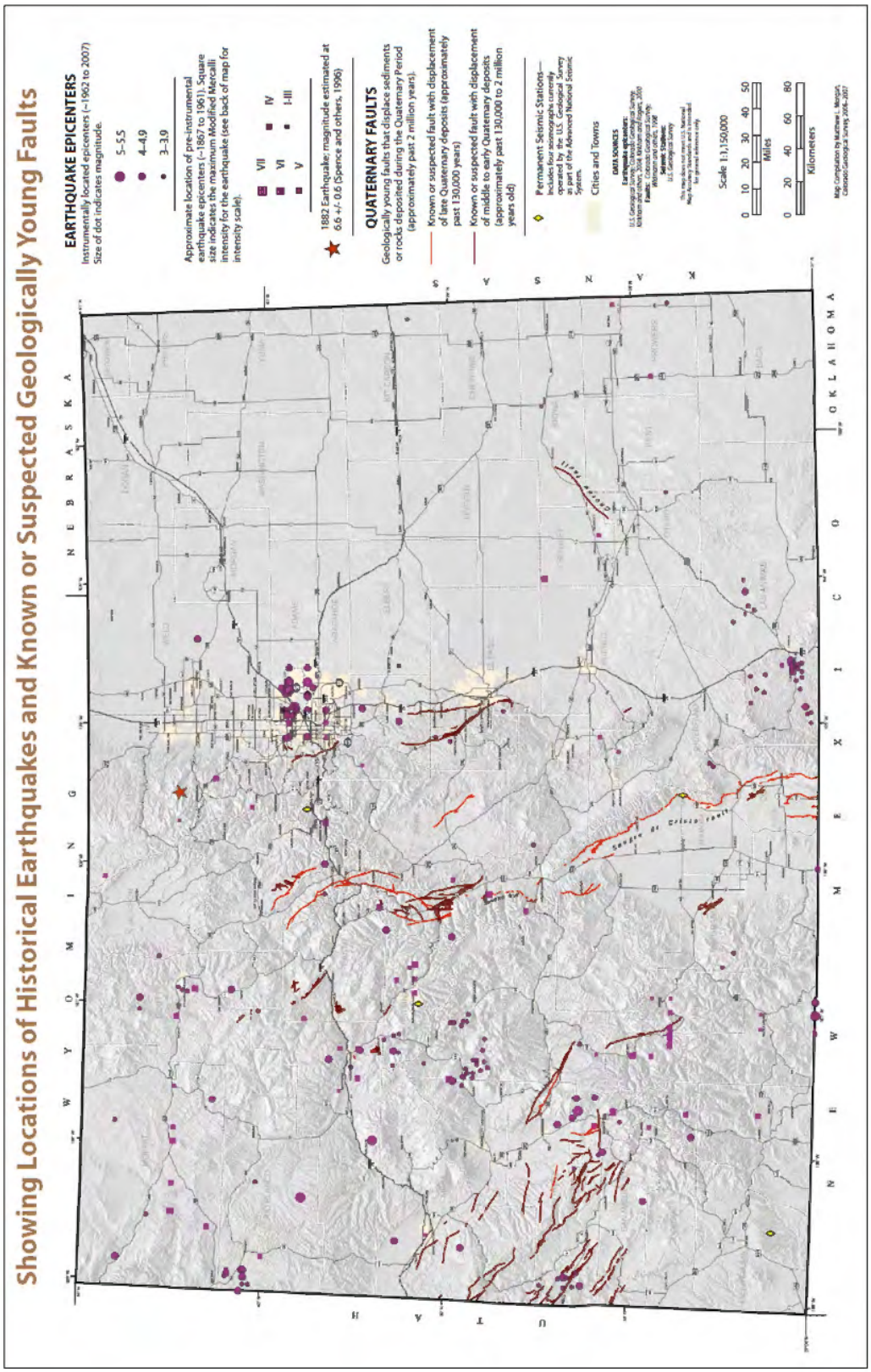


Source: Colorado Geological Survey (http://dnrwebmapgdev.state.co.us/cgsonline/)

4.6.3 Location

Geological research indicates that faults capable of producing earthquakes are prevalent in Colorado. There are approximately 90 potentially active faults in Colorado with documented movement within the last 1.6 million years. Montezuma County does not contain any major faults; the nearest fault is in San Miguel County. Figure 4-13 and Figure 4-14 show potentially active faults near Montezuma County and in all of Colorado, respectively. More than 700 earthquake tremors of magnitude 2.5 or higher have been recorded in Colorado since 1867. This is considered relatively infrequent for a western state.

Figure 4-14 Colorado Earthquakes and Fault Map



Source: Colorado Earthquake Hazard Mitigation Council 2008

Faults have been classified based on the geologic time frame of their latest suspected movement (in order of activity occurrence, most recent is listed first):

- H—Holocene (within past 15,000 years)
- LQ—Late Quaternary (15,000 to 130,000 years)
- MLQ—Middle to Late Quaternary (130,000 to 750,000 years)
- Q—Quaternary (approximately past 2 million years)
- LC—Late Cenozoic (approximately past 23.7 million years)

Although recorded earthquake events are well documented throughout Colorado and the Western Slope, no named faults are located within Montezuma County. The Cannibal Fault (indicated on Figure 4-14) was used in earthquake scenarios for Montezuma County.

4.6.4 Frequency and Severity (Extent)

Research based on Colorado's earthquake history suggests that an earthquake of magnitude 6.3 or larger has a 1% probability of occurring each year somewhere in Colorado (Charlie, Doehring, Oaks Colorado Earthquake Hazard Reduction Program Open File Report 93-01 1993).

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

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking on people, buildings, and natural features. FEMA has outlined the seismic design category in Figure 4-15. Montezuma County is located in Categories A and B (0% to 17% and 17% to 33% of the force of gravity). Category B is considered potential moderate ground shaking.

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is calculated based on the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally measured value for each earthquake event.

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

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

Mapping that shows the impacts of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. One probabilistic scenario was selected for this plan:

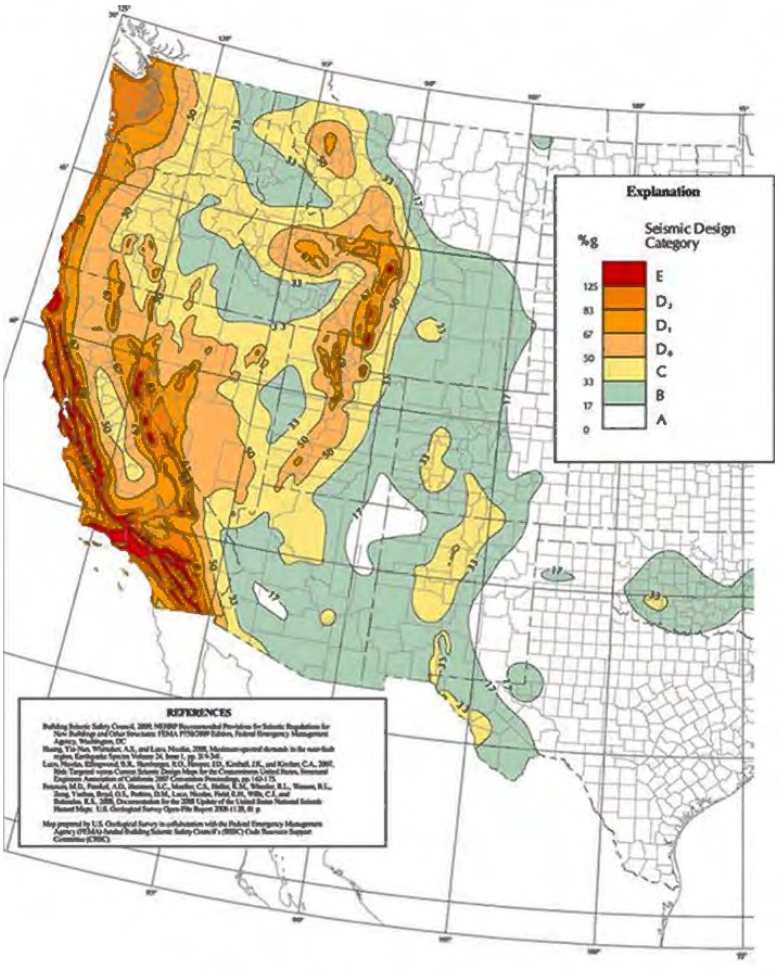
2,500-Year Probabilistic Scenario (see Figure 4-15)—This is a Hazus-MH Probabilistic Event scenario, which allows the user to generate estimates of damage and loss based on the seismic hazard for a specified return period. This scenario has a 2% probability of exceedance in 50 years and is considered more of a worst case scenario.

According to the information in this hazard profile, a large earthquake's impact on the county would be relatively minimal. Due to the low probability of damaging earthquakes, the overall significance is considered to have a minimal potential impact.

Figure 4-15 Earthquake Hazard and Potential Effects of Shaking

SDC	MAP COLOR	EARTHQUAKE HAZARD	POTENTIAL EFFECTS OF SHAKING*
A	White	Very small probability of experiencing damaging earthquake effects.	
B	Gray	Could experience shaking of moderate intensity.	Moderate shaking—Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
C	Yellow	Could experience strong shaking.	Strong shaking—Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built structures.
D0	Light brown	Could experience very strong shaking (the darker the color, the stronger the shaking).	Very strong shaking—Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures.
D1	Darker brown		
D2	Darkest brown		
E	Red	Near major active faults capable of producing the most intense shaking.	Strongest shaking—Damage considerable in specially designed structures; frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Shaking intense enough to completely destroy buildings.

* Abbreviated descriptions from The Modified Mercalli Intensity Scale



Source: FEMA

4.6.5 Warning Time

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 estimate 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 Colorado and the historical earthquake record is short, accurate estimations of magnitude, timing, or location of future dangerous earthquakes in Colorado are difficult to estimate.

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

4.6.6 Related Hazards

Earthquakes can cause large and sometimes disastrous landslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts, or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthquakes can also affect power infrastructure and compromise power poles. Earthen dams and levees are potentially susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes, though the level of expected maximum ground shaking for the four corners region makes this potential very low.

4.6.7 Climate Change Considerations

The impacts of global climate change on earthquake intensity and probability are mostly unknown but there is not expected to be a direct correlation.

4.6.8 Vulnerability

Earthquake vulnerability data was generated using a Level 1 Hazus-MH analysis. 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.

Population

The entire population of Montezuma County 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 type 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**—Approximately 4% of the planning area population over 5 years old speaks English "less than very well." 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 with incomes below the poverty level in 2012 made up 11.7% of all families and 15.1% of the total county population. These families 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**—Approximately 17% of the residents in Montezuma County are 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

Impacts on persons and households in the planning area were estimated for the 2500-Year Probabilistic Earthquake scenario event through the Level 1 Hazus-MH analysis. Table 4-22 summarizes the results. The model also estimates casualties, but results show approximately 8 minor injuries and no hospitalizations or fatalities.

Table 4-22 Estimated Earthquake Impact on Persons and Households

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
2,500-Year Earthquake	10	6

Property

According to Montezuma County Assessor records, there are 11,647 buildings in the planning area, with a total assessed value of $2.5 billion. Because all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the countywide property exposure to seismic events. Most of the buildings (98%) are residential.

Loss Potential

Property losses were estimated through the Level 1 Hazus-MH analysis for the 2,500-Year Probabilistic Earthquake scenario. The figure below is an excerpt from the Hazus global summary report and shows the results for two types building losses:

- Direct building losses, representing damage to building structures.
- Business interruption losses.

For the 2,500-Year probabilistic earthquake scenario the estimated damage potential is $36M.

Figure 4-16 Hazus Building Related Economic Loss Estimates for 2,500 Year Scenario

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.2461	1.5445	0.0378	0.0819	1.9103
	Capital-Related	0.0000	0.1050	1.3443	0.0227	0.0185	1.4905
	Rental	0.4284	0.4259	0.7316	0.0129	0.0402	1.6390
	Relocation	1.5106	0.5911	1.1299	0.0895	0.2921	3.6132
	Subtotal	**1.9390**	**1.3681**	**4.7503**	**0.1629**	**0.4327**	**8.6530**
Capital Stock Losses							
	Structural	2.0427	0.9905	1.3019	0.2057	0.3330	4.8738
	Non_Structural	7.6634	3.1516	3.4800	0.7052	0.8443	15.8445
	Content	2.9073	0.6979	2.0632	0.4492	0.5061	6.6237
	Inventory	0.0000	0.0000	0.0603	0.0977	0.0105	0.1685
	Subtotal	**12.6134**	**4.8400**	**6.9054**	**1.4578**	**1.6939**	**27.5105**
	Total	**14.55**	**6.21**	**11.66**	**1.62**	**2.13**	**36.16**

The Hazus-MH analysis also estimated the amount of earthquake-caused debris in the planning area for the 2,500-Year probabilistic earthquake scenario event is estimated to be 10,000 tons.

Critical Facilities and Infrastructure

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

Level of Damage

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. The model also estimates lifeline damages to linear networks such as transportation and utilities. Damage to transportation systems is estimated at $1.2M and utility lifelines at $45.7M.

Economy

Hazus-MH models total economic losses that includes building and lifeline related losses previously described. In total, $83M in economic losses is estimated for the 2,500 year scenario.

Historic, cultural and Natural 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 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.

4.6.9 Development Trends

Since the potential risk to earthquake is generally low, and land use and development growth trends are relatively moderate, there is not anticipated to be much change in exposure to seismic hazards.

4.6.10 Risk Summary

Earthquakes represent a low significance and low probability hazard, but damages could result to building stock and utility lifelines that could equate to millions of dollars based on Hazus-MH modeling; few casualties are anticipated.

Anticipated levels of shaking in the four corners region from earthquakes is low to moderate compared to more seismically active parts of the United States

Earthquake risk is relatively the same across all participating jurisdictions. Dolores may have additional risk to landslide and rockfall secondary hazards that could be triggered by earthquakes, as well as older building stock.

4.7 Erosion and Deposition, Expansive Soil, and Subsidence

EROSION AND DEPOSITION, EXPANSIVE SOIL, AND SUBSIDENCE HAZARD RANKING			
	Erosion and Deposition	Expansive Soil	Subsidence
Montezuma County	Medium	Medium	No Exposure
City of Cortez	Low	Medium	Low
Town of Dolores	Low	No Exposure	No Exposure
Town of Mancos	Medium	No Exposure	Low
Cortez Fire Protection District	Low	Medium	Low

4.7.1 Hazard Profile

Erosion and Deposition

The Colorado Geological Survey defines erosion as "the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice" (Colorado Geological Survey, 2014). Deposition is defined as "the placing of eroded material in a new location" (Colorado Geological Survey, 2014). All material that is eroded is later deposited in another location. Both erosion and deposition are continually occurring phenomenon, although the rate of erosion and deposition varies tremendously and can be affected by a variety of factors including rate of scour, type of material being eroded, and the presence or absence of vegetation.

DEFINITIONS

Ground Subsidence— Ground subsidence is the sinking of land over human-caused or natural underground voids and the settlement of native low density soils.

Soil Erosion— Soil erosion is the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice.

Deposition— Deposition is the

Expansive Soil

Expansive and collapsible soils are some of the most widely distributed and costly geologic hazards. Collapsible soils are a group of soils that can rapidly settle or collapse the ground. They are also known as metastable soils and are unsaturated soils that undergo changes in volume and settlement in response to wetting and drying, often resulting in severe damage to structures. The sudden and usually large volume change could cause considerable structural damage.

Expansive soil and rock are characterized by clayey material that shrinks as it dries or swells as it becomes wet. In addition, trees and shrubs placed closely to a structure can lead to soil drying and subsequent shrinkage. The parent (source) rock most associated with expansive soils is shale. Figure 4-17 shows expansive soil distribution in the United States.

Collapsible soils consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading. Soil collapse occurs when the land surface is saturated at depths greater than those reached by typical rain events. This saturation eliminates the clay bonds holding the soil grains together. Similar to expansive soils, collapsible soils result in structural damage such as cracking of the foundation, floors, and walls in response to settlement.

Subsidence and Sinkholes

According to the Colorado State Hazard Mitigation Plan, "ground subsidence is the sinking of land over human caused or natural underground voids and the settlement of native low density soils" (Colorado

DHSEM 2018). Subsidence can occur gradually over time or virtually instantaneously. There are many different types of subsidence; however, in Colorado, there are three types of subsidence that warrant the most concern: settlement related to collapsing soils, sinkholes in karst areas, and the ground subsidence over abandoned mine workings.

Collapsible Soils

Collapsible soils are a group of soils that can rapidly settle or collapse the ground. The most common type of collapsible soil is hydrocompactive soil. According to the Colorado Geological Survey, "hydrocompactive soils form in semi-arid to arid climates in the western US and large parts of Colorado in specific depositional environments" (Colorado Geological Survey 2014). These soils are low in density and in moisture content and are loosely packed together. Agents that bind these loosely packed particles together, such as clay and silk buttresses, are water sensitive. When water is introduced to these soils, the binding agents may quickly break down, soften, disperse, or dissolve. This results in a reorganization of the soil particles in a denser arrangement, which in turn results in a net volume loss indicated by resettlement or subsidence at the surface (Colorado Geological Survey 2014). Volume loss can be between 10 to 15%, which can result in several feet of surface-level displacement.

Sinkholes in Karst Areas

Most sinkholes in Colorado are related to the dissolution of evaporite minerals or limestone. Evaporite minerals dissolve in water and include gypsum and halite. Rocks containing limestone also form sinkholes based on dissolution by water. The term "karst" describes a landscape that has been shaped by the dissolution of these types of bedrock (Colorado Geological Survey 2014). According to a newsletter issued by the Colorado Geological Survey, "two characteristics of evaporative bedrock are important. One is that evaporative minerals can flow, like a hot plastic, when certain pressures and temperatures are exceeded. The second, and most important to land use and development is that evaporative minerals dissolve in the presence of freshwater. It is this dissolution of the rock that creates caverns, open fissures, streams out letting from bedrock, breccia pipes, subsidence sags and depressions, and sinkholes" (Colorado Geological Survey 2001).

Factors leading to the formation of sinkholes in these landscapes may be natural or may be induced by human activities. Natural contributing factors include the downward percolation of surface water through the rock formation or the lateral movement of water within a water table. Human activities that may contribute to such subsistence include stream channel changes, irrigation ditches, land irrigation leaking or broken pipes, temporary or permanent ponding of surface waters, and mining of soluble materials by means of forced circulation of water (Colorado Geological Survey, 2014).

Abandoned Mine Workings

The underground removal of minerals and rock can undermine underground support systems and lead to void spaces. These voids can then be affected by natural and man-made processes such as caving, changes in flowage, or changes in overlying rock and soil material resulting in collapse or subsidence. Hazards from these abandoned sites are complicated by the fact that many "final mine maps" are inaccurate or incomplete (Colorado Geological Survey, 2014). Mines operating after August 1997 were required by federal and state law to take potential surface subsidence into account; however, mining has been an activity in the state since the 1860s (Colorado Geological Survey, 2001). There are some mapped, known mine hazard areas in Colorado and in Montezuma County; however, it is likely that there are additional hazard areas for which no records exist.

4.7.2 Past Events

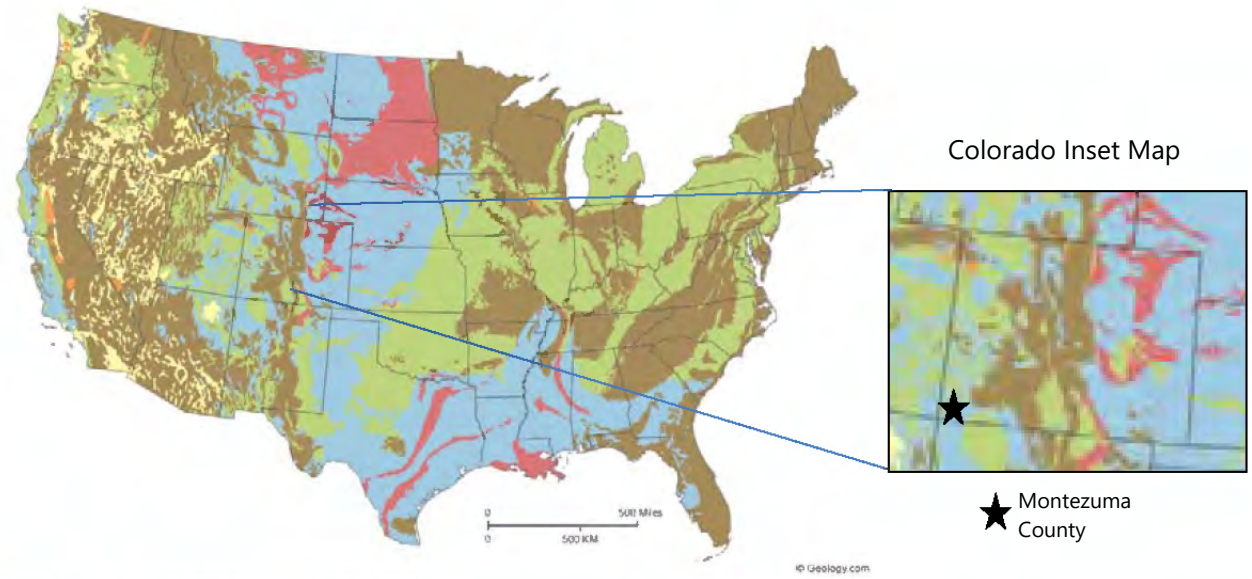
Erosion and Deposition

Soil erosion and deposition are ongoing events that can be affected by both natural and human-induced processes. Soil erosion and deposition events are continually occurring throughout the county. Portions of the county vary between highly erodible land to not highly erodible land. The majority of the highly erodible land is in higher sloped and mountainous areas.

Expansive Soil

Montezuma County soils are mostly underlain by soils with less than 50% of clays with high swelling potential, with some areas, primarily the Southern San Juan Mountains in the northeastern portion of the county that are areas underlain by soils with little to no clays with swelling potential (Figure 4-18). Therefore, the portions of the county outside of the mountainous northeastern portion are exposed to risks from expansive soil. Areas within the Southern San Juan Mountains are not exposed to expansive soils. Expanding soils can cause structural damage; however, past events are difficult to identify and measure.

Figure 4-17 Expansive Soils in the United States and Montezuma County



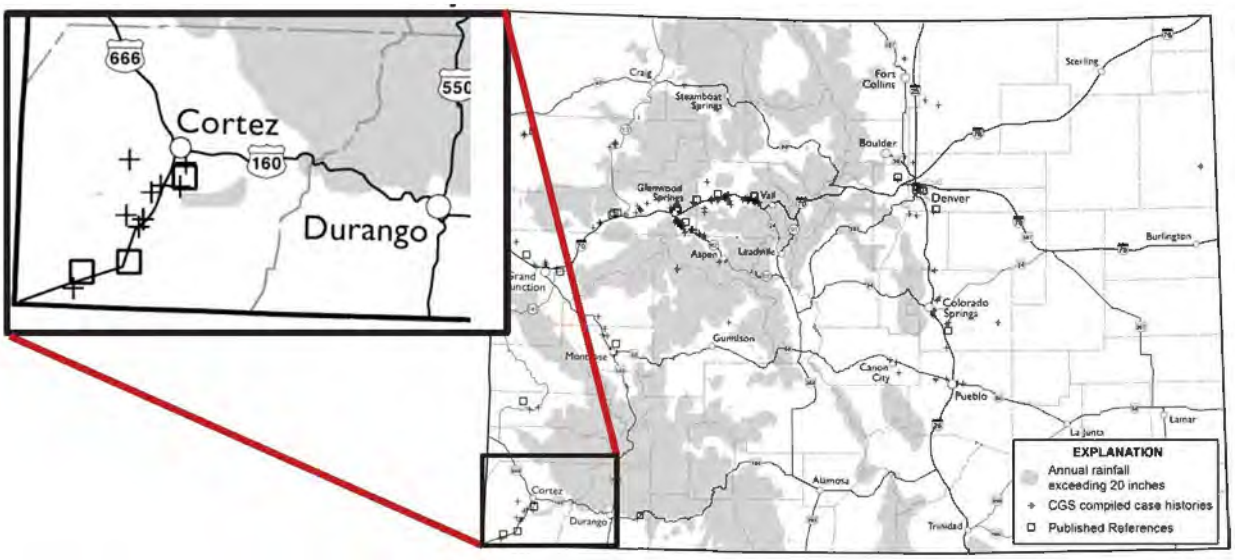
Over 50% of these areas are underlain by soils with abundant clays of high swelling potential
Less than 50% of these areas are underlain by soils with clays of high swelling potential.
Over 50% of these areas are underlain by soils with abundant clays of moderate swelling potential
Less than 50%of these areas are underlain by soils with abundant clays of moderate swelling potential
These areas are underlain by soils with little to no clays with swelling potential.
Data insufficient to indicate the clay content or the swelling potential of soils.

Subsidence and Sinkholes

The occurrence of subsidence is an on-going process resulting from natural and human induced causes. There is no known history of subsidence and sinkhole events that have occurred within Montezuma County and according to the USGS, the risk of ground collapse is low.

According to the Ute Mountain Ute risk assessment, there have been expansive soil occurrences damaging buildings, water pipelines, and electrical line systems. There are nine historic cases of collapsible soil events ranging from southwest of Cortez in the Montezuma Valley south to the Navajo Wash West of Hwy 491. These soils are derived from decomposed Mancos Shale, which is very expansive (Figure 4-18).

Figure 4-18 Colorado Geological Survey's Collapsible Soil Case Histories



Colorado Geological Survey 2018 (https://coloradogeologicalsurvey.org/2018/28848-collapsible-soils/)

4.7.3 Location

Erosion and Deposition

Soil erosion and deposition occur in all parts of the county. Point sources of erosion often occur in areas where humans interact with exposed areas of the earth's surface, such as construction sites. Waterways are continually involved in erosion and deposition processes. Erosion and deposition may be exacerbated in areas where wildfires have occurred. According to the State of Colorado's Hazard Mitigation Plan, "there is a high risk for erosion in the aftermath of a wildfire event. As a fire burns, it destroys plant material and the layers of litter that blanket the floor of an ecosystem. These materials, as well as trees, grasses, and shrubs, buffer and stabilize the soil from intense rainstorms. The plant materials slow runoff to give rainwater time to percolate into the ground. When fire destroys this protective later, rain and wind wash over the unprotected soil and erosion occurs" (Colorado Division of Emergency Management, 2011). Areas in Montezuma County that were recently burned are more susceptible to exacerbated erosion and deposition. Additionally, areas with high slopes and mountainous regions have a higher susceptibility to soil erosion. Figure 4-20 shows the erosion potential from water throughout Colorado where data were available.

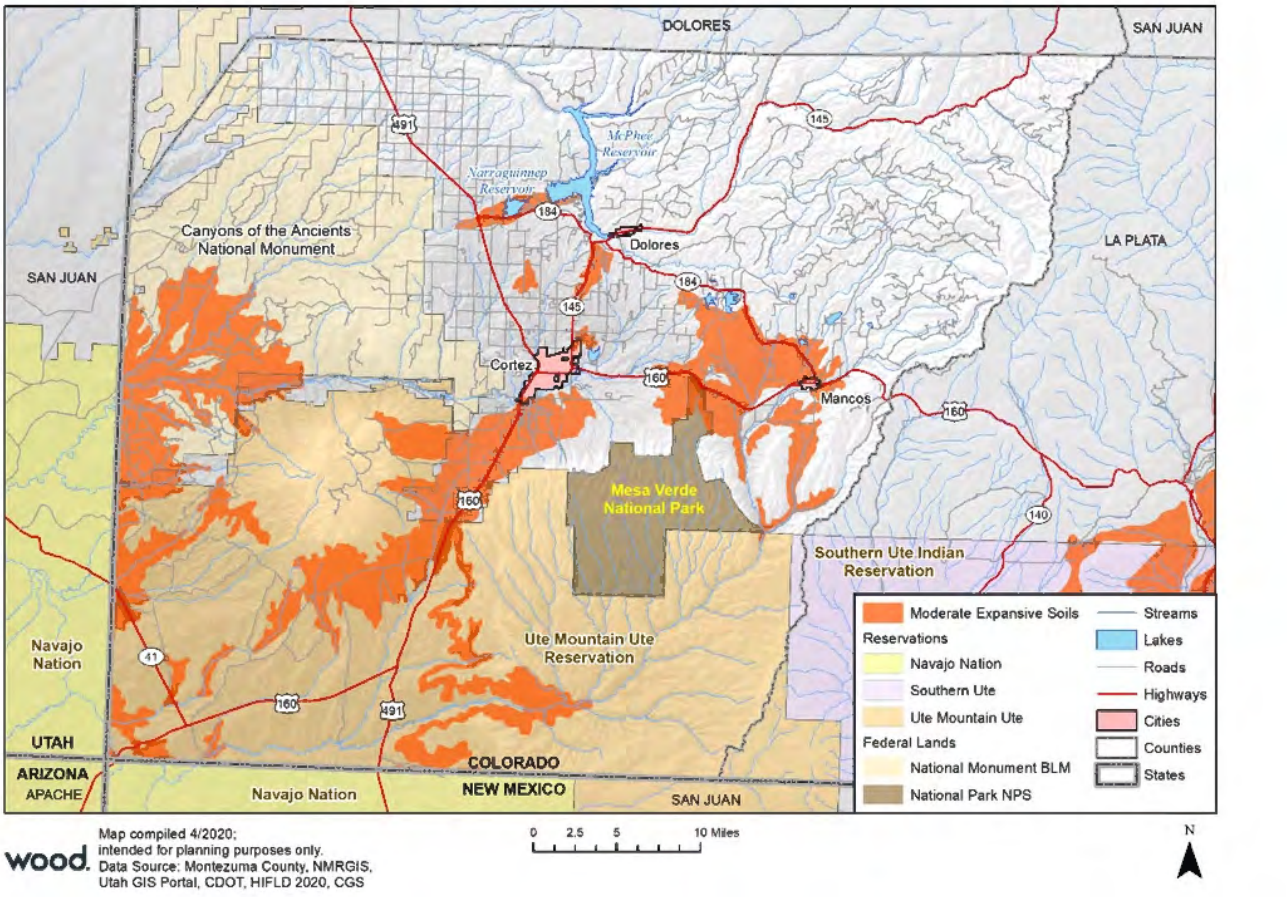
Figure 4-20 shows the erosion potential from water (streams/rivers/creeks and precipitation) in portions of Montezuma County. The Towns of Dolores and Mancos both appear to be predominately in areas with not highly erodible land. The interior portions of the City of Cortez appear to be predominately not highly erodible land, but the boundary of the City is considered to be highly or potentially highly erodible land.

Expansive Soil

Colorado has extensive areas of expansive soil, particularly bentonite. The leading cause of foundation damage in this type of soil is uneven moisture. Drying soil can shift and crack foundation as it shrinks. When moisture is applied, the resulting swelling can crumble foundation. The entire planning area is exposed to risks from expansive soil.

Moderate expansive soil is present through central and southwestern portions of Montezuma County, with a majority in the Ute Mountain Ute Reservation. The expansive soils are present outside of Cortez along US-160 as well as in and outside of Mancos along CO-184 and US-160.

Figure 4-19 Expansive Soils in Montezuma County

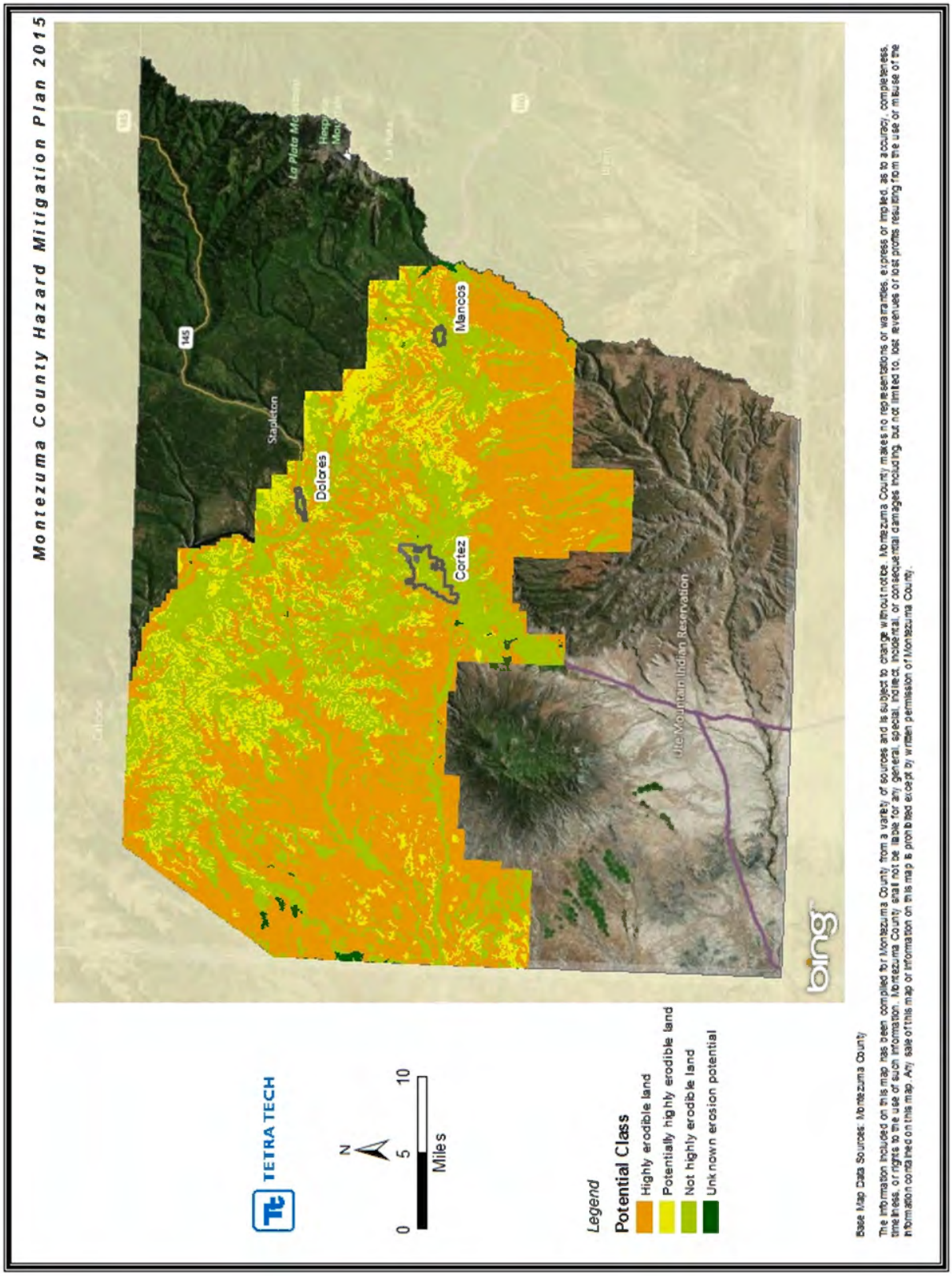


Subsidence and Sinkholes

According to the Colorado Geological Survey, "Most catalogued sinkholes of Colorado lie on surficial deposits such as flat-lying glacial outwash terraces, recent valley side sediments, or older deposits on pediment slopes overlying the evaporite bedrock. The highest density of sinkholes that are manifested at the surface in Colorado occur in the Garfield County, Eagle County, Rio Blanco County, and Park County" (Colorado Geological Survey 2001).

In Montezuma County, there are no known areas of evaporite-bearing bedrock or areas where gypsum mining has occurred.

Figure 4-20 Erosion Potential from Water (Streams/Rivers/Creeks and Precipitation)



4.7.4 Frequency and Severity (Extent)

Erosion and deposition, subsidence, and sinkholes are occurring continuously throughout the county. Large precipitation events as well as human activity may influence the frequency of these events.

The severity of erosion, deposition, subsidence, and sinkholes is largely related to the extent and location of areas that are impacted. Such events can cause property damage as well as loss of life; however, events may also occur in remote areas of the county where there is little to no impact to people or property. According to the CGS, "In general, the type and severity of surface subsidence is governed by the amount of ground surface and the location of removal or compression, and the geological conditions of a particular site" (Colorado Geological Survey 2014).

Based on the information in this hazard profile, the magnitude/severity of erosion and deposition, expansive soil, and subsidence is considered to have a moderate potential impact for the county. The City of Cortez and the Towns of Dolores and Mancos are considered to have minimal to moderate potential impacts for erosion and deposition, and expansive soil.

4.7.5 Warning Time

Subsidence can happen suddenly and without warning or can occur gradually over time. Soil erosion and deposition generally occurs gradually over time; however, these processes may be intensified as a result of natural or human-induced activities.

4.7.6 Related Hazards

Flooding related erosion can cause undercutting that can result in an increase in property damage as well as landslide or rockfall hazards. Additionally, erosion can result in the loss of topsoil, which can affect agricultural production in the area. Deposition can have impacts that aggravate flooding, bury crops, or reduce capacities of water reservoirs.

Highly erodible land is exacerbated by increased precipitation or high precipitation events as well as recently burned areas. There is typically at least one fire in the county each year. Droughts can also cause expansive soil to contract.

4.7.7 Climate Change Considerations

Changes in precipitation events and the hydrological cycle may result in changes in the rate of subsidence and soil erosion. According to the Colorado State Hazard Mitigation Plan, projected increase in frequency and duration of droughts due to climate change may cause an increase in frequency of expansive soil events. More intense precipitation in short periods of time can result in erosive flash flood events.

4.7.8 Vulnerability

Population

Residents of the county living or travelling in areas prone to subsidence and erosion are exposed to the hazard. Population exposure estimates are unavailable, but likely to be limited. The majority of the population is not exposed to subsidence. The risk of injury or fatalities as a result of these hazards are limited, but possible. Spontaneous collapse and opening of voids are rare, but still may occur resulting in death or injury to any people in the area at the time. It is likely that any such injuries would be highly localized to the area directly impacted by an event. Erosion can adversely impact populations who have respiratory issues by reducing air quality, so those with existing respiratory issues are likely to be more vulnerable.

Property

Structures and other improvements located in areas prone to subsidence or soil erosion are potentially exposed to risk from these hazards, particularly structures and utilities located along streams and other waterways. Additionally, deposition may result in damage to structures and property. Property in Mancos is exposed to moderately expansive soils. Structures exposed to erosion hazard areas may be undermined, resulting in damages. This may also result in the condemnation of a structure, but there has been little evidence that erosion, expansive soils and subsidence have had much impact on general property in the County. According to the HMPC there are some properties in the unincorporated area along the Dolores River east of Dolores that is at increasing risk of fluvial erosion and flooding.

Critical Facilities and Infrastructure

Critical facilities or infrastructure that are located on or near areas prone to subsidence or soil erosion are potentially exposed to risk from the hazard; particularly facilities located along streams and other waterways. Deposition may result in additional exposure to facilities and infrastructure, including dams, bridges, and roads.

Subsidence can result in serious structural damage to critical facilities and infrastructure such as, roads, irrigation ditches, underground utilities, and pipelines. According to CGS, large ground displacements caused by collapsing soils can totally destroy roads and structures and alter surface drainage. Minor cracking and distress may result as the improvements respond to small adjustments in the ground beneath them. Erosion can also impact structures such as bridges and roads by undermining their foundations. Structures and underground utilities found in areas prone to subsidence or soil erosion can suffer from distress. The shifting and settling of the structure can be seen in a number of ways:

- Settlement, cracking and tilting of concrete slabs and foundations,
- Displacement and cracking in door jams, window frames, and interior walls, or
- Offset cracking and separation in rigid walls such as brick, cinderblock, and mortared rock (Colorado Geological Survey, 2001).

Economy

Economic impacts typically center around transportation routes temporarily closed by erosion, expansive soils and subsidence. The areas outside of Cortez along U.S. 160 and near Mancos in CO-184 have been identified as areas of expansive soils. 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 some level of reconstruction and affect the local economy indirectly.

Historic, Cultural and Natural Resources

Subsidence, erosion, and deposition are all naturally occurring processes, but can still cause damage to the natural environment. Environments located in areas prone to subsidence and deposition are exposed. Additionally, areas where sediments are deposited are also exposed.

Ecosystems that are exposed to increased sedimentation as a result of erosion and deposition degrades habitat. However, some erosion and deposition is required for healthful ecosystem functioning. Ecosystems that are already exposed to other pressures, such as encroaching development, may be more vulnerable to impacts from these hazards.

The McElmo Creek Flume is a historic structure and was listed as an Endangered Place in 2011 under Colorado Preservation, Inc. It has since been saved but will continue to be threatened by the natural elements, including erosion (Colorado Preservation, Inc. 2020).

4.7.9 Development Trends

According to the 2018 Colorado State Hazard Mitigation Plan, Montezuma County will experience a 37% population change between 2010 – 2030. Jurisdictions in the planning area should ensure that known hazard areas are regulated under their planning and zoning programs. In areas where hazards may be present, permitting processes should require geotechnical investigations to access risk and vulnerability to erosion, subsidence, and expansive soil hazard areas particularly along river channels (fluvial erosion). Recent land use trends are not expected to change the exposure to these hazards significantly.

4.7.10 Risk Summary

- There has been little evidence that erosion, expansive soils and subsidence have had much impact on general property in the County, but the potential for issues exists if new development is not carefully sited. Significance is generally low to medium for the participating jurisdictions.
- Most impacts have been to linear infrastructure including roads and highways in the southwestern corner of the County.
- Riverine erosion can impact private property and critical infrastructure.

4.8 Flood

FLOOD HAZARD RANKING	
Montezuma County	Medium
City of Cortez	Low
Town of Dolores	High
Town of Mancos	Medium
Cortez Fire Protection District	Low

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area of flooding that has a 1% chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1% annual chance flood is the standard used by most federal and state agencies.

Riparian Zone—The area along the banks of a natural watercourse.

4.8.1 Hazard Profile

Flood

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from:

- the overflow of stream banks,
- the unusual and rapid accumulation of runoff of surface waters from any source, or
- mudflows or the sudden collapse of shoreline land.

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat sloped) streams.

The causes of floods relate directly to the accumulation of water from precipitation, rapid snowmelt, or the failure of man-made structures, such as dams or levees. Floods caused by precipitation are further classified as coming from: rain in a general storm system, rain in a localized intense thunderstorm, melting snow, rain on melting snow, and ice jams. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure's capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised due to age, poor construction and maintenance, seismic activity, rodent tunneling, or myriad other causes. For more information on floods resulting from dam and levee failure refer to Chapter 4.5 of this plan.

General Rain Floods

General rain floods can result from moderate to heavy rainfall occurring over a wide geographic area lasting several days. They are characterized by a slow steady rise in stream stage and a peak flood of long duration. As various minor streams empty into larger and larger channels, the peak discharge on the mainstream channel may progress upstream or downstream (or remain stationary) over a considerable length of river. General rain floods can result in considerably large volumes of water. The general rain flood season is historically from the beginning of May through October. Because the rate of rise is slow and the time available for warning is great, few lives are usually lost, but millions of dollars in valuable public and private property are at risk.

Thunderstorm Floods

Damaging thunderstorm floods are caused by intense rain over basins of relatively small area. They are characterized by a sudden rise in stream level, short duration, and a relatively small volume of runoff. Because there is little or no warning time, the term "flash flood" is often used to describe thunderstorm floods. The average number of thunderstorm days per year in Colorado varies from less than 40 near the western boundary to over 70 in the mountains along the Front Range. The thunderstorm flood season in Colorado is from the middle of July through October.

Snowmelt Floods

Snowmelt floods result from melting of winter snowpack in the high mountain areas. Snowmelt floods typically begin as spring runoff appears, after the first spring warming trend. If the warming trend continues up to 8 to 10 consecutive days in a basin where the snowpack has a water content more than about 150% of average, serious flooding can develop. The total duration of snowmelt floods is usually over a period of weeks rather than days. They yield a larger total volume in comparison to other types of floods in Colorado. Peak flows, however, are generally not as high as flows for the other types. A single cold day or cold front can interrupt a melting cycle causing the rising water to decline and stabilize until the cycle can begin again. Once snowmelt floods have peaked, the daily decreases are moderate, but fairly constant. Snowmelt flooding usually occurs in May, June, and early July.

Rain on Snowmelt Floods

Rain on snow flooding occurs most often in Colorado during the month of May. It is at this time of year that large general rainstorms occur over western Colorado. These rainstorms are most often caused when warm moist air from the Gulf of Mexico begins pushing far enough north that it begins to affect western weather. In combination with this movement of air mass is the continued possibility of cold fronts moving into Colorado from the Pacific Northwest. When these weather phenomena collide, long lasting general rainstorms can often occur. Rain on snowmelt exacerbates an already tenuous situation as snowmelt waters rush down heavily incised stream channels. Any abnormal increase in flow from other sources usually causes streams to leave their banks.

During the summer months of May and June when rivers are running high, there is a potential for flooding due to rain falling on melting snow. Usually such rain is over a small part of a basin, and the resulting flood is of short duration and may often go unnoticed in the lower reaches of a large drainage basin. To some extent, the cloud cover associated with the rain system can slow the melting cycle and offset the compound effect. In some cases, however, rainfall may be heavy and widespread enough to noticeably affect peak flows throughout the basin.

Ice Jam Floods

Ice jam floods can occur by two phenomena. In the mountain floodplains during extended cold periods of 20 to 40 degrees below zero, the streams ice over. The channels are frozen solid and overbank flow occurs, which results in ice inundation in the floodplains. Ice jam floods can occur when frozen water in the upper reaches of a stream abruptly begins to melt due to warm Chinook winds. Blocks of ice floating downstream can become lodged at constrictions and form a jam. The jam can force water to be diverted from the stream channel causing a flood. An ice jam can also break up, suddenly causing a surge of water as the "reservoir" that was formed behind it is suddenly released. Ice jamming occurs in slow moving streams where prolonged periods of cold weather are experienced. Sometimes the ice jams are dynamited, allowing a controlled release of the backed up water to flow downstream.

Floodplain

A floodplain is the area adjacent to a river, creek, or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage. The 0.2% annual chance flood, or the 500-year event, is another commonly referenced flood event that has a one in 500 chance of occurrence in a given year. The 500-year flood hazard area is often included on FEMA maps to further express areas of risk to communities.

Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts

4.8.2 Past Events

In the past, Montezuma County has had significant seasonal floods; however, many streams and creeks in the area have been diverted into irrigation ditches for agricultural uses and many waterways have been dammed for drinking water reservoirs.

Flooding in the county is now predominantly the result of snowmelt and cloudbursts that result in flash flooding. Severe flash flooding poses the greatest risk. These rain events are most often microbursts, which produce a large amount of rainfall in a short amount of time. Flash floods, by their nature, occur suddenly but usually dissipate within hours. Despite their sudden nature, the NWS is usually able to issue advisories, watches, and warnings in advance of a flood. In mountainous, rugged terrain, runoff can damage drainage systems or cause them to fail.

The potential for flooding can change and increase through various land use changes and changes to land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities (e.g., development). These changes 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.

Potential flood impacts include loss of life, injuries, and property damage. Floods can also affect infrastructure (water, gas, sewer, and power utilities), transportation, jobs, tourism, the environment, and ultimately local and regional economies.

The National Centers for Environmental Information (NCEI) Storm Events Database includes flood events that happened in Montezuma County between 2000 and 2020, as listed in Table 4-23.

Table 4-23 Montezuma County Flood Events (2000-2020)

			Estimated Damage Cost	
Location	Date	Event Type	Property	Crops
Cortez	8/11/2000	Flood	$0	$0
Lewis	9/10/2002	Flash Flood	$4,000	$0
Cortez	9/11/2002	Flood	$0	$0
Cortez	11/9/2002	Flood	$0	$0
Cortez	9/9/2003	Flash Flood	$0	$0
Cortez	9/9/2003	Flash Flood	$20,000	$0
Cortez	9/9/2003	Flash Flood	$10,000	$0
Lewis	9/29/2005	Flash Flood	$250,000	$0
Cortez	6/8/2006	Flash Flood	$30,000	$40,000
Cortez	8/6/2006	Flash Flood	$10,000	$0

			Estimated Damage Cost	
Location	Date	Event Type	Property	Crops
Towaoc	8/23/2012	Flash Flood	$0	$0
Mancos	8/25/2013	Flash Flood	$0	$0
Lewis	9/14/2013	Flash Flood	$0	$0
Cortez	9/14/2013	Flash Flood	$0	$0
Cortez	7/16/2018	Flood	$0	$0

Source: NCEI, Storm Events Database

Notable incidents causing damages from the Storm Events Database in Montezuma County are described below:

- **September 2002** - Water flowed across and temporarily closed U.S. Highway 491 near Lewis. Two sections of County Road X were washed out, as well as a driveway on County Road 23. Water rose to the top of a bridge on County Road W.
- **September 2003** - Flash flood waters washed out several roads in the McElmo Canyon area. A second flash flood on September 9, 2003 caused water one foot deep to flow through streets in Cortez. A road at the Cortez Municipal Airport was washed out.
- **September 2005** - Flash flooding was reported in many areas of Montezuma County where 3 to 5 inches of rain fell within a 12-hour period between midnight and noon. Flood waters were still flowing high in the early evening hours. A house located in a floodplain was inundated with about 4 feet of water and furniture was observed floating in the yard. About 2 feet of water also inundated a nearby restaurant at the intersection of Highways 491 and 184. Many roads were closed, including those in the McElmo Canyon area where residents were evacuated. The sewage treatment plant for Cortez overflowed. Road washouts occurred in many areas and some bridges were destroyed.
- **June 2006** - Heavy rainfall from a thunderstorm cell that moved north over Sleeping Ute Mountain and then across McElmo Canyon produced flash flooding, which heavily damaged a number of bridges, driveways, and irrigation ditches. Damage also was reported to Sideroll Irrigation systems. Flood waters 10 to 12 feet deep rushed down some large and normally dry arroyos, and extensive erosion occurred throughout the flooded areas. Fast moving water up to two feet deep crossed G Road and blocked traffic for about one hour. A combination of flood waters and hail damaged the crops of many vineyards, orchards, hay, and alfalfa fields. The water rose so quickly that one farmer had to abandon his truck and move to higher ground, leaving the truck to be engulfed by the flood waters. More than one inch of rain fell within a 40 minute period at the Archeological Research Center. Some windows at the center were blown in by strong outflow winds that preceded the heavy rainfall.
- **August 2006** - Heavy rain-producing thunderstorms caused flash flooding in and around Cortez, flooding streets, parks, and a few homes. The most intense downpour during this event produced 1.7 inches of rain within 80 minutes. Some residences were evacuated as water reached over knee high in depth at those properties. Water was flowing through some streets and yards like a raging river. Water was 3 to 4 feet deep on some streets.

4.8.3 Location

Montezuma County is in the Dolores/San Juan River basin. All streams in the county are either direct or indirect tributaries of either the San Juan or Dolores Rivers and flow in a general east to west direction. The Dolores River flows through the northern portion of the county, entering from the northeast corner, through the Town of Dolores, and then out the northwest corner of the county. Plateau Creek is a major tributary that joins the Dolores River at McPhee Reservoir. The San Juan River only flows through a small portion of the southwest corner of the county. However, the Navajo Wash and Mancos River are major

tributaries that run through the southern portion of the county and join the San Juan River near Four Corners. These streams normally flow year round, although they may dry up during unusually dry years. Large irrigation canals (not mapped) can also contribute to localized flooding.

The SHFA in Montezuma County and in the participating communities of Cortez, Dolores, and Mancos are shown on Figure 4-21 through Figure 4-24.

Figure 4-21 Special Flood Hazard Areas in Montezuma County

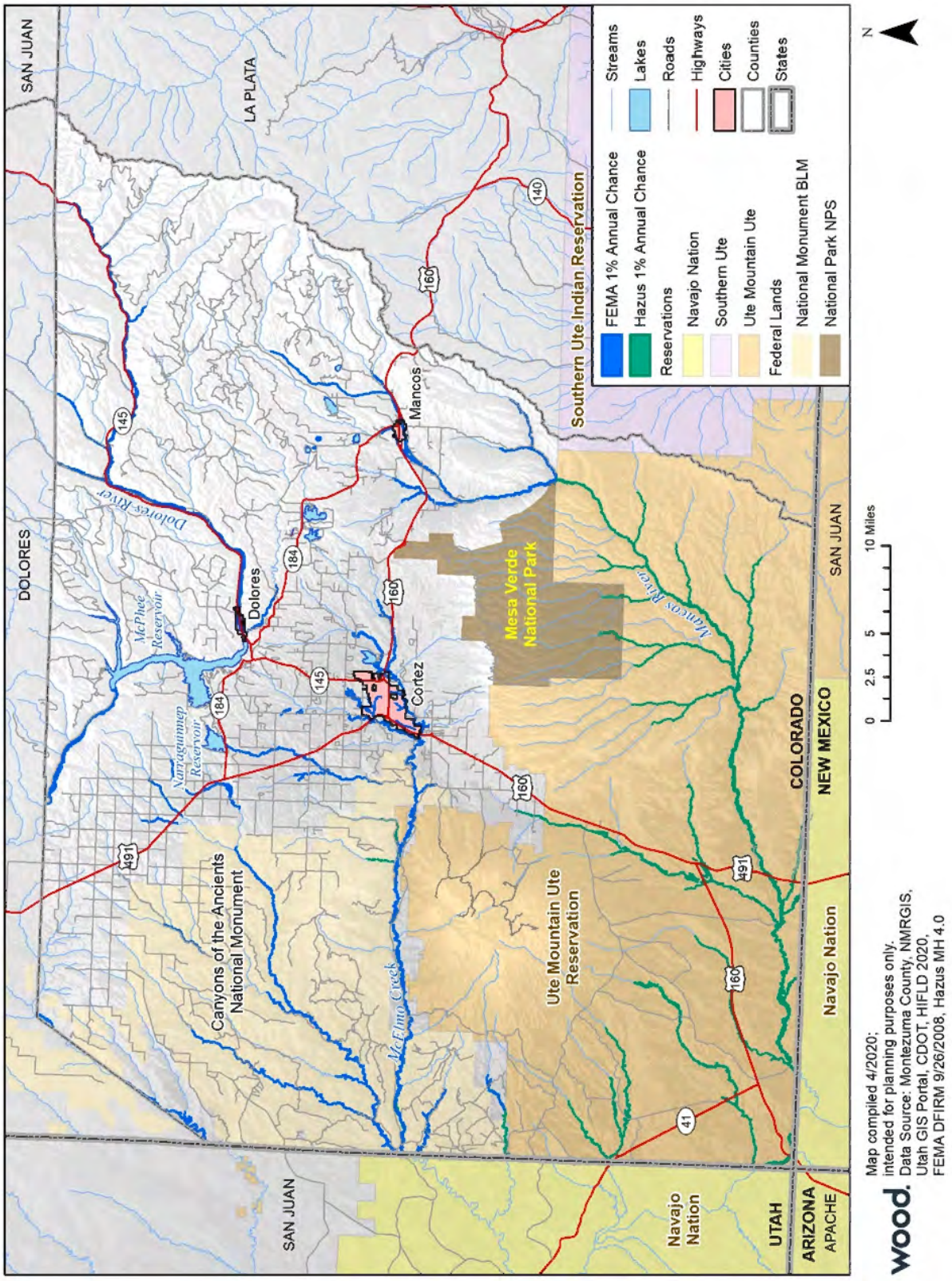


Figure 4-22 Special Flood Hazard Areas in Cortez

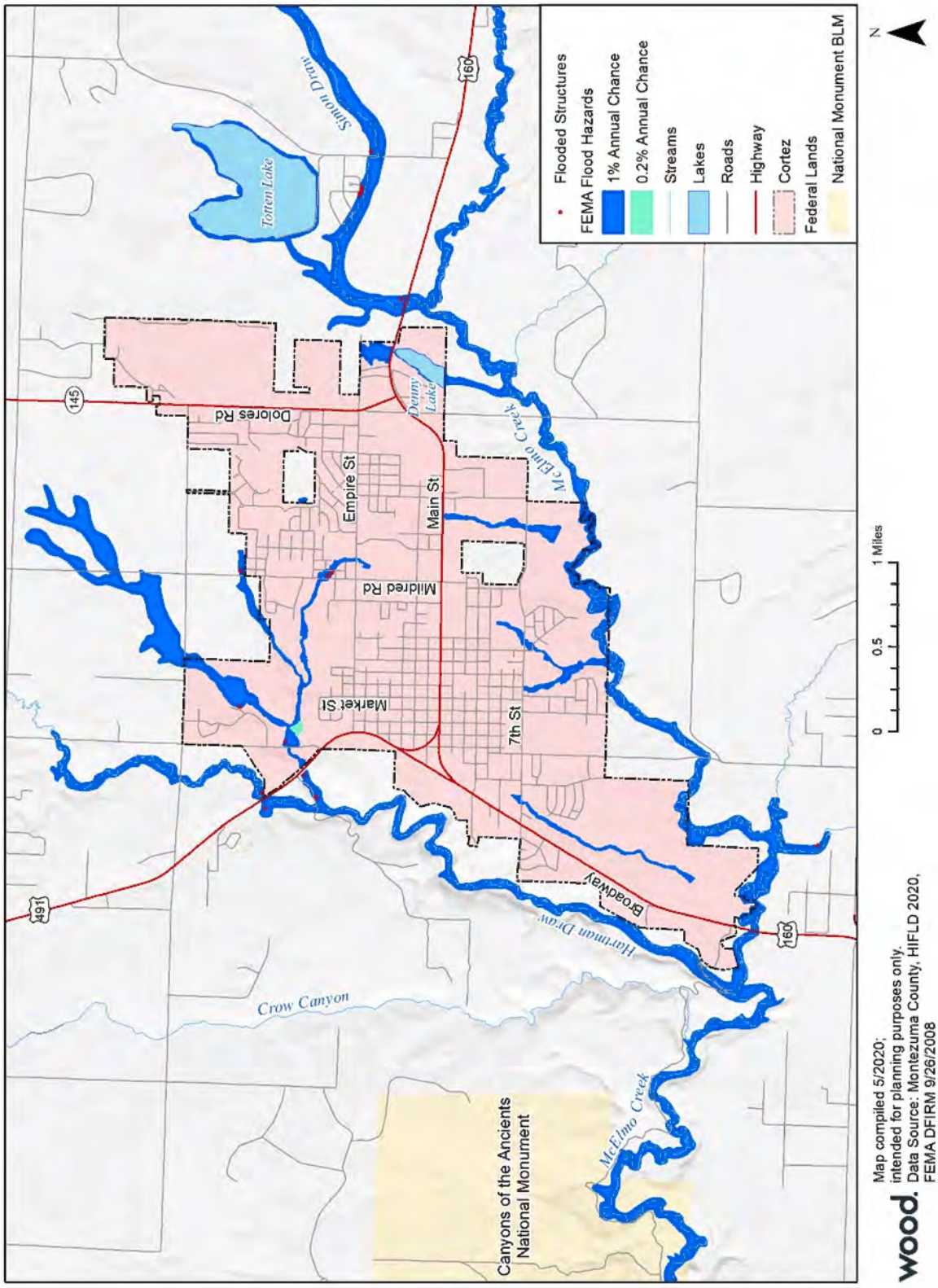


Figure 4-23 Special Flood Hazard Areas in Dolores

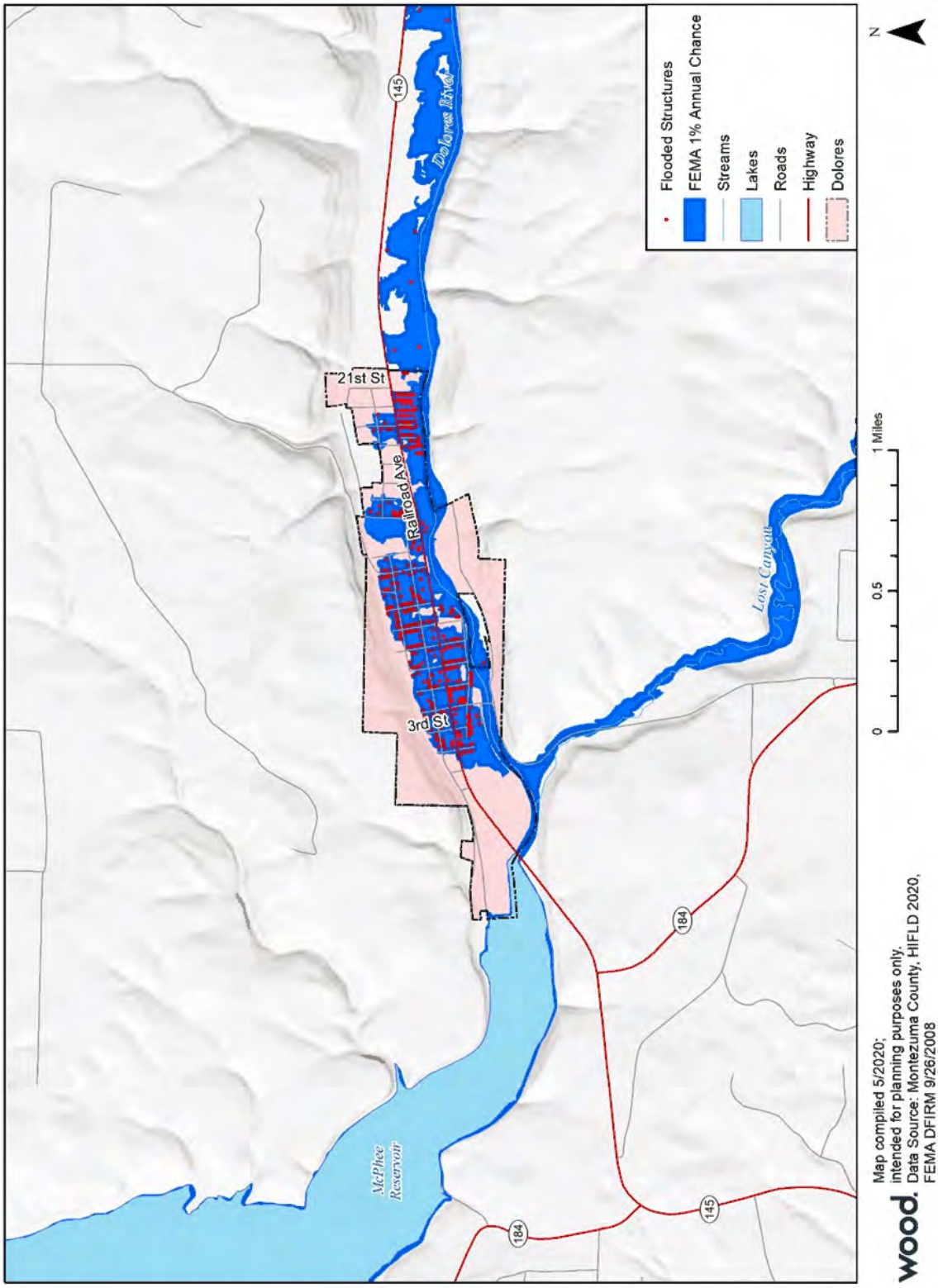
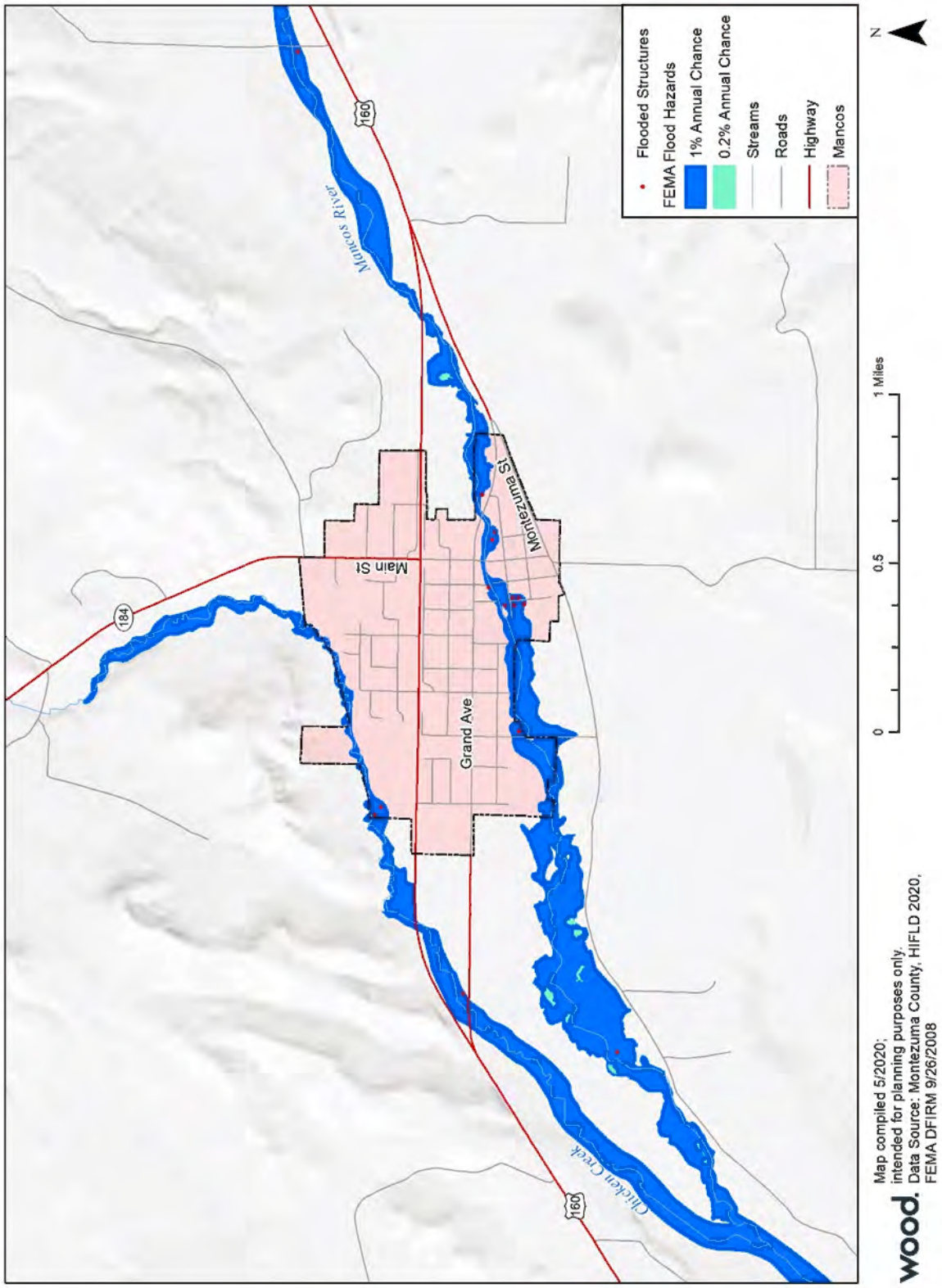


Figure 4-24 Special Flood Hazard Areas in Town of Mancos



4.8.4 Frequency and Severity (Extent)

Flash floods and floods are considered to be highly likely to occur, with nearly a 75% chance of occurrence in any given year somewhere in the County. This probability is based on the 15 events occurring over the 20 years reported in the NCEI Storm Events Database (Table 4-23).

Based on the information in this hazard profile, the magnitude/severity of flooding is limited for the City of Cortez. Therefore, the overall significance is considered low for Cortez. Across unincorporated areas of Montezuma County flood could have moderate potential impact. Conversely, Dolores has significant flood risk. The Towns of Mancos and Dolores have a high percentage of the municipality located within the floodplains; 14% and 58% of the town's acreage is within the 100-year floodplain, respectively. The overall significance of flooding for Mancos is considered medium, with moderate potential impact and the significance for Dolores is considered high, with severe potential impact. See the Vulnerability subsection for additional specifics.

4.8.5 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Flood warnings are issued by radio and television media, NOAA weather radio, public address systems, emergency sirens, or emergency personnel. Police and fire officials may be on hand to direct evacuations.

The NWS has issued general flood forecasting guidance for the region. The four corners region has been noted by the HMPC as having insufficient weather radar coverage, which hinders accurate forecasting.

Although it can be difficult to predict how much rain will result in a flood event on any given day, there are some general principles regarding when flood events are more likely to occur (NWS 2010):

- If 1 inch or more of rain falls in an urban or mountain area in 1 hour, a flood statement should be issued. In mountain areas, a flash flood warning may be necessary.
- If 2 or more inches of rain falls in an urban or mountain area in 1 hour, a flash flood warning should be issued.
- In rural areas on the plains, if rainfall reaches 2 inches in 1 hour, a flood statement should be issued and if rainfall reaches 3 inches in 1 hour, a flash flood warning should be issued.
- If precipitable water values exceed 150% of normal, this is a good indicator that flash flood-producing rains will develop if precipitation occurs.

4.8.6 Related Hazards

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or storm sewers.

4.8.7 Climate Change Considerations

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the

climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

4.8.8 Vulnerability

Many of the areas exposed to flooding as shown on NFIP maps may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment. The vulnerability analysis was performed at the parcel level using GIS during the 2020 update. This methodology improves upon the census-block level analysis done previously, which likely overestimated impacts from both the modelled 100-year and 500-years flood events as it is assumed that both structures and the population are evenly spread throughout census block. This section describes vulnerabilities in terms of population, property, infrastructure, and environment. Results of the analysis for each vulnerability subject are presented in the following sections

Population

Injuries or fatalities typically result if people are caught off guard by the flood event, more commonly associated with flash floods. Most fatalities occur when people attempt to drive across flooded areas.

Population counts of those living in the floodplain in the planning area were generated by analyzing tax assessor data and building locations that intersect with the 100-year and 500-year floodplains identified on FIRMs. Since both floodplains are nearly identical spatially (that is, the 100-year and 500-year floodplains overlap), they contain the same number of structures and therefore have the same population distribution. Total populations were estimated by multiplying the number of residential properties exposed to the 100-year floodplain by the average Montezuma County household size of the respective communities (2.15 to 2.4 persons per household).

Using this approach, it was estimated that the exposed population for the entire county is 696 within the 100-year floodplain. For the unincorporated portions of the county, it is estimated that the exposed population is 166 within the 100-year floodplain. For the City of Cortez, Town of Dolores, and the Town of Mancos, it is estimated the exposed population to the 100-year floodplain are 5, 507, and 18, respectively.

Property

Structures in the Floodplain

Table 4-24 summarizes the total area and number of structures in the 100-year floodplains by municipality. The 500-year floodplain contains the same number and distribution as the 100-year floodplain as the footprint is nearly identical, but typically the mapping of the 500-year floodplain is not as thorough. The analysis determined that there are 427 structures within the 100-year floodplain. Approximately 19% of these structures are in unincorporated areas. Approximately 74% of the structures are residential. The analysis does not account for those structures that might have been more recently constructed in accordance with local floodplain management regulations.

Table 4-24 Structures in the 100-Year Floodplain

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Loss Estimate
Cortez	Commercial	1	1	$250,810	$250,810	$501,620	$125,405
	Residential	2	2	$130,568	$65,284	$195,852	$48,963
	Vacant Land	1	1	$199,041	$199,041	$398,082	$99,521
	Total	**4**	**4**	**$580,419**	**$515,135**	**$1,095,554**	**$273,889**
Dolores	Commercial	26	28	$3,344,434	$3,344,434	$6,688,868	$1,672,217
	Exempt	5	24	$1,282,152	$1,282,152	$2,564,304	$641,076
	Mixed Use	14	39	$3,012,407	$3,012,407	$6,024,814	$1,506,204
	Residential	202	236	$25,208,145	$12,604,073	$37,812,218	$9,453,054
	Vacant Land	2	2	$266,814	$266,814	$533,628	$133,407
	Total	**249**	**329**	**$33,113,952**	**$20,509,880**	**$53,623,832**	**$13,405,958**
Mancos	Mixed Use	2	3	$243,667	$243,667	$487,334	$121,834
	Residential	8	8	$981,292	$490,646	$1,471,938	$367,985
	Vacant Land	1	1	$270,439	$270,439	$540,878	$135,220
	Total	**11**	**12**	**$1,495,398**	**$1,004,752**	**$2,500,150**	**$625,038**
Unincorporated County	Agricultural	5	5	$513,596	$513,596	$1,027,192	$256,798
	Commercial	1	1	$325,094	$325,094	$650,188	$162,547
	Exempt	1	1	$103,727	$103,727	$207,454	$51,864
	Industrial	1	1	$327,551	$491,327	$818,878	$204,719
	Mixed Use	4	4	$1,113,906	$1,113,906	$2,227,812	$556,953
	Residential	69	69	$13,811,233	$6,905,617	$20,716,850	$5,179,212
	Vacant Land	1	1	$160,844	$160,844	$321,688	$80,422
	Total	**82**	**82**	**$16,355,951**	**$9,614,110**	**$25,970,061**	**$6,492,515**
	Grand Total	**346**	**427**	**$51,545,720**	**$31,643,877**	**$83,189,597**	**$20,797,399**

Source: Montezuma Assessor, Wood GIS analysis

Exposed Value

Table 4-24 summarizes the estimated value of exposed buildings in the planning area in the 100-year floodplain. This methodology estimated $83M of building-and-contents exposure in flood hazard areas, representing approximately 1.6% of the total assessed value of the planning area. Losses to properties were estimated at $20M as 25% of the total value of a property exposed to the floodplain, based on typical FEMA depth-damage relationships.

National Flood Insurance Program

Table 4-25 lists flood insurance statistics that help identify vulnerability in the planning area. Montezuma County, the City of Cortez, and the Towns of Dolores and Mancos all participate in the NFIP. Dolores has had the highest number of paid losses since they joined the NFIP.

Table 4-25 National Flood Insurance Program Statistics

	Initial FIRM Effective Date	# of Paid Losses, 11/1978 to 3/2020	Total Losses Paid, 11/1978 to 3/2020
Cortez	4/01/1977	1	$2,487
Dolores	9/29/1989	11	$745
Mancos	9/29/1989	0	$0.00
Unincorporated County	5/4/1989	3	$16,100
Total	--	15	$19,333

Source: FEMA CIS

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built within a flood hazard area before a FIRM was adopted are more vulnerable to flooding because they do not meet floodplain management regulations that require mitigation.

The following information from flood insurance statistics is relevant to reducing flood risk:

- The use of flood insurance in the planning area is below the national average.
- The average claim paid in the planning area is below the national average.

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up only 1% to 2% of flood insurance policies in force nationally, yet they account for 40% of the nation's flood insurance claim payments. There are no repetitive loss, or severe repetitive loss properties in Montezuma County, including the City of Cortez and the towns of Dolores and Mancos.

Critical Facilities and Infrastructure

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 in the area have been known to cause extensive damage to roadway infrastructure.

Table 4-26 summarize the critical facilities and infrastructure in the 100-year and 500-year floodplain of the planning area. The 100 and 500-year floodplains have the same spatial coverage and, therefore, contain the same critical facilities. Dolores has 7 critical facilities located in the 100-year floodplain. The Mancos library was recently constructed and may be mitigated in accordance with the Town's floodplain ordinance.

Table 4-26 Critical Facilities in the 100-Year and 500-Year Floodplain

Jurisdiction	Nursing Home/ Assisted Living	Schools	Police Station	Water Treatment	Town Offices	Library	Total
Cortez	0	0	0	0	0	0	0
Dolores	1	2	1	1	1	1	7
Mancos	0	0	0	0	0	1	1
Rest of County	0	0	0	0	0	0	0
Total	**1**	**2**	**1**	**1**	**1**	**2**	**8**

Source: Montezuma Assessor, Wood GIS analysis

Utilities and Infrastructure

It is important to identify who may be at risk if infrastructure is damaged by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the county, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged, as well as overhead lines when poles are washed over. Dikes can fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

Roads

The major roads in the planning area that pass through the 100-year floodplain and thus are exposed to flooding are U.S. Highways 491 and 160 and State Highway 145. In severe flood events, these roads can be blocked or damaged, preventing access to some areas.

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. There are 12 bridges that are in or cross over the 100-year floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

Economy

Flooding can have a major economic impact on the economy, including indirect losses such as business interruption, lost wages, and other downtime costs. Flooding often coincides with the busy summer tourism months in Montezuma County.

Historic, Cultural and Natural Resources

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. 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 and levees, can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses. Areas that have recently experienced wildfires would contribute to the extent of flooding impacts.

4.8.9 Development Trends

Montezuma County and its planning partners are equipped to handle future growth within flood hazard areas. All municipal planning partners have comprehensive plans that address frequently flooded areas. All partners have committed to linking their comprehensive plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas.

Additionally, all municipal planning partners are participants in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. All municipal planning partners have committed to maintaining their good standing under the NFIP through initiatives identified in this plan.

Urban flooding issues that contribute to flash floods are also a concern in more highly developed areas in Montezuma County. Jurisdictions in the county incorporate stormwater design requirements and rely on the State of Colorado's stormwater permitting program as mandated by the National Pollutant Discharge Elimination System. This program helps jurisdictions apply effective mitigation measures for stormwater runoff.

4.8.10 Risk Summary

- Flash flooding that occurs with little or no warning will continue to impact the planning area, and deficiencies in radar coverage are a concern for appropriate alert and warning.
- The Town of Dolores has significant and high flood risk; the unincorporated areas and Mancos have moderate risk; Cortez and the Cortez Fire Protection District have low risk but are prone to stormwater floods.
- The intensity of storms contributing to flooding issues may increase due to climate change.
- Flooding may be exacerbated by other hazards, such as wildfires.
- Damages resulting from flood may impact tourism, which may have significant impacts on the local economy.
- Continued compliance with the NFIP and the promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.

4.9 Hail, Lightning, and Severe Wind

HAIL, LIGHTNING, AND SEVERE WIND HAZARD RANKING			
	Hail	Lightning	Severe Wind
Montezuma County	Medium	High	High
City of Cortez	Medium	High	High
Town of Dolores	High	Low	High
Town of Mancos	High	High	Medium
Cortez Fire Protection District	Medium	High	High

4.9.1 Hazard Profile

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air), it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.
Thunderstorms have three stages (see Figure 4-25):

DEFINITIONS

Severe Local Storm—Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

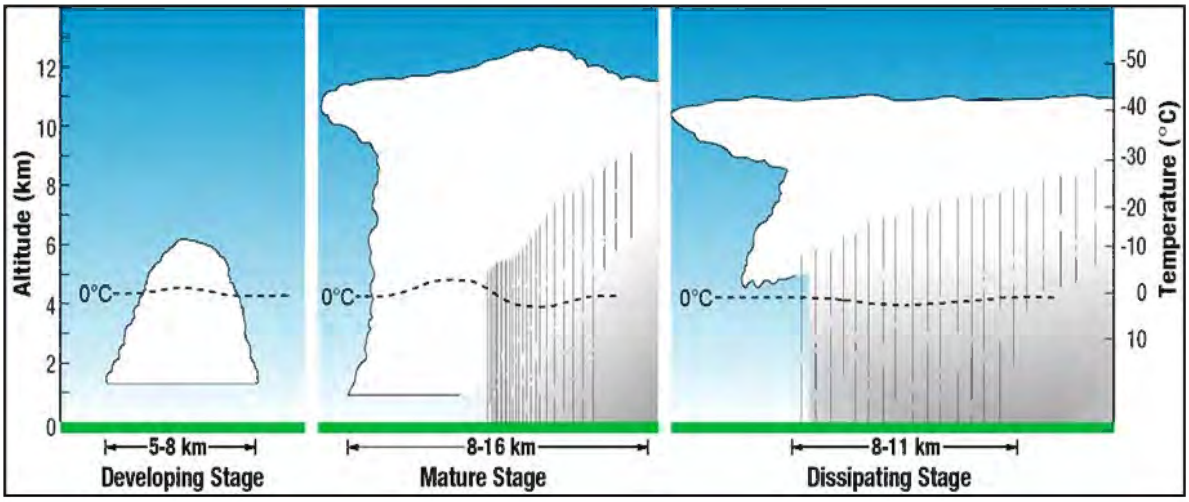
Thunderstorm—A storm featuring heavy rains, strong winds, thunder, and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Windstorm—A storm featuring violent winds. Windstorms tend to damage ridgelines that face into the winds.

- The **developing stage** of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the **mature stage** when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.

- Eventually, a large amount of precipitation is produced, and the updraft is overcome by the downdraft beginning the **dissipating stage**. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

Figure 4-25 Thunderstorm Life Cycle



There are four types of thunderstorms:

- **Single-Cell Thunderstorms**—Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm**—A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods, and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line**—A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm**—A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles per hour or more, and strong to violent tornadoes.

Hail

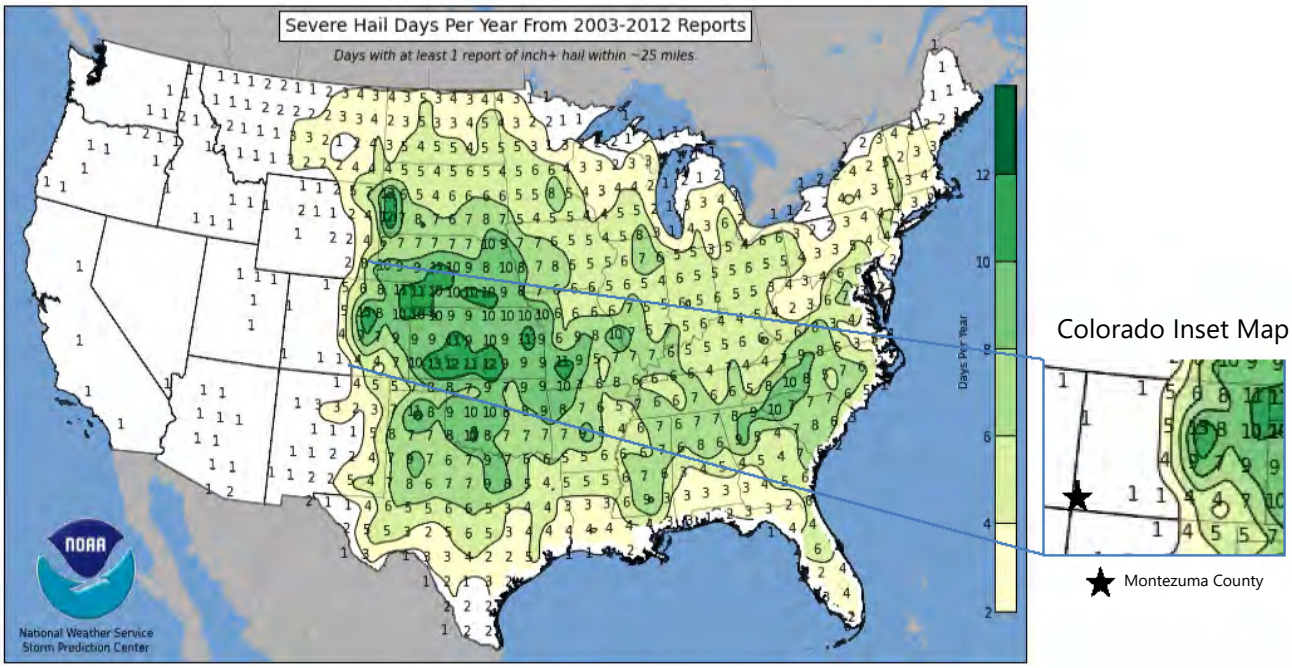
Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed forward across and above the updraft 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.

The NWS classifies hail as non-severe and severe based on hail diameter size. Descriptions and diameter sizes are provided in Table 4-31

According to the NWS Storm Prediction Center, Montezuma County experiences only one severe hail day a year on average (Figure 4-26).

Figure 4-26 Severe Hail Days per Year (2003-2012)



Lightning

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.

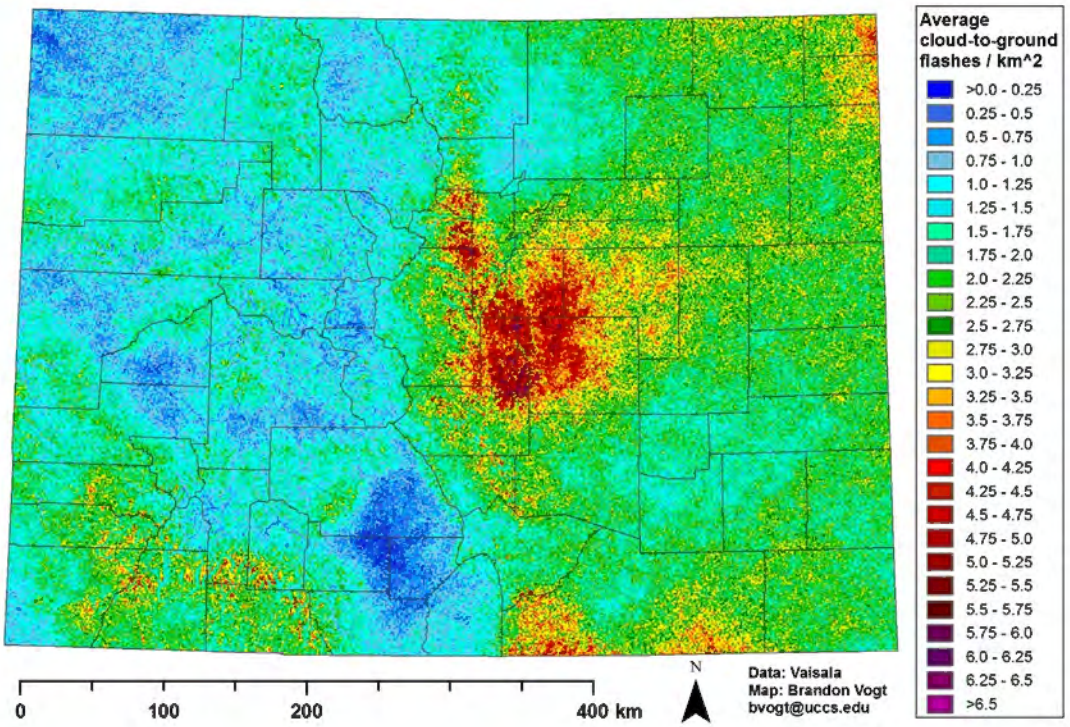
Lightning is one of the more dangerous and unpredictable weather hazards in the United States and in Colorado. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines and electrical systems. Lightning also causes forest and brush fires as well as deaths and injuries to livestock and other animals. According to the National Fire Protection Association (NFPA), between 2007 and 2011 local fire departments in the U.S. responded to an average of 22,6000 structural fires per year due to lightning. On average the Rocky Mountain region has a report of 1,395 lighting-caused fires. On average the number of acres burned due to lightning-caused fires is nine times (402 acres) higher than the average acres burned for human-caused fires (45 acres) (NFPA 2013). The National Lightning Safety Institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $8-10 billion per year Impacts can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or near it.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel can be visible for many miles.

Although not as common, 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 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. On average, Montezuma County experiences 11,100 cloud-to-ground lightning flashes annually (NWS).

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm to storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth. Using a network of lightning detection systems, NOAA monitors a yearly average of 25 million strokes of lightning from the cloud-to-ground. Figure 4-27 shows the lightning flash density for the state of Colorado between 1996 and 2016. The map shows the number of Cloud to Ground lightning flashes per square kilometer per year.

Figure 4-27 Cloud to Ground Lightning Flash Density (1996-2016)

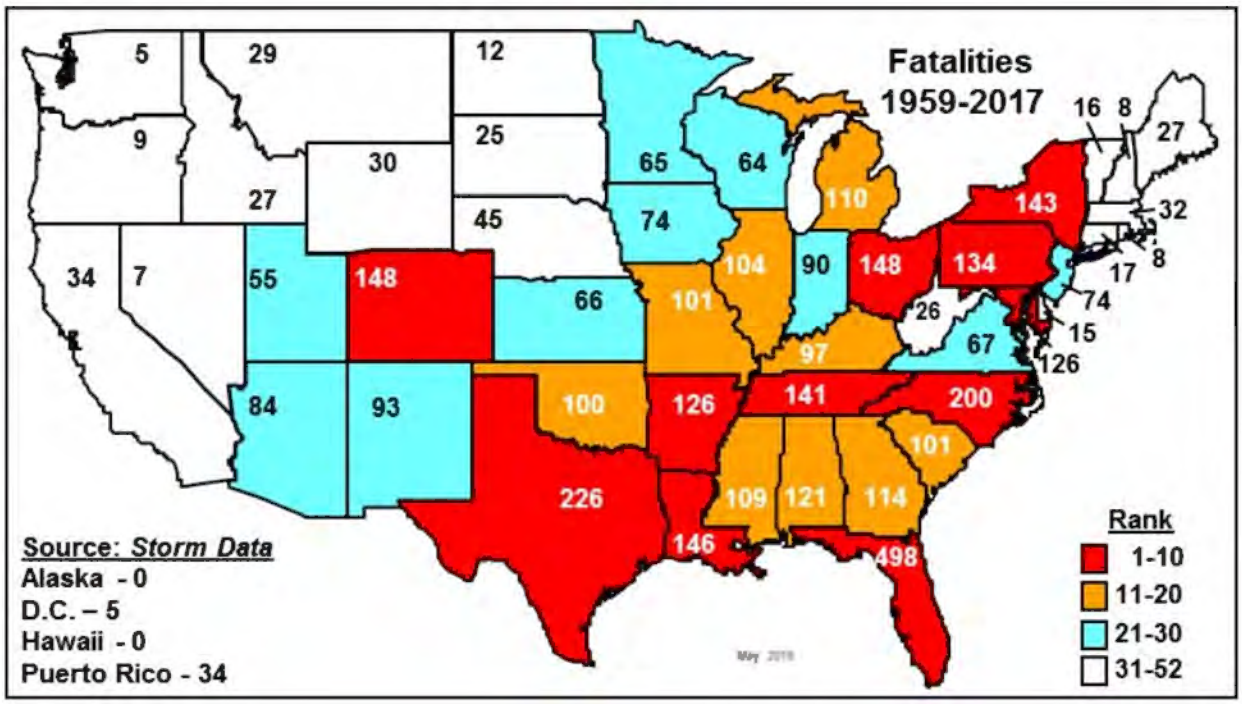


Source: NWS. Dr. Brandon Vogt, University of Colorado, Colorado Springs

Data from the National Lightning Detection Network ranks Colorado 20th in the nation (excluding Alaska and Hawaii) with respect to the number of lighting counts, cloud-to-ground strokes plus cloud pulse, with an average number of more than 3,704,799 lightning counts per year. U.S. lightning statistics compiled by NOAA between 1959 and 1994 indicate that most lightning incidents occur during the summer months of June, July, and August, and during the afternoon hours from between 2 and 6 p.m.

Figure 4-28 shows state-by-state lightning deaths between 1959 and 2017. Colorado ranks fourth for the number of deaths at 148. Florida (498), Texas (226), and North Carolina (200) were ranked higher. Based on National Weather Service data since 1980 an average of 3 people are killed and 12 are injured in Colorado.

Figure 4-28 Lightning Fatalities in the United States (1959-2017)



Source: National Weather Service, www.lightningsafety.noaa.gov/

Severe Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds**—Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts**—A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts**—A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts**—A small, concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front**—A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.

- **Derecho**—A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word "derecho" is of Spanish origin and means "straight ahead." Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

4.9.2 Past Events

Hail

The National Center Environmental Information's (NCEI) Storm Events Database lists 21 hail events in Montezuma County between 1992 and 2019. These events resulted in a total of $1,039,000 in property damages and $140,000 in crop damages. These events are noted in Table 4-27. Note, the NCEI database does not have records of hail events after 2013 for Montezuma County.

Table 4-27 Montezuma County Hail Events (1992-2019)

Location	Date	Maximum Hail Size (inches)	Location	Date	Maximum Hail Size (inches)
Montezuma Co	5/22/1992	1.75	Yellow Jacket	9/9/2003	1.5
Mancos	10/23/2000	1.00	Towaoc	9/29/2005	1.5
Pleasant View	7/14/2001	0.75	Mesa Verde National Park	9/29/2005	0.88
Stoner	7/15/2002	1.00	Cortez	6/8/2006	0.75
Mancos	9/12/2002	0.88	Cortez	8/26/2006	1.00
Cortez	8/14/2003	1.5	Cortez	10/25/2006	1.00
Mancos	8/14/2003	1.00	Arriola	110/7/2010	1.00
Cortez	8/14/2003	0.75	Dolores	10/7/2010	1.5
Mancos	8/14/2003	0.75	Mesa Verde National Park	7/12/2012	0.88
Mancos	8/14/2003	1.00	Yellow Jacket	9/17/2013	1.00
Cortez	8/14/2003	1.00			

Source: National Center for Environmental Information

Lightning

According to the NCEI Storm Events Database, 13 lightning events occurred in Montezuma County between 1997 and 2017. The events are noted in Table 4-28. The events resulted in $251,500 in property damages and 3 injuries. Of the 13 recorded events in the NCEI database, 6 of them lead to fire, both structural and wildfire, and 2 resulted in power outages. The reported injuries occurred on August 6, 2001 when three men were struck by lightning. The men were on a golf course and sought shelter from the thunderstorm under a tall tree; lightning struck the tree and then passed through each of the men. The National Weather Service reports one casualty due to lighting on May 1, 1982 that was not recorded in the Storm Events database.

Table 4-28 Montezuma County Lightning Events (1997-2014)

Location	Date	Deaths	Injuries	Property Damage
Cortez	7/16/1997	0	0	$150,000
Cortez	7/22/1997	0	0	$60,000
Towaoc	8/12/1997	0	0	$0
Cortez	7/18/1998	0	0	$2,000
Towaoc	7/31/1998	0	0	$0
Cortez	10/16/1998	0	0	$500
Cortez	8/6/2001	0	3	$0
Cortez	7/31/2005	0	0	$4,000
Cortez	9/29/2005	0	0	$20,000
Mancos	8/19/2010	0	0	$1,000
Mesa Verde National Park	7/20/2013	0	0	$2,000
Cortez	8/10/2013	0	0	$2,000
Cortez	5/9/2017	0	0	$10,000

Source: National Center Environmental Information

Severe Winds

High winds can occur year round in Montezuma County. In the spring and summer, high winds often accompany severe thunderstorms. The varying topography in the area has the potential for continuous and sudden gusting of high winds. According to the State of Colorado Plan, Chinook winds are a fairly common wintertime phenomena in Colorado. These winds develop in well-defined areas and can be quite strong. Atmospheric conditions are expected to continue unchanged with windstorms remaining a perennial occurrence. The areas within the county that have the highest wind potential are located in the Southern San Juan Mountains, along the northeastern portion of the county.

Although these high winds may not be life-threatening, they can disrupt daily activities, cause damage to building and structures, and increase the potential damage of other hazards. Wind resource information is shown in Table 4-29 as a proxy for typical wind speeds. Wind resource information is estimated by the National Renewable Energy Laboratory (NREL) to identify areas that are suitable for wind energy applications. The wind resource is expressed in terms of wind power classes, ranging from class 1 (lowest) to class 7 (highest). Each class represents a range of mean wind power density or approximate mean wind

Table 4-29 Wind Power Class and Speed

	Wind Power Class	Wind Power Density at 50 meters (W/m2)	Wind Speed at 50 meters (mph)
Poor	1	0-200	0-12.5
Marginal	2	200-300	12.5-14.3
Fair	3	300-400	14.3-15.7
Good	4	400-500	15.7-16.8
Excellent	5	500-600	16.8-17.9
Outstanding	6	600-800	17.9-19.7
Superb	7	800-2000	19.7-26.6

Source: National Renewable Energy Laboratory Wind Energy Resource Atlas of the United States
mph miles per hour
W/m2 Watts per square meter

Historical severe weather data from the NCEI Storm Events Database includes 20 high wind events, 22 thunderstorm wind events, and 6 strong wind events in Montezuma County between 1974 and December 2018, as shown in Table 4-30. Wind-related events caused over $600,000 in damages to property and

crops and five injuries. On August 12, 2000, a strong thunderstorm wind hit a rock concert at the Echo Basin Ranch, causing the roof structure to fall onto the stage. Other injuries involved strong winds blowing vehicles off the road.

Table 4-30 Montezuma County Wind-Related Events (1974-2018)

Location	Date	Event Type	Peak Wind Speed (Knots)	Estimated Damage Cost	
				Property	Crops
Montezuma County	6/7/1974	Thunderstorm Wind	NA	$0	$0
Montezuma County	4/1/1978	Thunderstorm Wind	56	$0	$0
Four Corners/Upper Dolores River Basin	2/26/1996	High Wind	NA	$7,500	$0
Mancos	7/16/1997	Thunderstorm Wind	52	$5,000	$0
Dolores	7/17/1997	Thunderstorm Wind	75	$20,000	$0
Southwestern San Juan Mountains	10/11/1997	High Wind	100	$1,000	$0
Four Corners/Upper Dolores River/Cortez and Vicinity/ SW San Miguel/W Dolores/Montezuma except NE	2/24/1998	High Wind	50	$0	$0
Four Corners/Upper Dolores River/Cortez and Vicinity/ SW San Miguel/W Dolores/Montezuma except NE	6/17/1998	High Wind	NA	$200,000	$0
Cortez	7/16/1998	Thunderstorm Wind	50	$0	$0
Cortez	7/19/1998	Thunderstorm Wind	50	$0	$0
Cortez	8/19/1998	Thunderstorm Wind	50	$0	$0
Southwestern San Juan Mountains	11/17/1998	High Wind	78	$0	$0
Southwestern San Juan Mountains	1/25/1999	High Wind	83	$0	$0
Southwestern San Juan Mountains/C E Dolores/ San Juan/ S Hinsdale/N La Plata/ NE Montezuma County	3/7/1999	High Wind	50	$0	$0
Four Corners/Upper Dolores River/Cortez and Vicinity/ SW San Miguel/W Dolores/Montezuma except NE	4/9/1999	High Wind	50	$1,000	$0
Four Corners/Upper Dolores River/Cortez and Vicinity/ SW San Miguel/W Dolores/Montezuma except NE	6/2/1999	High Wind	65	$3,000	$0
Cortez	6/17/1999	Thunderstorm Wind	65	$8,000	$0
Four Corners/Upper Dolores River Basin	4/18/2000	High Wind	52	$0	$0
Southwestern San Juan Mountains	4/18/2000	High Wind	80	$0	$0
Mancos	8/12/2000	Thunderstorm Wind	50	$50,000	$0
Four Corners/Upper Dolores River Basin	3/14/2001	High Wind	50	$10,000	$0
Cortez	9/7/2002	Thunderstorm Wind	60	$7,000	$0
Cortez	2/22/2003	Thunderstorm Wind	45	$20,000	$0
Four Corners/Upper Dolores River Basin	4/23/2003	Strong Wind	48	$25,000	$0
Four Corners/Upper Dolores River Basin	5/9/2003	Strong Wind	45	$1,000	$0
Cortez	6/9/2003	Thunderstorm Wind	52	$0	$0
Cortez Airport	6/9/2003	Thunderstorm Wind	52	$0	$0
Four Corners/Upper Dolores River Basin	6/24/2003	Strong Wind	50	$1,000	$0
Mancos	7/21/2005	Thunderstorm Wind	52	$2,000	$0
Southwestern San Juan Mountains	2/15/2006	Strong Wind	94	$6,000	$0
Four Corners/Upper Dolores River Basin	5/22/2006	Strong Wind	48	$1,000	$0
Cortez	6/8/2006	Thunderstorm Wind	57	$0	$0

Location	Date	Event Type	Peak Wind Speed (Knots)	Estimated Damage Cost	
				Property	Crops
Cortez	9/20/2006	Thunderstorm Wind	52	$0	$0
Cortez	10/25/2006	Thunderstorm Wind	52	$20,000	$0
Four Corners/Upper Dolores River Basin	6/6/2007	Strong Wind	48	$5,000	$0
Cortez Airport	7/4/2007	Thunderstorm Wind	51	$0	$0
Southwestern San Juan Mountains	2/16/2011	High Wind	78	$0	$0
Towaoc	7/17/2011	Thunderstorm Wind	56	$0	$0
Southwestern San Juan Mountains	12/31/2011	High Wind	82	$0	$0
Cortez Airport	8/10/2013	Thunderstorm Wind	54	$0	$0
Arriola	10/3/2013	Thunderstorm Wind	75	$75,000	$150,000
Southwestern San Juan Mountains	12/21/2014	High Wind	87	$0	$0
Dolores	5/19/2015	Thunderstorm Wind	52	$0	$0
Southwestern San Juan Mountains	2/18/2016	High Wind	103	$0	$0
Southwestern San Juan Mountains	3/5/2017	High Wind	91	$0	$0
Four Corners / Upper Dolores River Basin (Zone)	6/12/2017	High Wind	55	$0	$0
Southwestern San Juan Mountains (Zone)	2/19/2018	High Wind	100	$0	$0
Four Corners / Upper Dolores River Basin (Zone)	4/12/2018	High Wind	53	$0	$0
			Total	**$468,500**	**$150,000**

Source: National Center for Environmental Information

4.9.3 Location

Severe weather events have the potential to happen anywhere in the planning area. Thunderstorms are generally expansive in size. The entire county is susceptible to any of the effects of a severe thunderstorm, including hail, heavy rain, and high winds.

While all of Montezuma County is potentially exposed to hail, most hailstorms occur in the central and northern portions of Montezuma County. Windstorms could occur anywhere in Montezuma County. They have the ability to cause damage over 100 miles from the center of storm activity. Higher elevations could experience the most significant wind speeds, but these areas are generally not developed or populated. Wind events are most damaging to areas that are heavily wooded. The entire area of Montezuma County is exposed to some degree of lightning hazard, though exposed points of high elevation have significantly higher frequency of occurrence.

4.9.4 Frequency and Severity (Extent)

Common problems associated with severe storms include the loss of utilities or immobility. Loss of life is uncommon but can occur during severe storms. Immobility can occur when roads become impassable due to heavy rains causing flooding, downed trees, or a landslide. Loss of utilities, specifically power lines can occur due to downed trees from high winds or lighting. Extent for severe weather, particularly severe thunderstorms that involve heavy rain, high wind hail can be measured according to hail by diameter sizes and wind speed.

Hail

Severe hailstorms can be quite destructive. Much of the damage inflicted by hail is to crops. In recent years in the United States, hail caused more than $1 billion in damage to property and crops each year representing 1% to 2% of the annual crop value. Even relatively small hail can shred plants to ribbons in a

matter of minutes. 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.

Colorado's severe hail season is between mid-April to mid-September and an average of 119 days per year (NICB 2020). According to the Rocky Mountain Insurance Information Association, hailstorms in the last 10 years have caused more than $5 billion in insured damaged in Colorado. The May 2017 event alone caused $3.6 billion in damage (NICB 2020). The costliest hailstorms have been centered in the Denver Metropolitan Area and Colorado Front Range.

According to the National Insurance Crime Bureau (NICB) April 2020 Hail Report, Colorado was second in the number of hail claims from 2017 to 2019 with 380,066 claims. Texas had the highest number of claims every year except 2018, where Colorado topped the states with 191,679 claims that year. The National Weather Service (NWS) classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-31 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.

The largest hailstone recorded in the NCEI database for Montezuma County was 1.75 inches on May 22, 1991. The most commonly recorded hailstone size is 1-inch hail.

Table 4-31 Hail Measurements

Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball
.75 inch	Dime/Penny
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

Lightning

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 County,

Montezuma is at risk to experience lightning in any of these categories. The LAL is reproduced in Table 4-32.

Table 4-32 Lightning Activity Level 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

The number of reported injuries from lightning is likely to be low, and county infrastructure losses equate to tens of thousands of dollars each year. The relationship of lightning to wildfire ignitions in the county increases the significance of this hazard. Based on the information in this hazard profile, the overall significance of lightning events is minimal for Montezuma County.

Severe Winds

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 Montezuma County 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.

Based on the information in this hazard profile, the magnitude/severity of severe winds is considered limited. Overall significance of the hazard is considered to have a moderate potential impact.

Damaging wind is measured using the Beaufort Wind Scale as shown in Table 4-33. This scale only reflects land-based effects and does not take into consideration the effects of wind over water.

Table 4-33 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.
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

4.9.5 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. Weather forecasts for the planning area are limited. People generally rely on weather forecasts for the City of Cortez. However, there are significant altitude, geothermal, and jet stream differences from Cortez to other areas in Montezuma County. At times warning for the onset of severe weather may be limited.

4.9.6 Related Hazards

The most significant related hazards associated with severe local storms are floods, falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and constructed drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Fires can occur as a result of lightning strikes. Many locations in the region have minimal vegetative ground cover and the high winds can create a large dust storm, which becomes a hazard for travelers and a disruption for local services.

High winds in the winter can turn small amount of snow into a complete whiteout and create drifts in roadways. Debris carried by high winds can also result in injury or damage to property. A wildland fire can be accelerated and rendered unpredictable by high winds, which makes a dangerous environment for firefighters.

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards of flood and landslide occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding, drifting snow, and landslides could further obstruct roads and bridges, further isolating residents.

4.9.7 Climate Change Considerations

It is difficult at this point in time to summarize the effects climate change may have on these hazards. However, as average temperatures increase over time, this generally will result in higher extreme temperatures. More warming in the atmosphere can trigger climate changes, which could result in more frequent extreme weather events. Much of the U.S. has already experienced prolonged periods of heavy downpours and severe flooding as a result of more extreme heavy rain and thunderstorm events.

4.9.8 Vulnerability

Population

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, while populations in low-lying areas are at risk for possible flooding. 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. In Montezuma County, 13% of Medicare Beneficiaries rely on electricity to live independently in their homes. 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. Hikers and climbers in the area may also be more vulnerable to severe weather events. Visitors to the area may not be aware of how quickly a thunderstorm can build in the mountains.

Property

All of these buildings are considered to be exposed to the thunderstorm, wind, and hail hazard, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

All property is vulnerable during thunderstorm, wind, lightning and hail 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 or be vulnerable to fires from lightning strikes.

Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage.

Hail

A total of 21 hail events have taken place in Montezuma County between 1992 and 2019. The loss estimates for the hail events in the City of Cortez, the Towns of Dolores and Mancos, and the rest of the county outside of the defined jurisdictions are listed in Table 4-34.

Table 4-34 Loss Estimates for Hail Events in Montezuma County

Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Cortez	0.29 events/year	$166,667/event	$48,333
Mancos	0.24 events/year	$0	$0
Dolores	0.05 events/year	$0	$0
Rest of County	0.43 events/year	$4,333/event	$1,863
Total	**1 event/year**	**$49,476/event**	**$49,476**

Note: Loss estimates based on historical record of 4 loss events and 21 total events.
Source: NOAA - National Climatic Data Center. 1992-2019.

Lightning

A total of 13 damaging lightning events have taken place in Montezuma County between 1997 and 2017. The loss estimates for the lightning events in the City of Cortez, the Towns of Dolores and Mancos, and the rest of the county outside of the defined jurisdictions are listed in Table 4-35.

Table 4-35 Loss Estimates for Lightning Events in Montezuma County

Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Cortez	0.62 events/year	$31,063/event	$19,115
Mancos	0.08 events/year	$1,000/event	$77
Dolores	-	-	-
Rest of County	0.23 events/year	$2,000/event	$154
Total	2 events/year	$25,150/event	$19,346

Note: Loss estimates based on historical record of 10 lightning events that caused damage and a total of 13 events.
Source: NOAA - National Climatic Data Center. 1997 - 2017.

Severe Winds

A total of 20 severe wind events have taken place in Montezuma County between 1974 and 2018. The loss estimates for severe wind events in the City of Cortez, the Towns of Dolores and Mancos, and the rest of the county outside of the defined jurisdictions are listed in Table 4-36.

Table 4-36 Loss Estimates for Severe Wind Events in Montezuma County

Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Cortez	0.25 events/year	$13,750/event	$1,250
Mancos	0.07 events/year	$19,000/event	$1,295
Dolores	0.05 events/year	$20,000/event	$455
Rest of County	0.68 events/year	$25,885/event	$7,648

Community	Annual Rate of Occurrence	Average Loss Expectancy	Annualized Loss
Total	1.1 event/year	$22,310/event	$10,648

Note: Loss estimates based on historical record of 20 wind-related events.
Source: NOAA - National Climatic Data Center. 1974 - 2018.

Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from thunderstorms, wind, and hail, mostly associated with related hazards. High winds 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. Prolonged obstruction of major routes due to landslides, debris, or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region. Severe windstorms and downed trees can create serious impacts on power and above-ground communication lines. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Lightning events in the county can have destructive effects on power and information systems. Failure of these systems would have cascading effects throughout the county and could possibly disrupt critical facility functions.

Facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with these weather events are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to secondary hazards such as landslides.

Economy

Economic impact of a severe thunderstorm is typically short term. Lightning and high wind 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, and flooding (refer to the Wildfire and Flood sections). In general, all severe thunderstorms pose a risk to the tourism economy in the county. These events can disrupt travel into and out of all areas of the county and create perilous conditions for residents, tourists and nature alike.

Historic, Cultural and Natural Resources

The environment is highly exposed to lightning, winds, and hail. Environmental impacts include the sparking of potentially destructive wildfires by lightning, and localized flattening of plants by high wind. Natural habitats such as streams and trees risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure.

4.9.9 Development Trends

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The Town of Dolores and Town of Mancos will be updating their building codes to the 2018 International Building Code. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in master plans and enforced through zoning code and the permitting process also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

4.9.10 Risk Summary

- There have been 82 recorded hail, lightning and severe wind events in Montezuma County since 1974, resulting in over $2 Billion in property and crop damages and 8 injuries.
- 13% of Medicare Beneficiaries in the County rely on electricity dependent medical equipment to live independently in their own homes making them vulnerable to lightning and severe wind events that may result in power outages.
- Related hazards: Flood, Wildfire, Avalanche, Landslide, Mud/Debris Flow

4.10 Landslide, Mud/Debris Flow, Rockfall

LANDSLIDE, MUD/DEBRIS FLOW, ROCKFALL HAZARD RANKING	
Montezuma County	High
City of Cortez	Low
Town of Dolores	High
Town of Mancos	High
Cortez Fire Protection District	Low

DEFINITIONS

Landslide—The sliding movement of masses of loosened rock and soil down a hillside or slope. Such failures occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)—A river of rock, earth, organic matter and other materials saturated with water.

4.10.1 Hazard Profile

Landslide

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. Some of the natural causes of ground instability are stream and lakeshore erosion, heavy rainfall, and poor quality natural materials. In addition, many human activities tend to make the earth materials less stable and, thus, increase the chance of ground failure. Human activities contribute to soil instability through grading of steep slopes or overloading them with artificial fill, by extensive irrigation, construction of impermeable surfaces, excessive groundwater withdrawal, and removal of stabilizing vegetation. Landslides typically have a slower onset and can be predicted to some extent by monitoring soil moisture levels and ground cracking or slumping in areas of previous landslide activity.

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 30%.
- A history of landslide activity or movement during the last 10,000 years.
- Stream or wave activity that has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments.
- The presence of impermeable soils such as silt or clay that are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Figure 4-29 through Figure 4-32 show common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

Figure 4-29 Deep Seated Slide

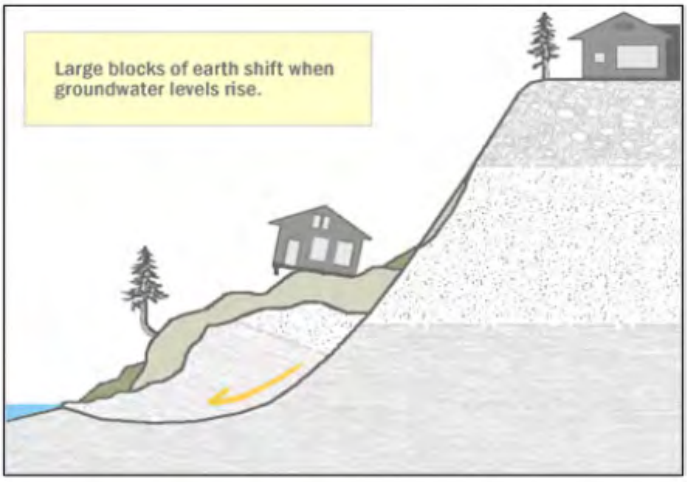


Figure 4-30 Shallow Colluvial Slide

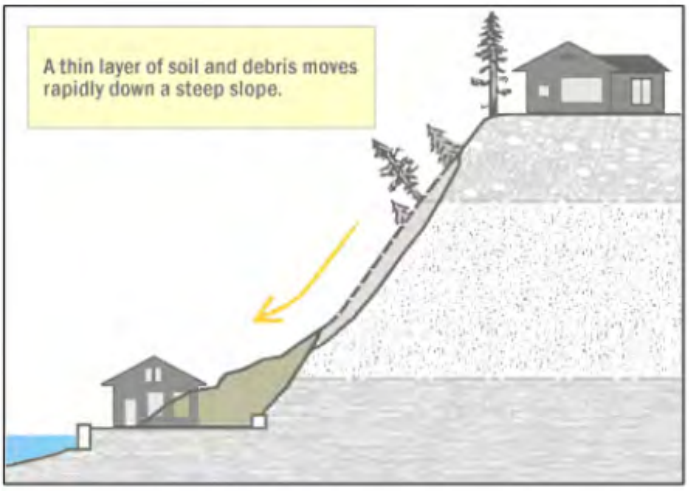


Figure 4-31 Bench Slide

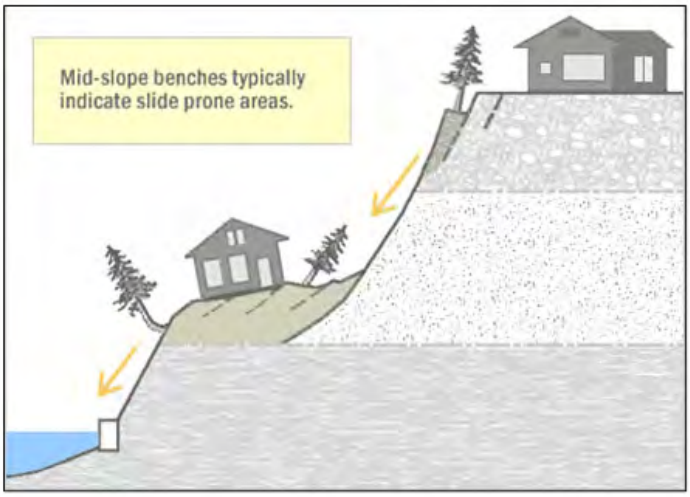
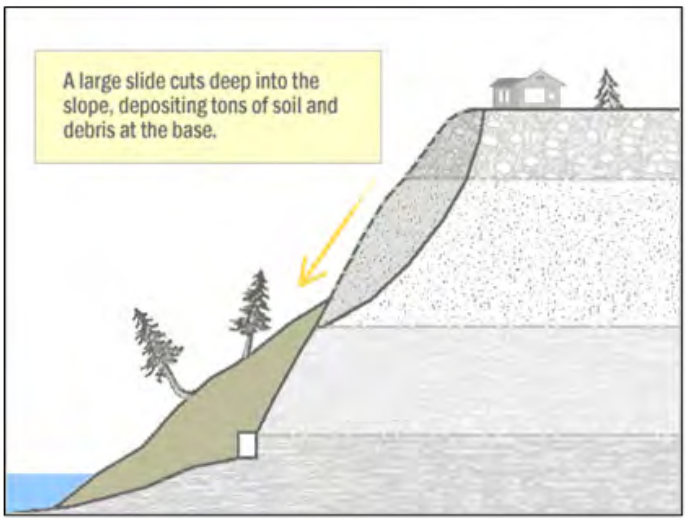


Figure 4-32 Large Slide



Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

Mud and Debris Flow

According to the Colorado Geological Survey, a mudslide is a mass of water and fine-grained earth that flows down a stream, ravine, canyon, arroyo, or gulch. If more than half of the solids in the mass are larger than sand grains (rocks, stones, boulders), the event is called a debris flow. A debris fan is a conical landform produced by successive mud and debris flow deposits, and the likely spot for a future event. Mud and debris flow problems can be exacerbated by wildfires that remove vegetation that serves to stabilize soil from erosion. Heavy rains on the denuded landscape can lead to rapid development of destructive mudflows.

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. Rockfalls can threaten human life, impact transportation corridors and communication systems and result in other property damage. Spring is typically the landslide/rockfall season in Colorado as snow melts and saturates soils and temperatures enter into freeze/thaw cycles. Rockfalls and landslides are influenced by seasonal patterns, precipitation and temperature patterns. Earthquakes could trigger rockfalls and landslides too.

4.10.2 Past Events

The National Centers for Environmental Information does not list any landslide events that impacted Montezuma County between 1996 and 2018. Although there are no recorded landslide, mud/debris flow, or rockfall events in this database, events have likely occurred, but have not been documented because of remote access or because they resulted in no damage or injuries.

In May 2019 over the Memorial Day weekend, two boulders fell 1,000 feet onto Colorado 145 between Dolores and Telluride. Repairing the road cost $1.3 million and involved blasting and clearing one of the boulders. The boulder also impacted a power pole, causing temporary power outages. The other one, an 8.5 million-pound boulder, was left and named Memorial Rock. An embankment was built by CDOT on the western, slope side of the highway to stop any future potential slide from reaching the highway.

Figure 4-33 Memorial Rock and the Repaired Section of Colorado 145

Photo courtesy of CDOT

4.10.3 Location

According to the State of Colorado Hazard Mitigation Plan "Many of Colorado's landslides occur along transportation networks because soil and rock along the transportation corridor has been disturbed by roadway construction. Construction along roads can occur with or without proper landslide hazard mitigation procedures. Also, landslides and rock falls are correlated with slope and elevation change, with the threat generally increasing with slope and susceptibility (Colorado DHSEM 2018).

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

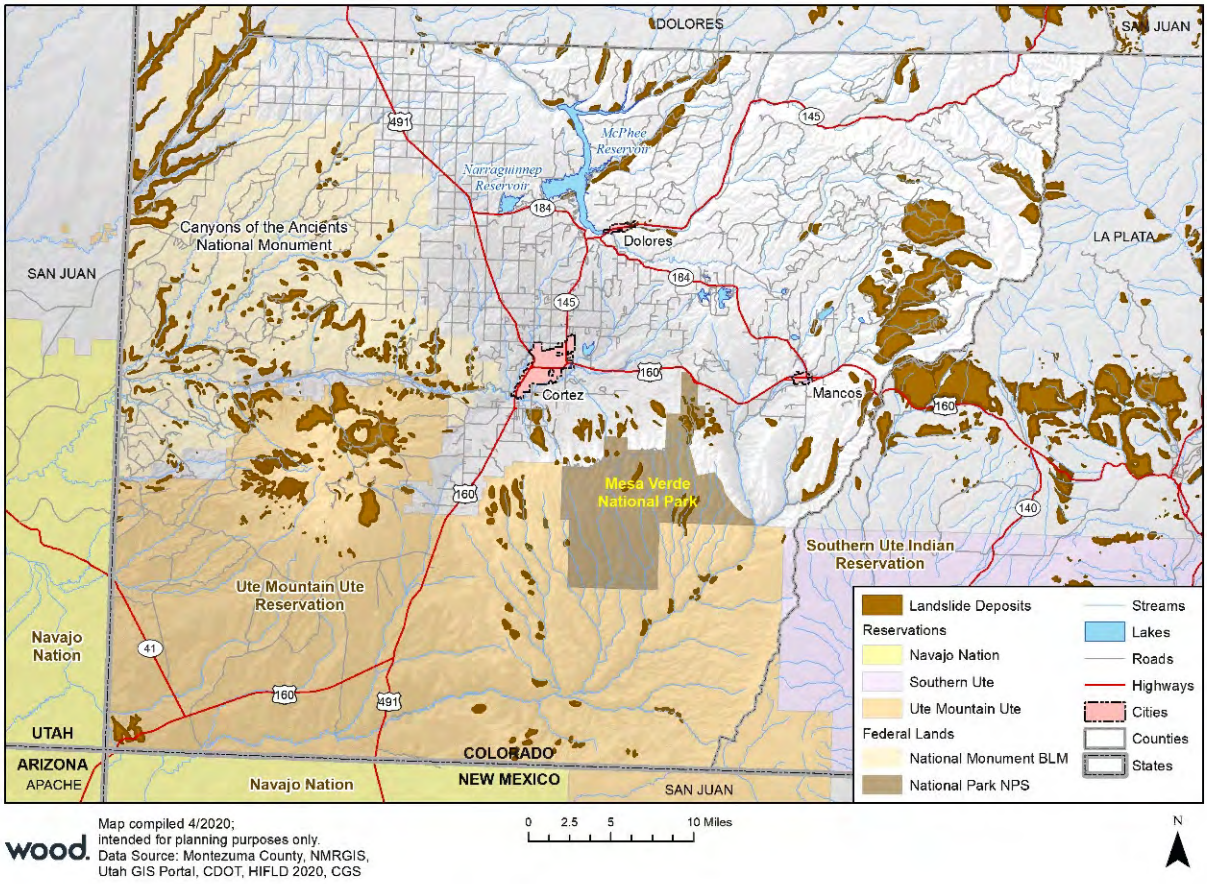
The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding.

The geographic location of landslides and rockfalls throughout Montezuma County is isolated. Figure 4-34 shows mapped landslide hazard areas within the county. Of all the participating jurisdictions in Montezuma County, the unincorporated areas and the Town of Dolores is the most likely jurisdiction to be impacted by landslides, mud/debris flows, or rockfalls because of its proximity to the San Juan

Mountains and more varied terrain. There is the potential for landslides, mud/debris flows, and rockfalls along State Highway 145 and could disrupt traffic along the highway, just as the rockfall did in May 2019

Although there are no landslide deposits within any of the three municipalities, there are landslide deposits immediately north and east of the town of Dolores, east of the town of Mancos, and south of the City of Cortez (4-30).

Figure 4-34 Landslide Deposits in Montezuma County



4.10.4 Frequency and Severity (Extent)

Landslides and rockfall have the potential destroy property and infrastructure and can take the lives of people in Montezuma County. The estimated annual direct costs from geologic hazard events to CDOT for the entire state is between $17 and $20 million, including the Maintenance Program. The CDOT Maintenance staff responded to geologic hazards resulting in $4.5 to $5.5 million annually for high frequency but low-cost events (Colorado Division of Homeland Security and Emergency Management 2018).

Based on this hazard profile, the magnitude/severity of a landslide/rock fall event in Montezuma County is considered high due to the potential for loss of life and economic impacts when roadways are impacted. Despite recent events in 2019, the frequency of landslide events within the county are difficult to ascertain due to a lack of information regarding past events, but it can be reasonably assumed that a damaging event will occur somewhere in the County at least every 10 years. The incidence of landslides, debris flow and rockfall is typically greater during the spring freeze-thaw cycles and during wet cycles.

Primarily, the area with likely landslides is in the southern San Juan Mountains, away from large human populations, in the northeastern portion of the county. Cortez has less susceptibility, while Dolores has the potential for significant impacts including property damage.

4.10.5 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to identify what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements, or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped roadbeds
- Rapid increase in creek water levels, possibly accompanied by increased soil content
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows and visible gaps indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

4.10.6 Related Hazards

Landslides and rockfalls can also be triggered by earthquakes. Debris flow events are often associated with flooding and are more likely to occur on areas burned by wildfires. Large landslides in steep mountain valleys may have the potential to cause landslide dams and associated downstream flood risk.

4.10.7 Climate Change Considerations

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

4.10.8 Vulnerability

Major landslides in the planning area occur as a result of soil conditions that have been affected by wildfire, natural erosion, severe storms, groundwater, or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding in burn scar areas. Landslides are most likely during late spring and summer months. After heavy spring and summer rains, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the

weakening of the slope. Burn scars, gravity, poor drainage, a rising groundwater table, and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of town centers and into areas less developed in terms of infrastructure. Most mass movements would be isolated events affecting specific areas. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines and knock out transportation corridors through the county. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power, and communication access to residents.

Population

Exposure and vulnerability estimates for the landslide hazard were assessed using a methodology based on assumptions. Most of the landslide risk areas in the county are outside of population centers. According to a GIS analysis there are 45 improved parcels with 50 buildings designated as residential in the unincorporated areas that intersect landslide hazard areas. Assuming an average household size of 2.4 persons, this equates to approximately 120 persons potentially exposed. Population exposure to landslide hazard areas is likely limited. The only mapped hazard areas within incorporated jurisdictions are in the eastern portion of the county, including the Town of Mancos. It is most likely that individuals exposed to landslide, mud/debris flow, and rockfall hazards would be in recreation areas or driving on roadways.

In general, all persons exposed to landslide hazard areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

Property

Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. Property exposure to landslide hazard areas according to a GIS analysis indicates a total of 60 improved parcels with 74 buildings worth $10.9M in the unincorporated areas that intersect landslide hazard areas. Loss estimations for the landslide hazards are more difficult, as no such damage functions have been developed. A site-specific analysis would need to be performed to refine loss estimates beyond the exposure analysis performed here. While no landslide prone hazard areas intersected property in the municipalities based on input from the HMPC there is potential for landslides and rockfall from steep slopes on the north side of town to impact property in Dolores.

Table 4-37 Landslide Property Exposure

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value
Unincorporated County	Agricultural	6	14	$857,005
	Mixed Use	7	8	$2,766,509
	Residential	45	50	$6,853,282
	Vacant Land	2	2	$469,109
Total		**60**	**74**	**$10,945,905**

Source: Montezuma Assessor, Wood GIS analysis

In terms of estimating losses based on past events, other than the rock fall damage on Colorado 145 in 2019, there are no reports of property damage or injury in association with landslides, mud/debris flows, and rockfalls in Montezuma County. Areas of higher susceptibility are mainly located away from population centers in the northeastern portion of the county in the San Juan Mountains.

Critical Facilities and Infrastructure

Based on GIS analysis performed during the 2020 update there were no critical facilities located within the landslide deposit locations. Based on anecdotal information from the HMPC there is potential for landslides and rockfall from steep slopes on the north side of Dolores to impact school property in town, including a close call with a school bus.

A significant amount of road infrastructure is exposed to mass movement. Landslides, mud/debris flow, or rockfalls can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses. More significantly, landslides can limit the ability of emergency response services to access and serve portions of the county and State Highway 145. Landslides and rockfall can also impact power line infrastructure and cause mid to long term outages.

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.

Historic, Cultural and Natural Resources

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.

4.10.9 Development Trends

Sometimes the severity of landslide problems is related to human activity in hazard areas. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. The mountainous topography of the northern section of the county presents considerable constraints to development, most commonly in the form of steeply sloped areas. These areas can become unstable when disturbed by development. Many of these areas are adjacent to roadway systems that are heavily used. Recent and projected development trends are not anticipated to change exposure to landslide/rockfall hazards significantly. According to the 2018 Colorado State Hazard Mitigation Plan, Montezuma County will experience a 37% population change between 2010 – 2030 with a landslide Growth Risk Rating of 'High', although the rated risk of landslides is 'Low'.

4.10.10 Risk Summary

- There is a risk of landslide or rock fall on roadways and infrastructure that run through steep terrain in the northeastern and eastern portions of the county. Highways include Colorado 145 and US 160. Not only does this have the potential to cause injury, death, and costly damage to infrastructure, but also delay or re-direct tourist traffic.
- There are no critical facilities in landslide prone areas based on available GIS data. Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- There are some existing structures in landslide risk areas throughout the county. The degree of vulnerability would require site specific analysis and analysis of the codes and standards the structures were constructed to.
- Risk significance is high for Dolores, Mancos and the unincorporated areas, while low for Cortez and the Cortez Fire Protection District.

- As incidents of wildfires increase debris flow incidents are more likely.
- Future development could lead to more homes in landslide risk areas if not carefully sited.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

4.11 Tornado

TORNADO RANKING	
Montezuma County	Medium
City of Cortez	Low
Town of Dolores	No Exposure
Town of Mancos	Low
Cortez Fire Protection District	Low

DEFINITIONS

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5, or the Enhanced Fujita Scale.

4.11.1 Hazard Profile

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can form from individual cells within severe thunderstorm squall lines. They also can form from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

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) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed in Table 4-38. These estimates vary with height and exposure. Standard measurements are taken by weather stations in open exposures. Table 4-38 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. In a typical year, approximately 1,000 tornadoes affect the U.S. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S.

Figure 4-35 shows the annual average number of tornadoes between 1991 and 2010. Colorado experienced an average of 53 tornado events annually in that period. Colorado ranks 9th among the 50 states in frequency of tornadoes, but 38th for the number of deaths. Colorado ranks 31st for injuries and 30th for the cost of repairing the damages due to tornadoes. When these statistics are compared to other states by the frequency per square mile, Colorado ranks 28th for injuries per area and 37th for costs per area.

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 4-36 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

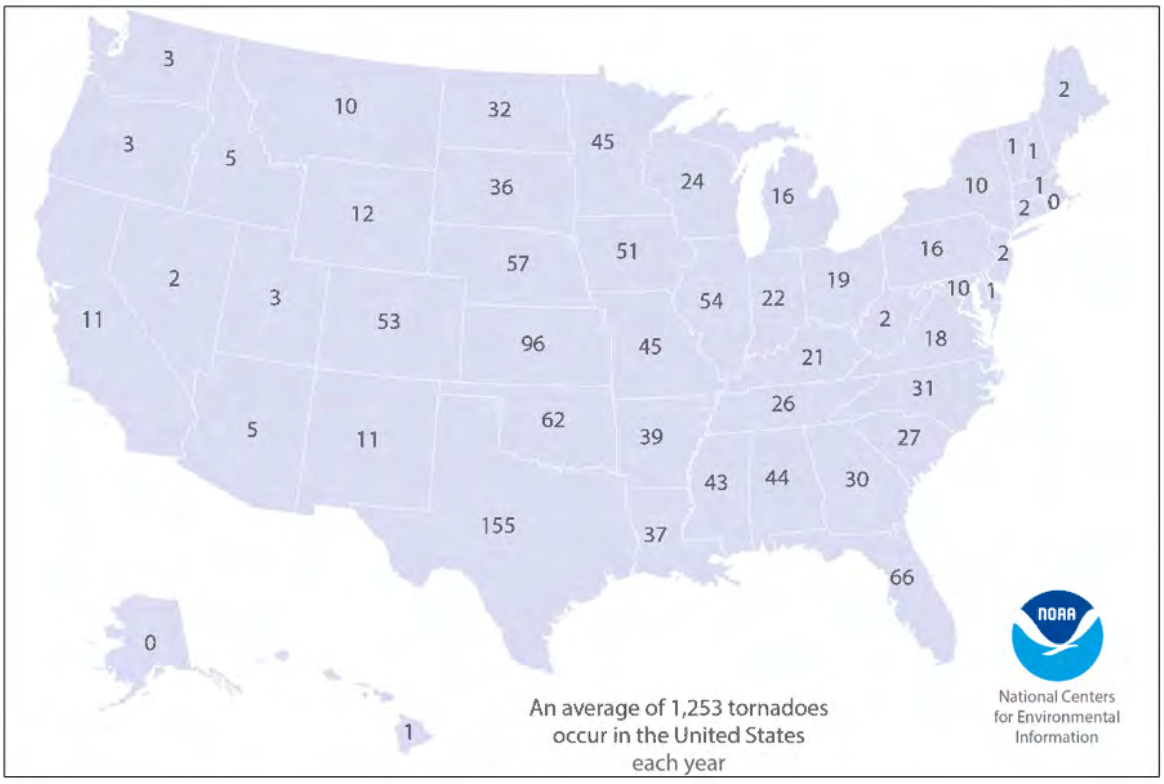
period of record. It should be noted that the density number does NOT indicate the number of events that can be expected across the entire zone on the map.

Table 4-38 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

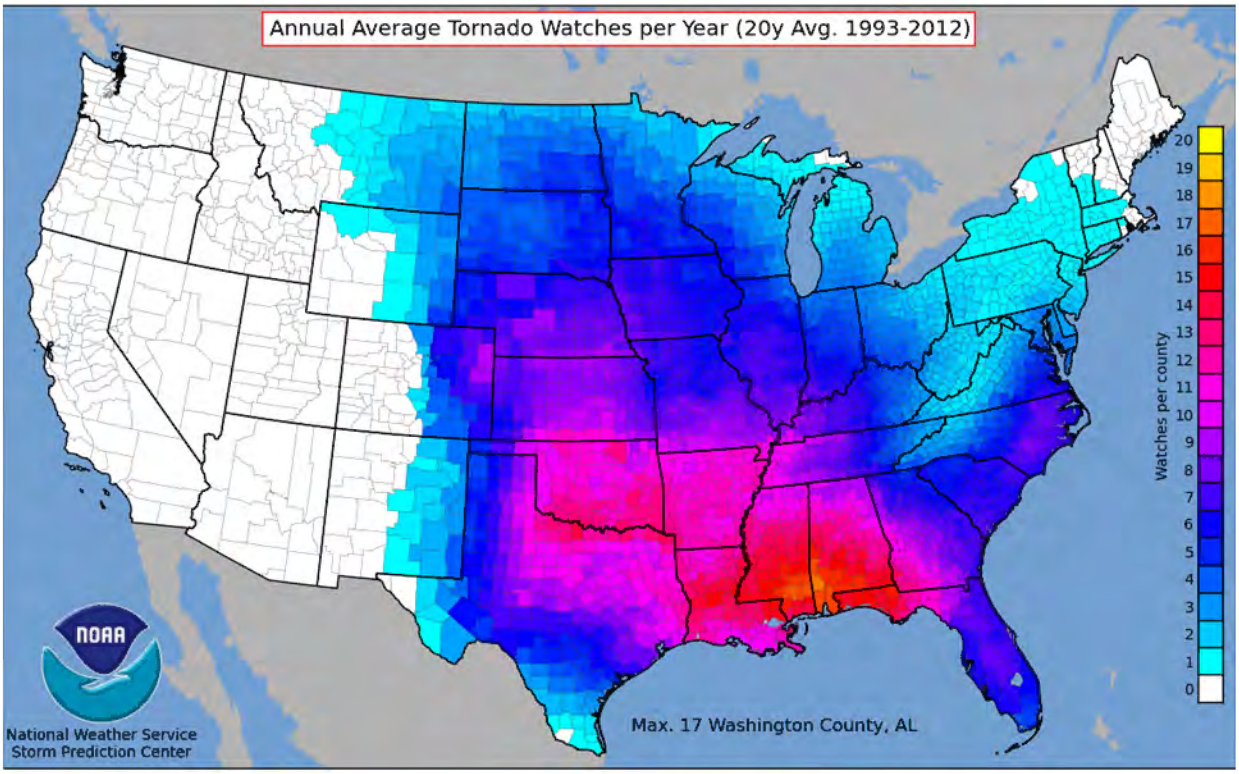
Notes:
EF Enhanced Fujita
F Fujita
mph Miles per Hour

Figure 4-35 Annual Average Number of Tornadoes in the U.S. (1991-2010)



Source: NOAA

Figure 4-36 Total Annual Tornado Watches in the U.S. (1993-2012)



Source: NOAA

4.11.2 Past Events

Table 4-39 lists tornadoes in Montezuma County recorded by the NOAA storm prediction center from 1970 to 2020 that caused property damage. Two tornadoes that have or may have caused property damage were recorded in Montezuma County since 1970, rated F1 and F2. One other tornado has been recorded in July 2011 but did not cause any property damage or injuries. There are no known injuries or fatalities from tornadoes within the county and property damage has been moderate. According to the Ute Mountain Ute 2019 Hazard Mitigation Plan a tornado was observed in the summer of 2017 that lead to damages to a mobile home in the area and the issuance of an evacuation message from the Bureau of Indian Affairs. This event was not recorded in the NCEI Storm Events Database.

Table 4-39 Tornadoes in Montezuma County (1970-2020)

Date	Tornado Rating	Injuries	Property Damage	Tornado Length (miles)	Tornado Width (yards)
9/5/1970	F1	0	$25,000	1.5	100
4/25/1985	F2	0	$25,000	0.5	40
7/18/2011	EF0	0	$0	0.25	50

Notes: Source: NCEI
EF Enhanced Fujita
F Fujita

4.11.3 Location

Recorded tornadoes in the planning area are typically small and short-lived. They are more likely to occur in the central portion of the county. In 1985, an F2 tornado occurred in the boundaries of the City of

Cortez. The tornado resulted in $25,000 in damages. The other two reported tornadoes that occurred in Montezuma County in 1970 and 2011 were outside the City of Cortez, and Towns of Mancos and Dolores.

4.11.4 Frequency and Severity (Extent)

Tornadoes have been reported 9 months of the year in Colorado, with peak occurrences between mid-May through mid-August. State-wide, June is by far the month with the most recorded tornadoes. Table 4-39 lists three recorded tornadoes between 1970 and 2020, therefore, an average of 0.07 tornadoes occur each year in Montezuma County.

Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike within the populated areas of Montezuma County, 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. Historically, tornadoes have not typically been severe or caused minor damage in the planning area. The reported F2 tornado that occurred on April 25, 1985, was located in the southern portion of the City of Cortez, likely contributing to the property damage.

Based on the information in this hazard profile, the past tornadoes in Montezuma County have been on the low end of the EF scale, though larger tornadoes are possible. The impact to quality of life or critical facilities and functions in the affected area would depend on where the tornado occurred. Injuries or deaths are possible due to wind thrown trees or property damage caused by wind events.

4.11.5 Warning Time

The NOAA's storm prediction center issues tornado watches and warnings for Montezuma County:

- **Tornado Watch**—Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- **Tornado Warning**—A tornado has been sighted or indicated by weather radar. Take shelter immediately.

Once a warning has been issued, residents may have only a matter of seconds or minutes to seek shelter.

4.11.6 Related Hazards

Tornado events have the potential to occur during severe thunderstorms. Tornadoes may cause loss of power if utility service is disrupted. Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure is damaged that houses such materials or if such a material is in transport.

4.11.7 Climate Change Considerations

It is difficult at this point to summarize the effects climate change will have on the frequency and severity of tornadoes. 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. Because of uncertainty with the influence of climate change on tornadoes, future updates to the mitigation plan should include the latest research on how the tornado hazard frequency and severity could change. The level of significance of this hazard should be revisited over time.

4.11.8 Vulnerability

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. If an EF3 or higher tornado were to hit populated areas of the county, such as the City of Cortez, substantial damage to property and loss of life could result. Likelihood of injuries and fatalities would increase if warning time was limited before the event or if residents were unable to find adequate shelter. Damage to critical facilities and infrastructure would likely include loss of power, water, sewer, gas and communications. Roads and bridges could be blocked by debris or otherwise damaged. 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. 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.

Population

People are potentially the most vulnerable to tornadoes. 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 Hail, Lightning and Severe Wind vulnerability assessment subsection 4.10.4, 13% 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.

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. General damages are both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. 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. In Montezuma County, 18% of total housing is mobile homes.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power lines and communication transmission lines, coupled with disruption to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado can put tremendous strain on a community.

Tornadoes occur very infrequently in Montezuma County. Two of the three reported tornadoes since 1970 were outside plan jurisdiction areas. Based on historic tornado data, an average of 0.07 tornadoes occur each year in Montezuma County. The average loss expectancy for each event is $16,667, but because of the infrequency of tornado occurrences in Montezuma County, the annualized loss is only $1,167.

Critical Facilities and Infrastructure

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.

Economy

Tornado events are generally short-lived, but the impacts may last longer. Damages to commercial structures have the potential to be significant. The costs to recover from a tornado event including debris removal can be expensive for small communities. Tourism may also be interrupted after a tornado event.

Historic, Cultural, and Natural Resources

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris. This is part of a natural process and the environment will return to its original state in time. According to the Ute Mountain Ute Hazard Mitigation Plan, high winds from a tornado may lead to damage or loss of natural vegetation on and around the Sleeping Ute Mountain as well as potentially damage archeological sites within the Ute Mountain Tribal Reservation.

4.11.9 Development Trends

All future development will be affected by tornadoes, particularly development that occurs at lower elevations. Development regulations that require safe rooms, basements, or other structures that reduce risk to people would decrease vulnerability. Tornadoes that cause damage are uncommon in the county, so mandatory regulations may not be cost-effective. Growth trends are not anticipated to increase exposure of people or buildings to the tornado hazard substantially.

4.11.10 Risk Summary

- There have been 3 recorded tornado events in the County since 1970, resulting in $53,000 in property damages.
- Elderly and individuals who depend on electricity for medical needs are vulnerable to power outages caused by a tornado. 13% of Medicare Beneficiaries in the County rely on electricity-dependent equipment.
- All property is potentially vulnerable during tornado events, but mobile homes are disproportionately at risk due to the design of the homes. 18% of total housing in the County are mobile homes.
- Due to the sporadic nature and generally low intensity tornadoes are considered a medium to low significance hazard.

4.12 Wildfire

WILDFIRE HAZARD RANKING	
Montezuma County	High
City of Cortez	Medium
Town of Dolores	High
Town of Mancos	High
Cortez Fire Protection District	High

DEFINITIONS

Conflagration—A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup, and explosions are usually the elements behind a wildfire conflagration.

Interface Area—An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

4.12.1 Hazard Profile

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as wildland urban interface (WUI) areas, where development is adjacent to or intermixed with densely vegetated areas.

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 needles, leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Structures such as homes and associated combustibles are also potential fuel sources. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for fire spread. "Ladder fuels" are fuels low to the ground that can spread a surface fire upward through brush and into treetops. These fires, known as crown fires, burn in the upper canopy of forests and are nearly impossible to control. The volume of available fuel is described in terms of fuel loading. Many parts of the planning area are extremely vulnerable to wildfires, as a result of dense vegetation combined with urban interface living. Non-native species have become invasive in the area, specifically, Tamarisk and Russian Olive. These species burn readily and pose a threat to homes and other structures in the lower reaches of the county and into municipalities.
- **Topography** – An area's terrain and land slopes affect its susceptibility to wildfire spread. Both the fire intensity and the 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. In addition, topography impacts the ability of firefighters to combat the blaze by hampering access for equipment, supplies, materials and personnel.

- **Weather** – Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfires. High temperatures and low relative humidity dry out the fuels that feed the wildfire, increasing the odds that fuel will more readily ignite and burn more intensely. Wind is the most treacherous weather factor. The greater the wind, the faster a fire will spread, and the more intense it will be. In addition to wind speed, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. Lightning also ignites wildfires, which are often in terrain that is difficult for firefighters to reach. Drought conditions contribute to wildfire vulnerability and susceptibility. During periods of drought, low fuel moisture and lack of precipitation increase the threat of wildfire. There are no known effective measures for human mitigation of weather conditions. Careful monitoring of weather conditions that drive the activation and enforcement of fire-safety measures and programs, such as bans on open fires, are ongoing weather-related mitigation activities.

Wildfires are of significant concern throughout Colorado. According to the Colorado State Forest Service, vegetation fires occur on an annual basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and become wildfires, damage can be extensive. According to the State of Colorado Hazard Mitigation Plan (2018), a century of aggressive fire suppression combined with cycles of drought and changing land management practices has left many of Colorado's forests, including those in Montezuma County, unnaturally dense and ready to burn. Further, the threat of wildfire and potential losses is constantly increasing as human development and population increases and the WUI expands. Another contributing factor to fuel loads in the forest are standing trees killed by pine bark beetles, which have been affecting the forests of Colorado since 2002, becoming more widespread and a serious concern. According to the Montezuma County Hazard Mitigation Community Survey conducted in 2020 (see Appendix F), Montezuma County residents believe that wildfire is the one of the greatest threats to their safety; wildfire mitigation also was considered the highest priority type of mitigation by the public.

Fire Protection in Montezuma County

In May of 2002, Montezuma County in cooperation with the four surrounding counties, developed Community Fire Plans, which at the time were considered to be national models for collaborating and intergovernmental planning and action around wildlife hazards in rural communities. In 2005, this plan was updated to the Montezuma County Community Wildfire Protection Plan (CWPP), which was again updated in 2011.

Fire protection in Montezuma County is divided between fire protection districts, volunteer fire departments, Wildfire Adapted Partnership of Southwestern Colorado, Bureau of Land Management (BLM), and the U.S. Forest Service. Multiple community wildfire protection plans are in place, as discussed in Section 3.9.7.

Vegetation Classes in Montezuma County

General vegetation for Montezuma County is described in Table 4-40. The most common vegetation classes in the county are Pinon-Juniper and Shrubland comprising over 43% of the acreage in the county.

Table 4-40 Vegetation Classes in Montezuma County

Class	Acres	Percent (%)
Pinyon-Juniper	354,370	27.10%
Shrubland	347,092	26.50%
Ponderosa Pine	95,633	7.30%
Agriculture	90,420	6.9%
Hardwood	66,000	5%
Grassland	64,355	4.90%
Developed	61,405	4.70%
Sparsely Vegetated	53,837	4.10%
Spruce-Fir	41,287	3.20%
Mixed Conifer	33,643	2.60%
Conifer-Hardwood	28,908	2.20%
Oak Shrubland	25,768	2%
Riparian	25,528	2%
Barren	10,652	0.80%
Open Water	7,053	0.50%
Introduced Riparian	875	0.10%
Conifer	631	0%
Lodgepole Pine	201	0%

Source: Montezuma County Wildfire Risk Summary Report

4.12.2 Past Events

The 2011 Montezuma County CWPP notes that for centuries wildfire has been a natural, healthy part of the ecosystem, but that this cycle has been altered over the last 100 years by human uses such as logging, livestock grazing, and fire suppression. These changes have in turn been exacerbated by the effects of drought, and bark beetle infestations that decimated vast regions of forested lands.

Table 4-41 lists all federally reported wildfires in Montezuma County that burned 10 acres or larger between 2000 and 2018. The locations and burn areas of those fires are shown in Figure 4-37. Between them, these 26 fires burned 66,621 acres.

Table 4-41 Wildfires over 10 Acres in Montezuma County (2000-2018)

Name	Acres	Year
Bircher	23,310	2000
Pony	5,224	2000
Hovenweep	1,150	2000
Long Mesa	2,599	2002
Moccasin	2,305	2003
Trail East	2,525	2005
McElmo	14	2006
Oak	12	2006
Goodman	139	2007
Joes Canyon	13	2007
Little Cahone	202	2008
Bradfield	702	2009
Cash Canyon	119	2010

Name	Acres	Year
Ponds	18	2011
Weber	10,134	2012
Bean Canyon	355	2012
Roatcap	320	2012
Escarpment	41	2012
Road G	37	2012
Toe	378	2015
Haycamp	11	2015
Sage Hen	175	2016
Hoope Point	16	2017
Plateau	12,050	2018
Burro	4,588	2018
Moccasin Mesa	185	2018

Source: Montezuma County, NMRGIS

Between July 20 to 29, 2000, the Bircher Fire and the Pony Fire raged across the southern portion of Montezuma County consuming over 29,027 acres of Mesa Verde National Park, the Ute Mountain Ute Tribal Park, and private lands. This was the costliest wildfire in Montezuma County history. Four structures were lost and five were severely damaged, resulting in more than $1 million in property damage (Figure 4-39). Total fire suppression costs exceeded $8.4 million.

The 2018 fire season had major impacts on Montezuma County. The 416 Fire in neighboring La Plata County began in June and became one of the largest in Colorado history by the time it was contained in July; the smoke from the fire caused air quality impacts in Montezuma County. The Burro Fire also began in June 2018 in the Montezuma County-side of the Hermosa Creek Wilderness Area and burned more than 4,000 acres. Firefighters were still working to contain those fires in July when a lightning strike 13 miles north of Dolores ignited the Plateau Fire, which grew to over 12,000 acres causing numerous road closures and evacuations before it was contained in early October.

Figure 4-37 Montezuma County Wildfires of 10 Acres or Larger (2000-2018)

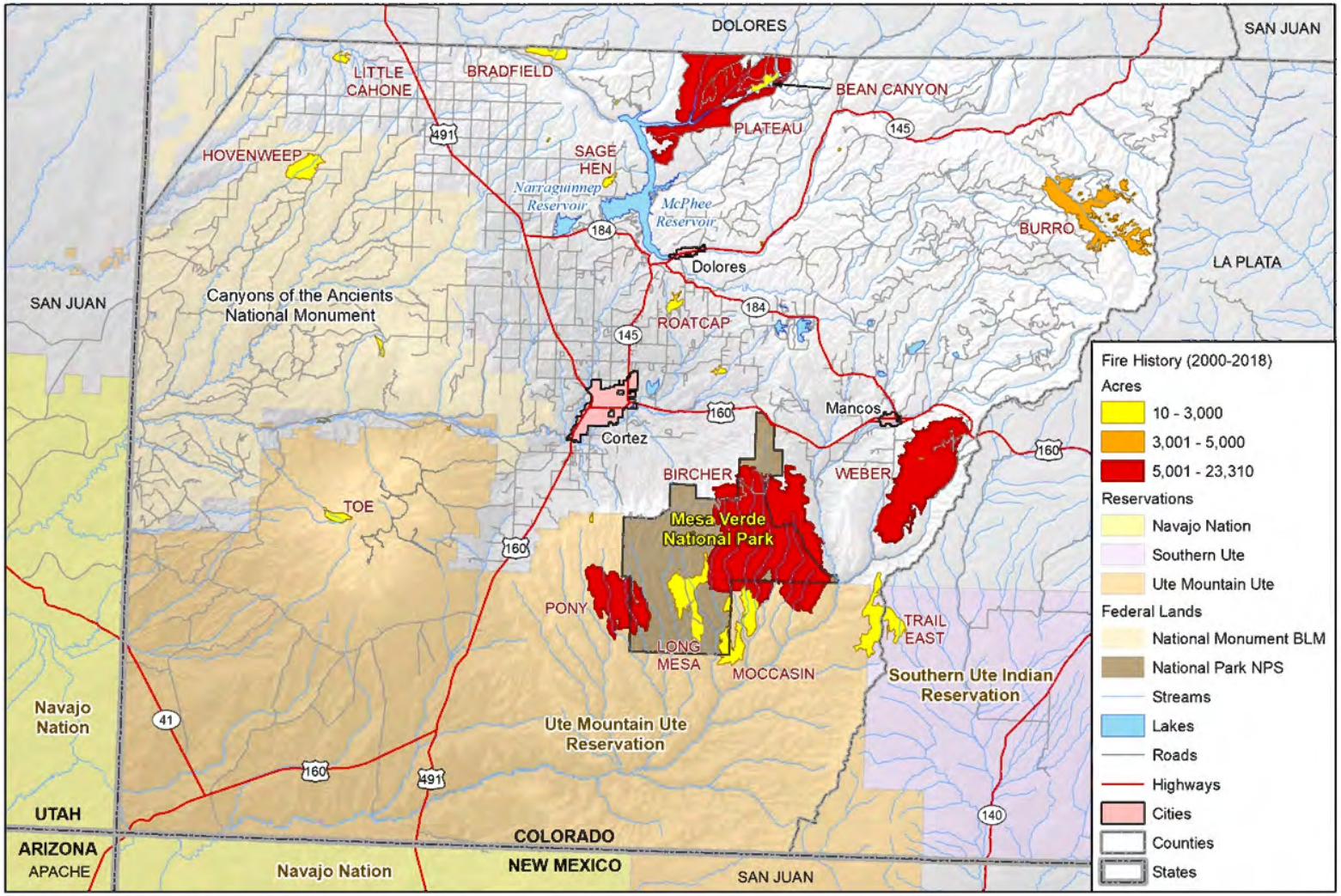


Figure 4-38 Mesa Verde National Park After Bircher and Pony Fires

4.12.3 Location

Over a third of the county is state and federal land, the majority of which is owned by the BLM. Other large areas in the county include Bureau of Indian Affairs (BIA), State of Colorado, National Parks Service, and U.S. Forest Service land. As such this land is periodically burned by wildfires, not all of which are necessarily bad fires, but often WUI growth abuts these federal lands.

Colorado overall is one of the fastest growing states in the nation. Much of this growth is occurring in the WUI area, where structures and other human improvements meet and mix with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk from wildfires. Figure 4-39 shows the Montezuma County housing density within the WUI.

The Colorado State Forest Service's Colorado Wildfire Risk Assessment Portal (CO-WRAP) 2017 report for Montezuma County maps the WUI Risk Index, which is a rating of the potential impact of a wildfire on people and their homes. The key input reflects housing density (Figure 4-39). The CO-WRAP report states that the location of people living in the WUI and rural areas is essential for defining potential wildfire impacts to people and homes. Figure 4-40 shows the WUI Risk Index for Montezuma County.

Wildfire risk represents the possibility of loss or harm occurring from a wildfire. Risk is derived by combining the wildfire threat and the fire effects assessment outputs. It identifies areas with the greatest potential impacts from a wildfire. Wildfire risk combines the likelihood of a fire occurring (threat) with those areas of most concern that are adversely impacted by fire to derive a single overall measure of wildfire risk. Figure 4-41 shows the wildfire risks for areas within Montezuma County.

Finally, as stated in the CO-WRAP report, wildfire threat is the likelihood of an acre burning. Threat is calculated by combining multiple landscape characteristics including surface and canopy fuels, fire behavior, historical fire occurrences, weather observations, terrain conditions, etc. The measure of wildfire threat used in CO-WRAP is called the threat index. Figure 4-46 maps the threat index for Montezuma County as identified in the CO-WRAP report.

Figure 4-39 Montezuma County Housing Density Within the Wildland Urban Interface (WUI)

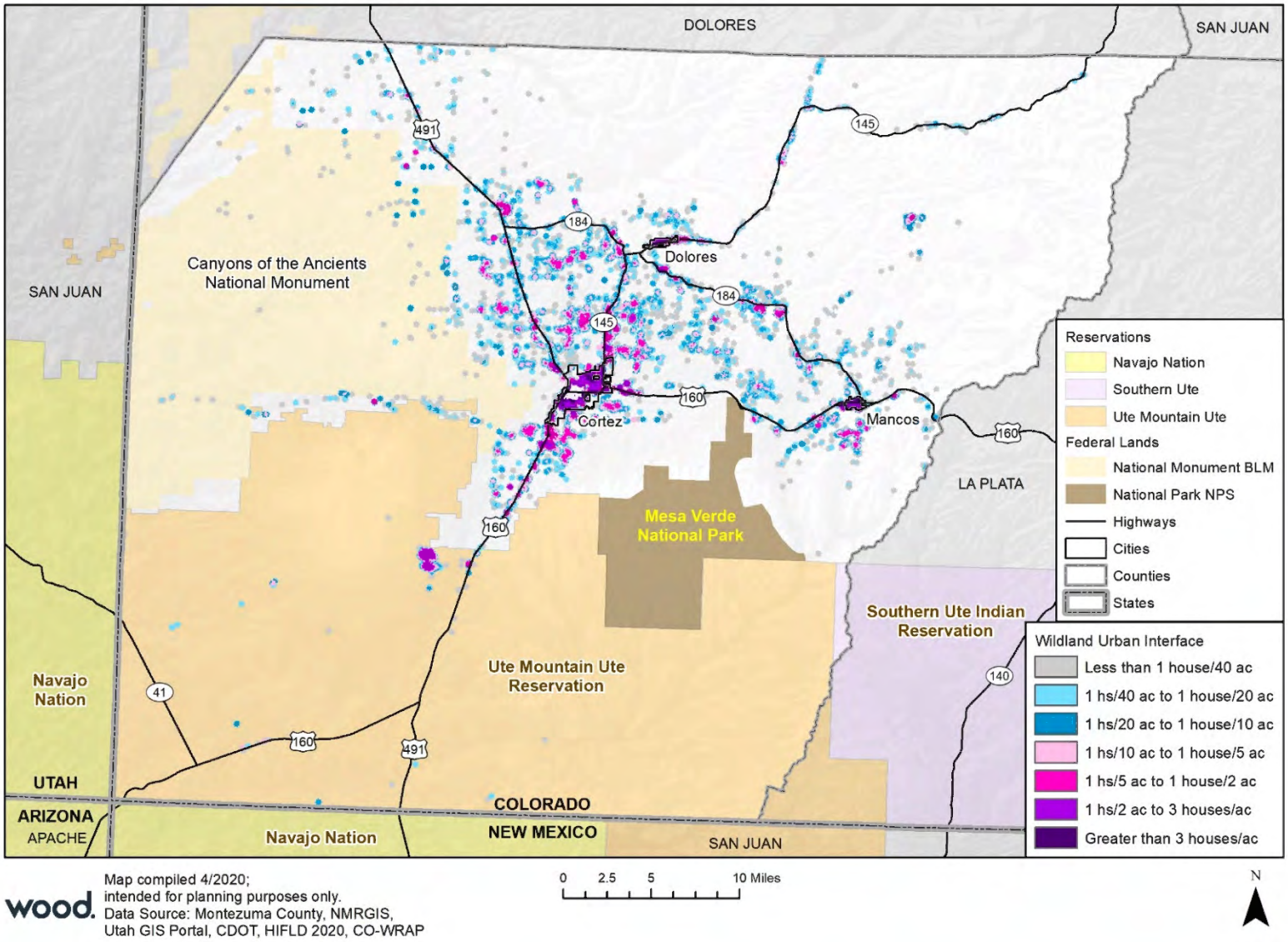


Figure 4-40 Wildland Urban Interface (WUI) Risk Index for Montezuma County

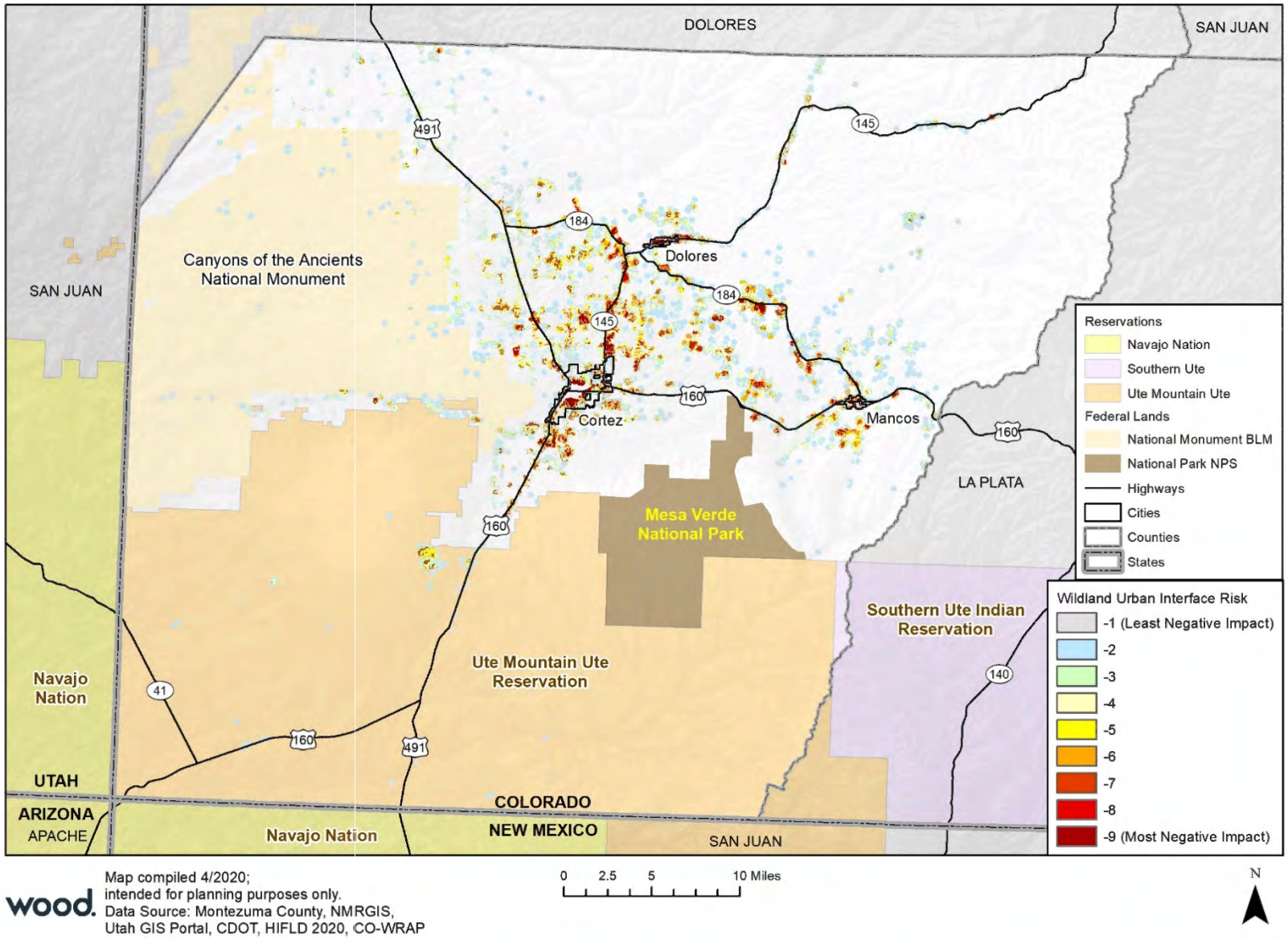
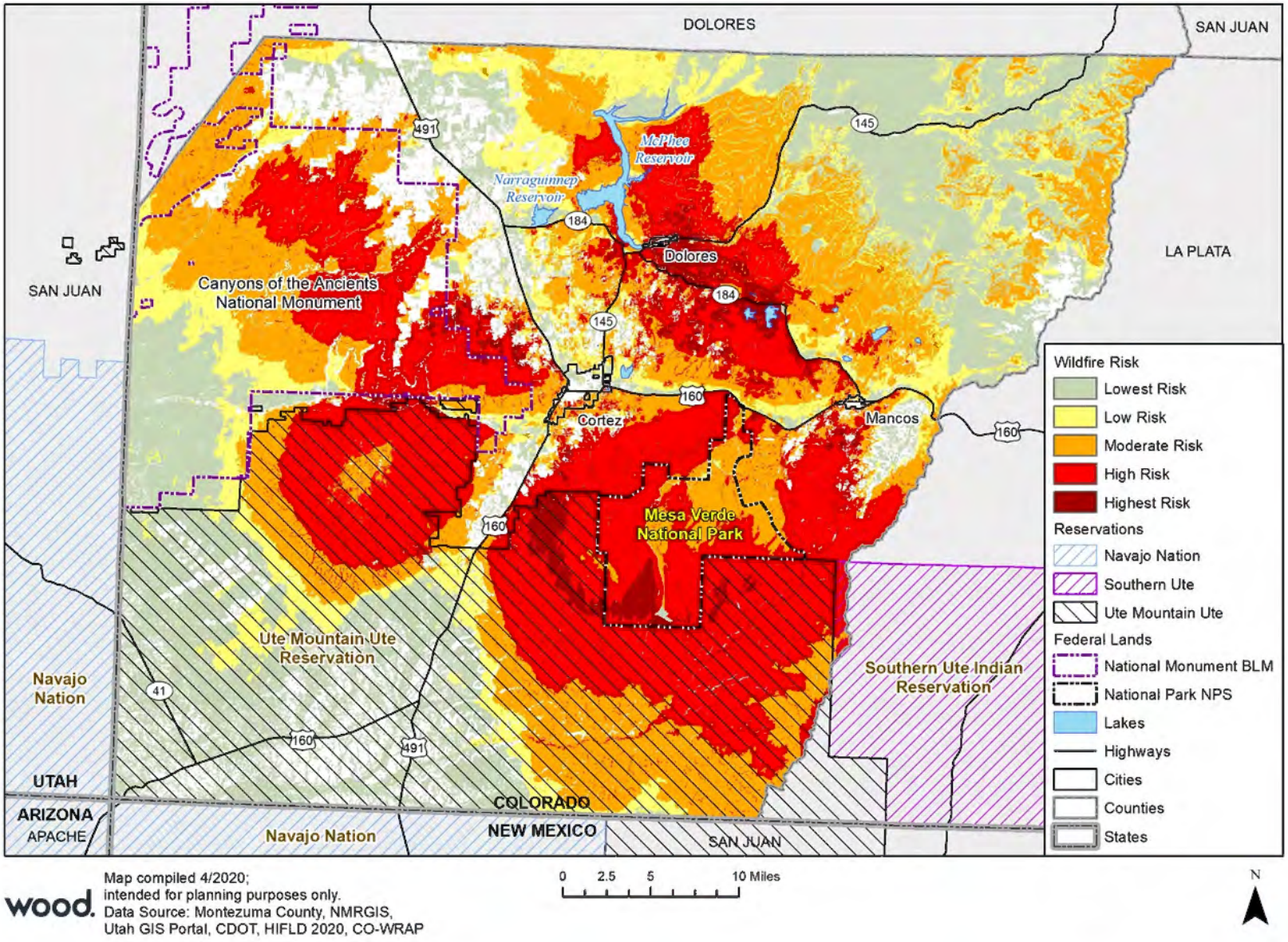


Figure 4-41 Wildfire Risk for Montezuma County



Map compiled 4/2020;
intended for planning purposes only.
Data Source: Montezuma County, NMRGIS,
Utah GIS Portal, CDOT, HIFLD 2020, CO-WRAP

Figure 4-42 Wildfire Risk for the City of Cortez

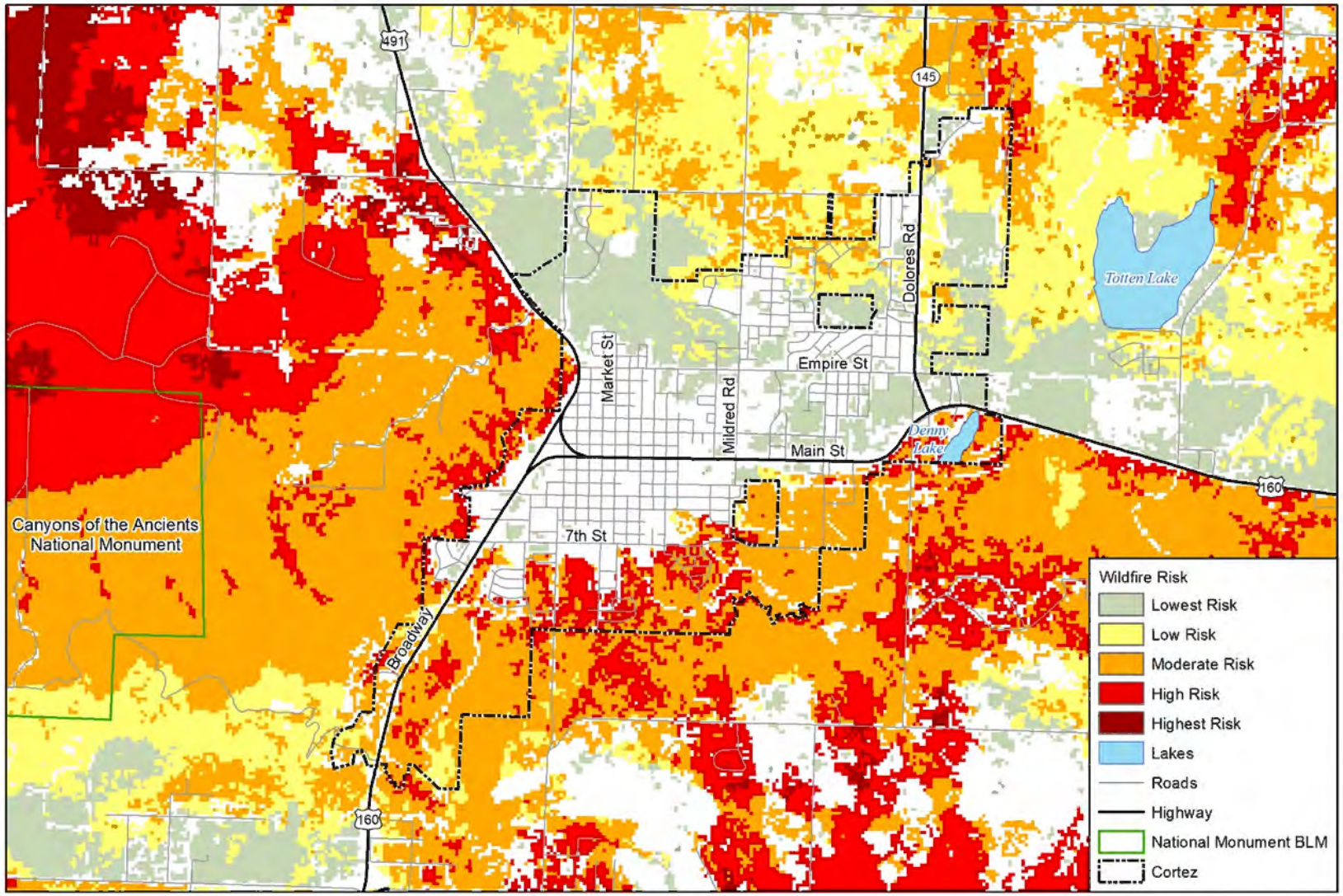


Figure 4-43 Wildfire Risk for the Cortez Fire Protection District

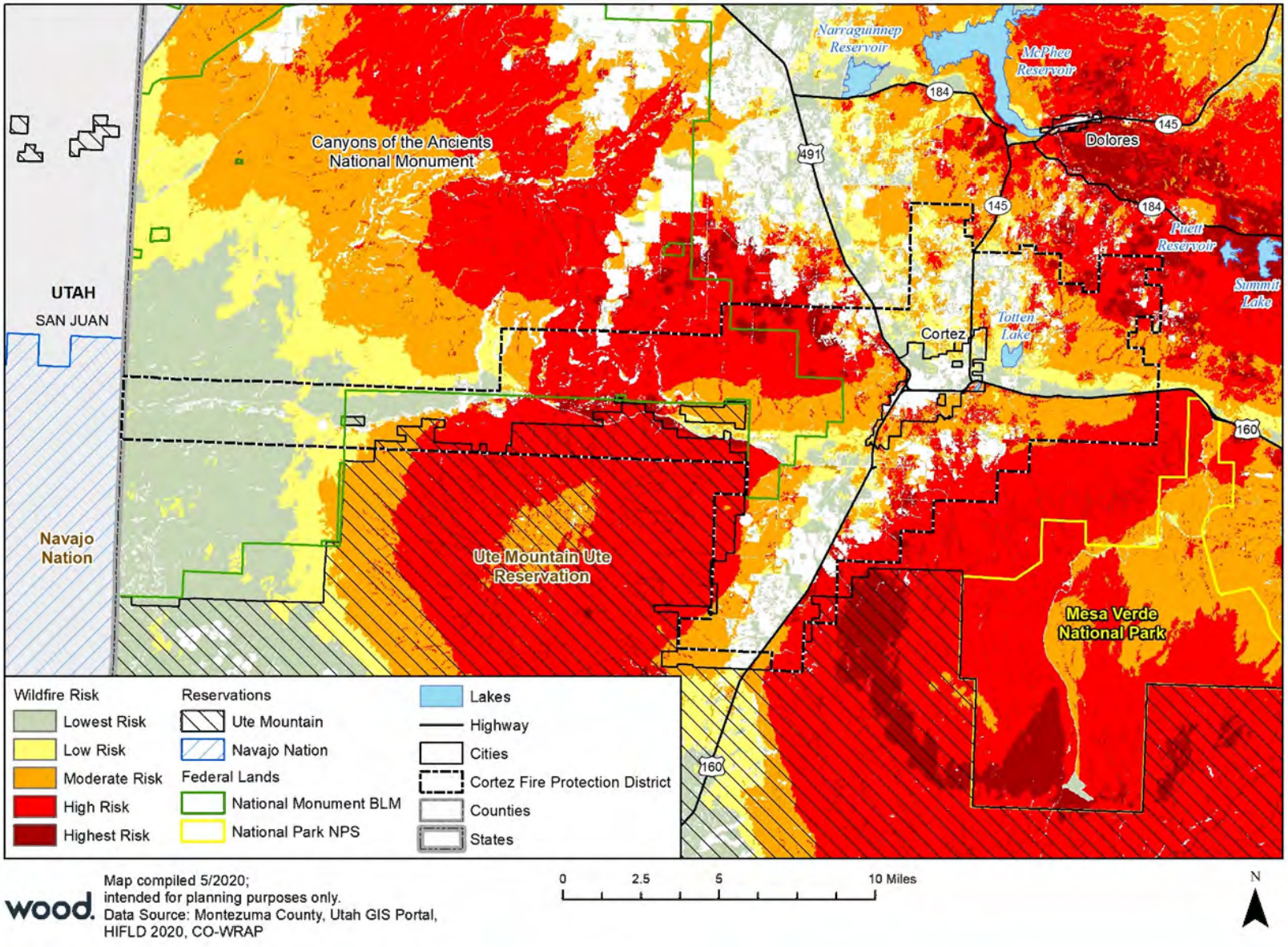


Figure 4-44 Wildfire Risk for the Town of Dolores

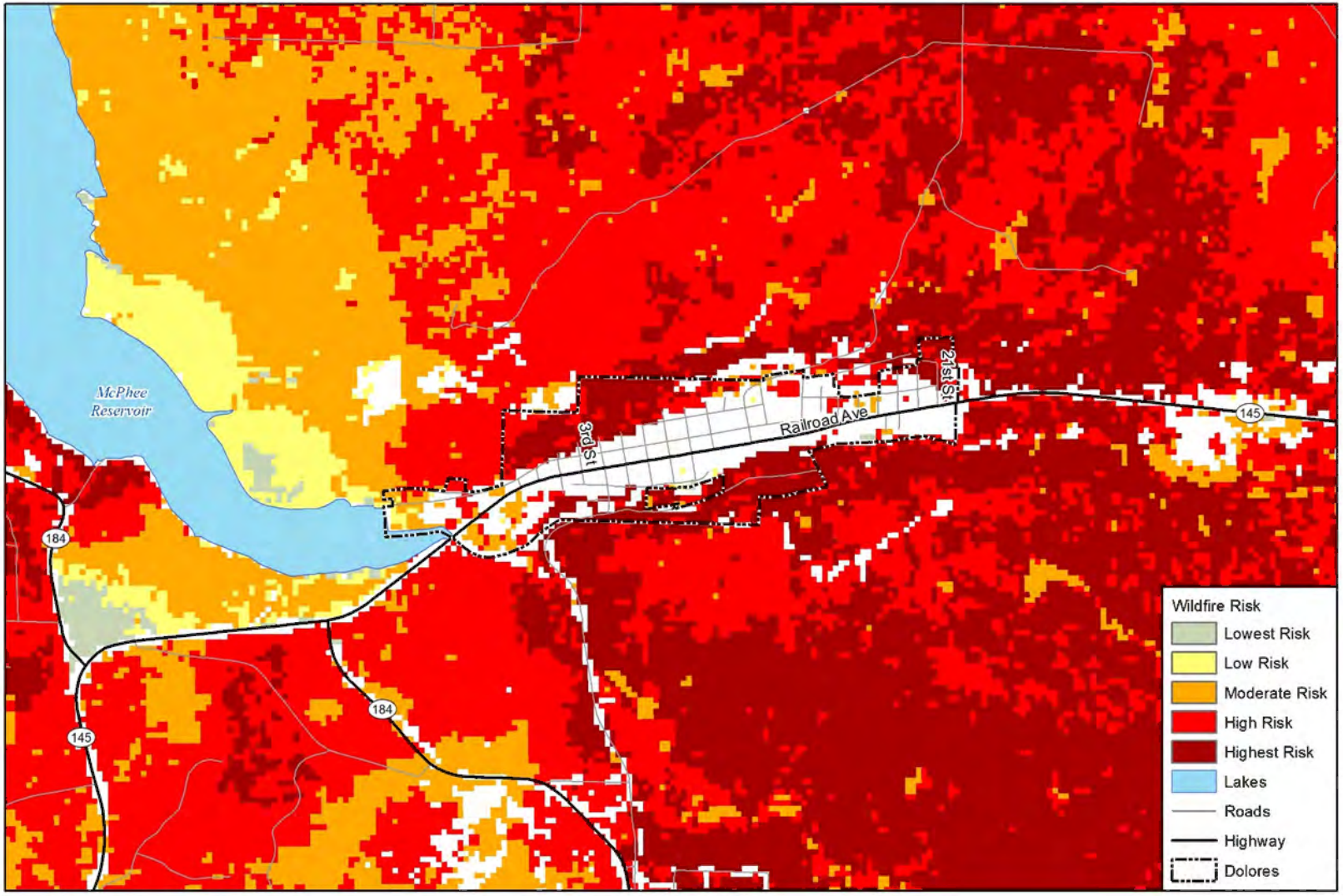


Figure 4-45 Wildfire Risk for the Town of Mancos

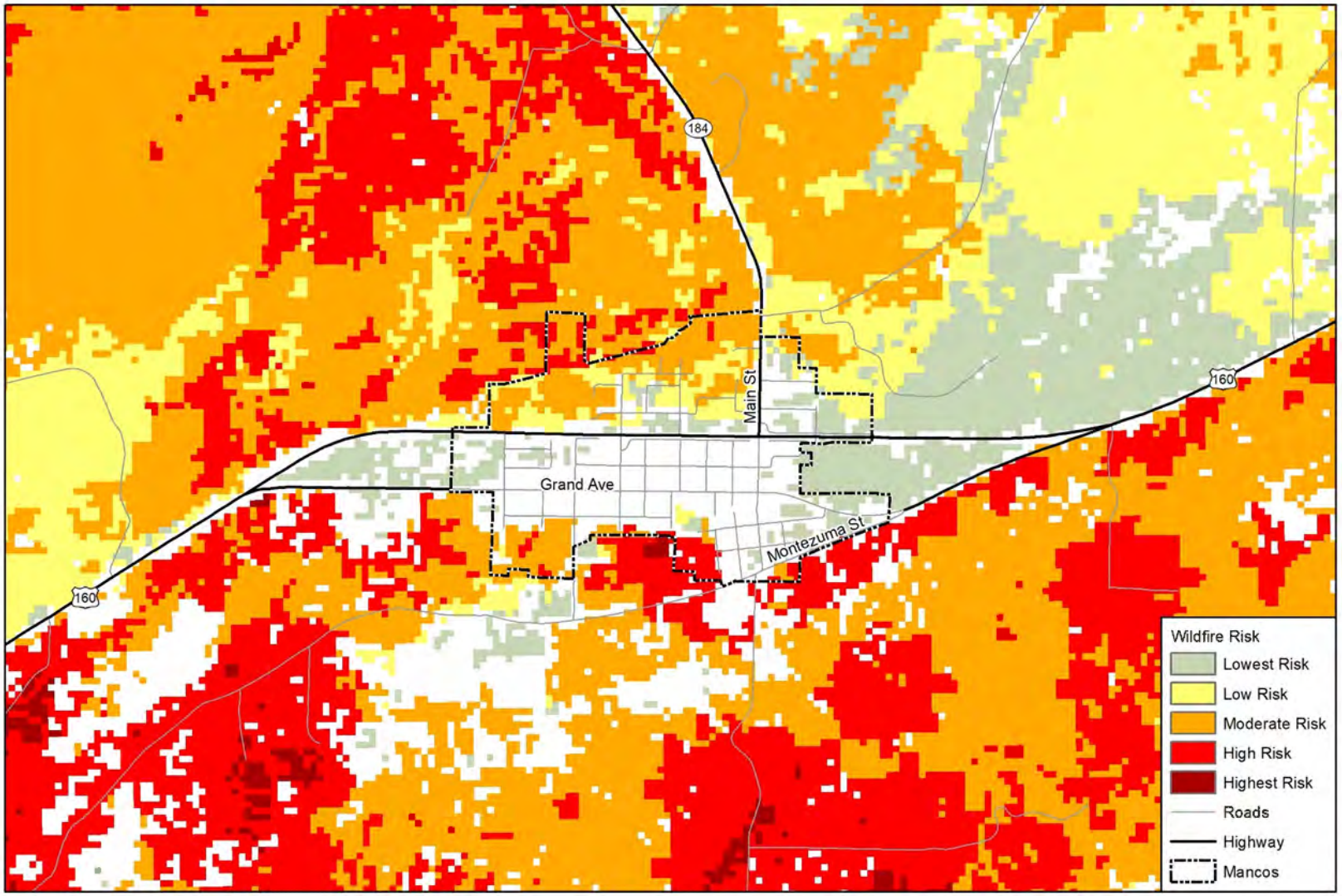
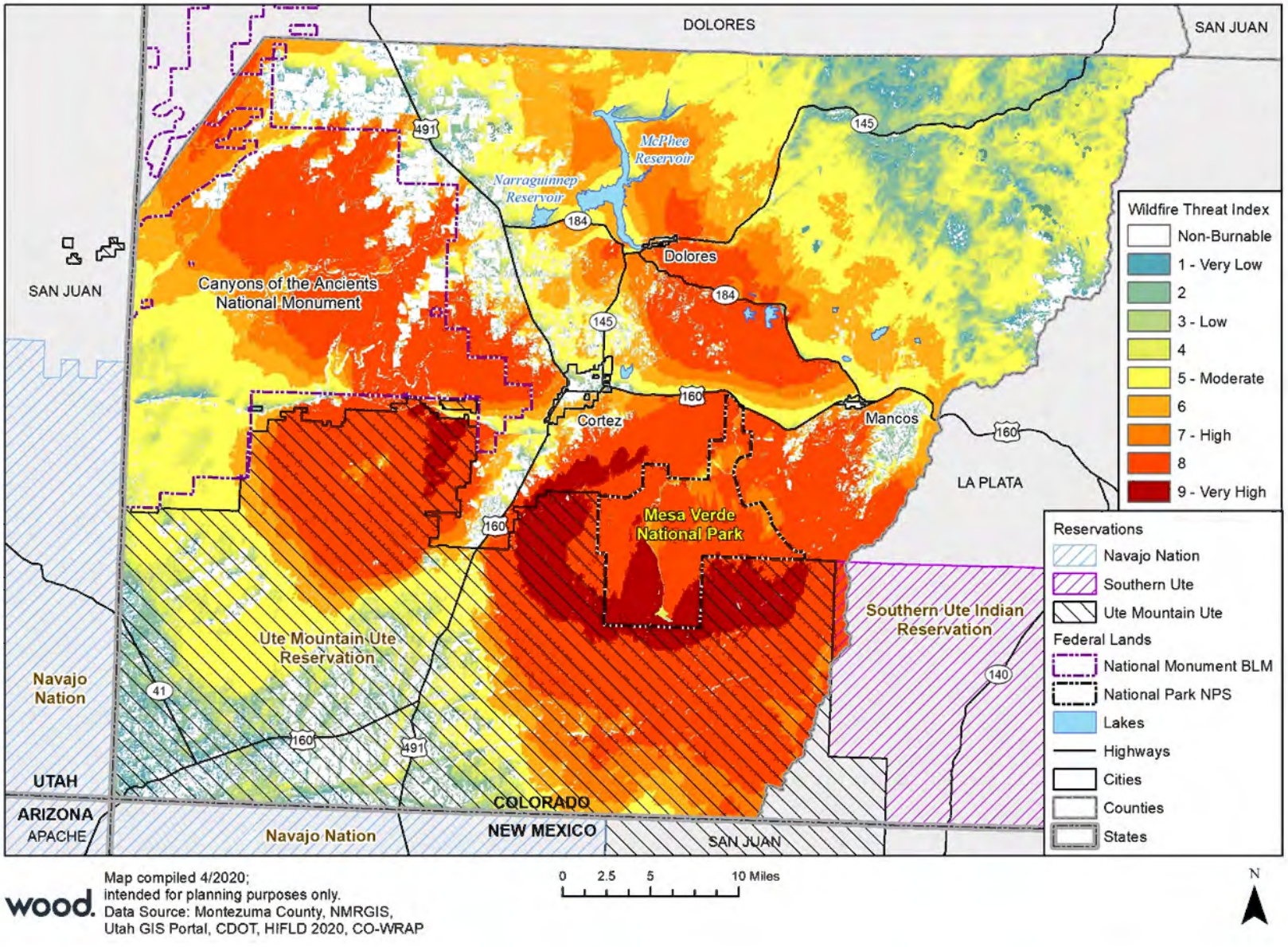
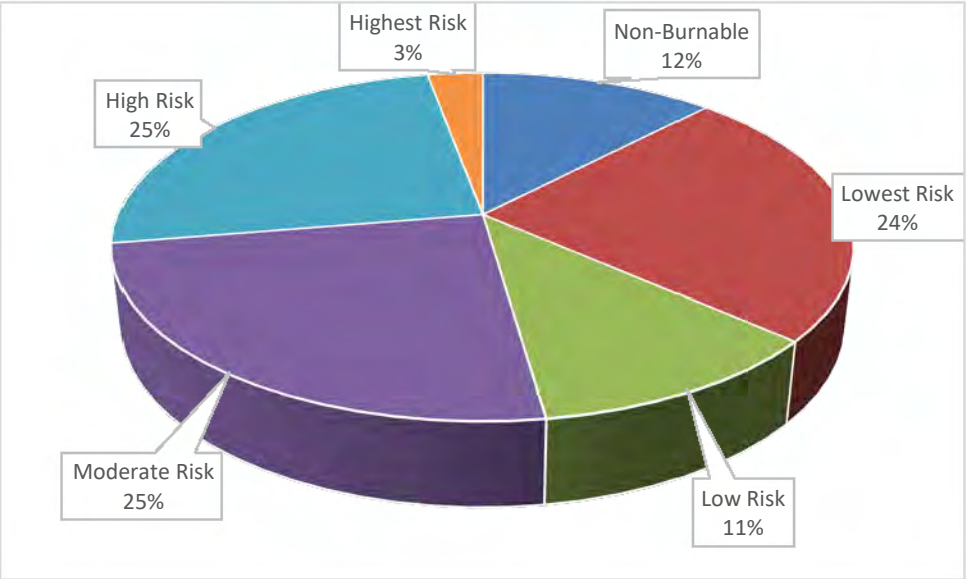


Figure 4-46 Wildfire Threat Index for Montezuma County



The percentage of acreage in Montezuma County exposed to different levels of wildfire risk is shown in Figure 4-47.

Figure 4-47 Montezuma County Wildfire Risk by Percentage of Land Area



For additional information on the types and locations of different fuels in the County, see the 2011 Montezuma County CWPP.

4.12.4 Frequency and Severity (Extent)

According to the Colorado State Wildfire Risk Assessment Report for Montezuma County, there is a strong probability that at least one wildfire will occur each year in Montezuma County. Many of these fires will be 5 acres or less. Based on the data shown in Table 4-41, over the past 19 years the County has experienced 26 wildfires that burned more than 10 acres; this equates to roughly 1.4 fires per year.

Based on the information in this hazard profile and the widespread impacts, the magnitude/severity of severe wildfires is considered critical, causing isolated deaths and multiple injuries; major or long-term property damage that threatens structural stability; or interruption of essential facilities and services for 24 to 72 hours—as well as longer duration economic impact due to interrupted tourism, which plays a major part in the economy of Montezuma County and its municipalities. Overall significance of the hazard is considered high.

4.12.5 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Because fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable NWS lightning warnings are available on average 24 to 48 hours before a significant electrical storm.

If a fire does break out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid expansion of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

4.12.6 Related Hazards

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Wildfires cause the contamination of reservoirs and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides and debris flows can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

4.12.7 Climate Change Considerations

Fire in western ecosystems is affected by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change is also may increasing the fire season to be year round. This could increase the potential for the stronger winds in the winter months to spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic Oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region.

Climate scenarios project summer temperature increases between 2 degrees Celsius (ºC) and 5°C and precipitation decreases of up to 15%. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

4.12.8 Vulnerability

Information for the exposure analyses provided in the sections below was downloaded from the CO-WRAP Wildfire Risk theme from the CO-WRAP website in April 2020. The distribution of risk areas in the planning area are shown in Figure 4-42 through Figure 4-45 above. The County incorporated CO-WRAP data and on-the-ground assessment to provide a more accurate wildfire risk analysis.

Structures, above ground infrastructure, critical facilities, and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure, and environment are assumed to be the same as described in the section on exposure.

Population

Population living in WUI areas was estimated using the structure count of buildings in the WUI area and applying the census value of 2.4 persons per household for Montezuma County, 2.3 persons per

household for Cortez, 2.15 persons per household for Dolores, and 2.31 for Mancos. These estimates are shown in Table 4-42. In all, 11,517 people (44% of population) are estimated to live in wildfire risk areas.

Table 4-42 Population Within Wildfire Risk Areas

	Low and Lowest Risk		Moderate Risk		High and Highest Risk	
	Population	% of Total	Population	% of Total	Population	% of Total
Cortez	536	6%	252	3%	280	3%
Dolores	0	0%	19	2%	144	16%
Mancos	231	13%	120	7%	16	1%
Unincorporated	2,640	18%	2,638	18%	4,642	32%
Total	**3,407**	**13%**	**3,029**	**12%**	**5,081**	**20%**

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Smoke and air pollution from wildfires can also be a severe health hazard, especially for sensitive populations such as children, the elderly, and those with respiratory and cardiovascular diseases. Dense smoke from the 2018 416 wildfire in neighboring La Plata County was mentioned by the HMPC as causing issues in Montezuma County. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Property

Property damage from wildfires can be severe and can significantly alter entire communities. Loss estimations for the wildfire hazard were modeled by intersecting the CO-WRAP wildfire risk data with 2020 county tax assessor data for improved parcels and associated address points. Table 4-43 through Table 4-45 summarizes the estimated exposed value of improvements in each wildfire risk category. Wildfires typically result in total building loss, including contents. Contents values were estimated as a percentage of building value based on their property type, using FEMA/Hazus estimated content replacement values. This includes 100% of the structure value for commercial, exempt, open space, other and park structures, 50% for residential structures and 0% for vacant structures. Improved and contents values were summed to obtain a total exposure value. In all, a total of 5,870 parcels and 6,463 buildings are located in areas exposed to risk wildfire, with a total value of over $2 billion. The greatest exposure is located in the unincorporated parts of the County.

Table 4-43 Exposure and Value of Structures in High to Highest Wildfire Risk Areas

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Cortez	Commercial	6	9	$1,357,172	$1,357,172	$2,714,344
	Mixed Use	4	4	$488,129	$488,129	$976,258
	Residential	112	120	$15,904,822	$15,904,822	$31,809,644
	Vacant Land	18	18	$6,387,465	$6,387,465	$12,774,930
	Total	**140**	**151**	**$24,137,588**	**$24,137,588**	**$48,275,176**
Dolores	Commercial	1	1	$22,856	$22,856	$45,712
	Mixed Use	1	7	$424,180	$424,180	$848,360

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
	Residential	67	67	$10,129,557	$10,129,557	$20,259,114
	Vacant Land	6	7	$605,409	$605,409	$1,210,818
	Total	**75**	**82**	**$11,182,002**	**$11,182,002**	**$22,364,004**
Mancos	Exempt	1	1	$700,000	$700,000	$1,400,000
	Residential	7	7	$528,171	$528,171	$1,056,342
	Total	**8**	**8**	**$1,228,171**	**$1,228,171**	**$2,456,342**
Unincorporated County	Agricultural	250	278	$37,303,153	$37,303,153	$74,606,306
	Commercial	9	11	$5,061,894	$5,061,894	$10,123,788
	Exempt	8	8	$1,665,423	$1,665,423	$3,330,846
	Industrial	5	5	$8,600,431	$8,600,431	$17,200,862
	Mixed Use	83	112	$24,497,911	$24,497,911	$48,995,822
	Residential	1793	1934	$317,364,576	$317,364,576	$634,729,152
	Vacant Land	57	57	$9,227,027	$9,227,027	$18,454,054
	Total	**2,205**	**2,405**	**$403,720,415**	**$403,720,415**	**$807,440,830**
	Grand Total	**2,428**	**2,646**	**$440,268,176**	**$440,268,176**	**$880,536,352**

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Table 4-44 Exposure and Value of Structures in Moderate Wildfire Risk Areas

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Cortez	Commercial	9	10	$8,947,771	$8,947,771	$17,895,542
	Exempt	2	10	$1,949,374	$1,949,374	$3,898,748
	Industrial	1	1	$166,582	$166,582	$333,164
	Mixed Use	3	3	$611,744	$611,744	$1,223,488
	Residential	82	108	$13,584,640	$13,584,640	$27,169,280
	Vacant Land	26	26	$5,706,007	$5,706,007	$11,412,014
	Total	**123**	**158**	**$30,966,118**	**$30,966,118**	**$61,932,236**
Dolores	Residential	9	9	$1,470,775	$1,470,775	$2,941,550
	Total	**9**	**9**	**$1,470,775**	**$1,470,775**	**$2,941,550**
Mancos	Exempt	2	7	$1,567,296	$1,567,296	$3,134,592
	Industrial	1	1	$89,775	$89,775	$179,550
	Mixed Use	1	14	$123,500	$123,500	$247,000
	Residential	32	52	$4,437,713	$4,437,713	$8,875,426
	Vacant Land	4	4	$807,422	$807,422	$1,614,844
	Total	**40**	**78**	**$7,025,706**	**$7,025,706**	**$14,051,412**
Unincorporated County	Agricultural	218	239	$38,046,262	$38,046,262	$76,092,524
	Commercial	22	24	$5,736,868	$5,736,868	$11,473,736
	Exempt	4	4	$759,220	$759,220	$1,518,440
	Industrial	2	2	$888,957	$888,957	$1,777,914

	Mixed Use	66	92	$18,729,254	$18,729,254	$37,458,508
	Residential	1,043	1,099	$176,895,116	$176,895,116	$353,790,232
	Vacant Land	34	38	$15,705,525	$15,705,525	$31,411,050
	Total	**1,389**	**1,498**	**$256,761,202**	**$256,761,202**	**$513,522,404**
	Grand Total	**1,561**	**1,743**	**$296,223,801**	**$296,223,801**	**$592,447,602**

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Table 4-45 Exposure and Value of Structures in Low to Lowest Wildfire Risk Areas

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Cortez	Commercial	37	52	$16,985,939	$16,985,939	$33,971,878
	Exempt	10	11	$4,994,954	$4,994,954	$9,989,908
	Industrial	3	3	$1,529,489	$2,294,234	$3,823,723
	Mixed Use	2	4	$493,214	$493,214	$986,428
	Residential	180	230	$31,775,340	$15,887,670	$47,663,010
	Vacant Land	21	21	$4,789,240	$4,789,240	$9,578,480
	Total	**253**	**321**	**$60,568,176**	**$45,445,251**	**$106,013,427**
Dolores	Mixed Use	1	3	$424,180	$424,180	$848,360
	Total	**1**	**3**	**$424,180**	**$424,180**	**$848,360**
Mancos	Commercial	8	8	$1,818,073	$1,818,073	$3,636,146
	Exempt	1	6	$1,367,218	$1,367,218	$2,734,436
	Industrial	2	2	$201,274	$301,911	$503,185
	Mixed Use	4	5	$542,885	$542,885	$1,085,770
	Residential	76	100	$11,698,562	$5,849,281	$17,547,843
	Vacant Land	7	7	$1,264,857	$1,264,857	$2,529,714
	Total	**98**	**128**	**$16,892,869**	**$11,144,225**	**$28,037,094**
Unincorporated County	Agricultural	330	351	$50,588,617	$50,588,617	$101,177,234
	Commercial	35	36	$6,660,175	$6,660,175	$13,320,350
	Exempt	10	11	$501,800	$501,800	$1,003,600
	Industrial	6	6	$2,008,080	$3,012,120	$5,020,200
	Mixed Use	73	87	$20,029,512	$20,029,512	$40,059,024
	Residential	1,044	1,100	$143,750,839	$71,875,420	$215,626,259
	Vacant Land	31	31	$23,100,085	$23,100,085	$46,200,170
	Total	**1529**	**1622**	**$246,639,108**	**$175,767,729**	**$422,406,837**
	Grand Total	**1,881**	**2,074**	**$324,524,333**	**$232,781,384**	**$557,305,717**

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Present Land Use

Present land use for each wildfire risk area is described in Table 4-46 and Table 4-47.

Table 4-46 Present Land use in Extreme and High Wildfire Risk Areas

	Extreme		High	
Present Use Classification	Area (acres)	% of total	Area (acres)	% of total
Agriculture	658	0.2	3,328	1.7
Barren Land	223	<0.1	187	0.1
Developed, High Intensity	0	0.0	1	<0.1
Developed, Medium Intensity	3	<0.1	6	<0.1
Developed, Low Intensity	83	<0.1	141	0.1
Developed, Open Space	288	<0.1	506	0.3
Forest	255,750	74.6	71,737	35.7
Grassland/Prairie	1,737	0.5	9,112	4.5
Shrub/Scrub	82,706	24.1	114,756	57.1
Water/Wetlands	1,439	0.4	1,129	0.6
Total	342,887	100.0	200,903	100.0
Note: Acreage covers only mapped parcels and thus excludes many rights of way and major water features.				

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Table 4-47 Present Land Use in Moderate and Lower Wildfire risk Areas

	Moderate		Lower	
Present Use Classification	Area (acres)	% of total	Area (acres)	% of total
Agriculture	47,754	10.2	70,016	23.8
Barren Land	734	0.2	9,183	3.1
Developed, High Intensity	9	<0.1	44	<0.1
Developed, Medium Intensity	127	<0.1	459	0.2
Developed, Low Intensity	1,945	0.4	2,613	0.9
Developed, Open Space	5,489	1.2	7,205	2.4
Forest	56,461	12.0	142,626	48.5
Grassland/Prairie	41,359	8.8	9,089	3.1
Shrub/Scrub	311,022	66.3	46,025	15.6
Water/Wetlands	3,920	0.8	6,834	2.3
Total	**468,820**	**100.0**	**294,094**	**100.0**
Note: Acreage covers only mapped parcels and thus excludes many rights of way and major water features.				

Source: Montezuma Assessor CO-WRAP Wood GIS analysis

Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Power lines downed by wind or other hazards can also be a source for ignitions. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

Table 4-48 identifies critical facilities exposed to the wildfire hazard in the county. A total of 101 critical facilities have been identified as located in areas exposed to wildfire risk; 27 of these are within high risk areas. 69 of the total facilities are in the unincorporated areas of the County.

Table 4-48 Critical Facilities Located in Wildfire Risk Areas

Jurisdiction	CWCB Type	Facility Type	High-Highest	Moderate	Low-Lowest
Cortez	At-Risk Population	Nursing Home/Assisted Living			2
	At-Risk Population	School	1	2	3
	Essential Services	Communications	2	1	
	Essential Services	Emergency Medical		1	1
	Essential Services	Fire Station		1	
	Essential Services	Helicopter Pad			1
	Essential Services	Police Station			1
	Essential Services	Sewage Treatment		1	
	Vital to Restoring Service	City Offices		1	3
	Vital to Restoring Service	County Offices			1
	Vital to Restoring Service	Court House			1
	Vital to Restoring Service	Jail			1
		Total	**3**	**7**	14
Dolores	Essential Services	Fire Station		1	
		Total	**0**	**1**	**0**
Mancos	At-Risk Population	Nursing Home/Assisted Living		1	1
	At-Risk Population	School			2
	Essential Services	Fire Station			1
	Essential Services	Sewage Treatment		1	
	Essential Services	Substation			1
		Total	**0**	**2**	**5**
Unincorporated County	At-Risk Population	Nursing Home/Assisted Living	1		
	At-Risk Population	School	2	1	5
	Essential Services	Communications	6	4	2
	Essential Services	Compressor Station	3	3	1
	Essential Services	Fire Station	3	2	3
	Essential Services	Helicopter Pad			1
	Essential Services	Park or Rec. Facility		1	1
	Essential Services	Substation	4	8	9
	Essential Services	Water Tank	1		
	Essential Services	Water Treatment	3		
	Vital to Restoring Service	City Offices			1
	Vital to Restoring Service	County Offices			1
	Vital to Restoring Service	Maintenance Yard	1		2
		Total	**24**	**19**	**26**
		Grand Total	**27**	**29**	**45**

Economy

Tourism, farming and ranching are important components of Montezuma County's economy. Wildland fires can have a direct impact on agricultural lands and the County's scenery, adversely affecting the ability of the County's residents to earn a living from these industries. Montezuma County's scenic beauty and cultural resources is a main draw for tourism, so the County can (and has) suffered economic losses from tourists not coming to the area due to wildfires. 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. Fires can cause direct economic losses in the reduction of harvestable timber.

Historic, Cultural and Natural Resources

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- **Damaged Fisheries**—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- **Soil Erosion**—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species**—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- **Disease and Insect Infestations**—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Destroyed Endangered Species Habitat**—Catastrophic fires can have devastating consequences for endangered species.
- **Soil Sterilization**—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

Historic, natural, and cultural resources such as Mesa Verde National Park, Canyons of the Ancients National Monument, and Sleeping Ute Mountain are also highly vulnerable to wildfires.

4.12.9 Development Trends

Montezuma County has a Montezuma County Community Wildfire Protection Plan. The plan was established to assist the county with wildfire preparation and provide effective techniques to combat wildfires while protecting property and persons. The continued migration of inhabitants to remote areas of the county increases the probability of human-caused ignitions from vehicles, grills, campfires, and electrical devices. Revisions to the Colorado Revised Statutes exempted properties divided into parcels of 35 acres or more from the statutory definition of a subdivision, restricting the county's ability to enforce county regulations and mitigation. According to the HMPC there are subdivisions outside of the Town of Dolores that are a concern to wildfire risk.

4.12.10 Risk Summary

- Overall significance of the hazard is considered high for all jurisdictions except Cortez which considers it to be medium.
- A total of 5,870 parcels and 6,463 buildings are located in areas exposed to risk wildfire, with a total value of over $2 billion. The greatest exposure is located in the unincorporated parts of the County.
- Wildfires within and in adjacent counties can deter tourism and affect the local economy and air quality.
- Wildfires could cause floods and debris flows as secondary natural hazards.
- Climate change could affect the frequency and intensity of the wildfire hazard.
- Both the natural and human-caused conditions that contribute to the wildland fire hazard are tending to exacerbate through time.

4.13 Winter Storm

WINTER STORM HAZARD RANKING	
Montezuma County	High
City of Cortez	High
Town of Dolores	High
Town of Mancos	Medium
Cortez Fire Protection District	High

4.13.1 Hazard Profile

Winter storms can include heavy snow, ice, and blizzard conditions. Heavy snow can immobilize a region, 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 damage can be 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 in injuries and deaths.

DEFINITIONS

Winter Storm—A storm having significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

Blizzard—Sustained wind or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow.

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to 6 tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—Small-scale atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms, and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Winter storms in Montezuma County, including strong winds and blizzard conditions, can result in property damage, localized power and phone outages and closures of streets, highways, schools, businesses, and non-essential government operations. People can also become isolated from essential services in their homes and vehicles. A winter storm can escalate, creating life threatening situations when emergency response is limited by severe winter conditions. Other issues associated with severe winter weather include hypothermia and the threat of physical overexertion that may lead to heart attacks or strokes. Snow removal costs can also impact budgets significantly. Heavy snowfall during winter can also lead to flooding or landslides during the spring if the area snowpack melts too quickly.

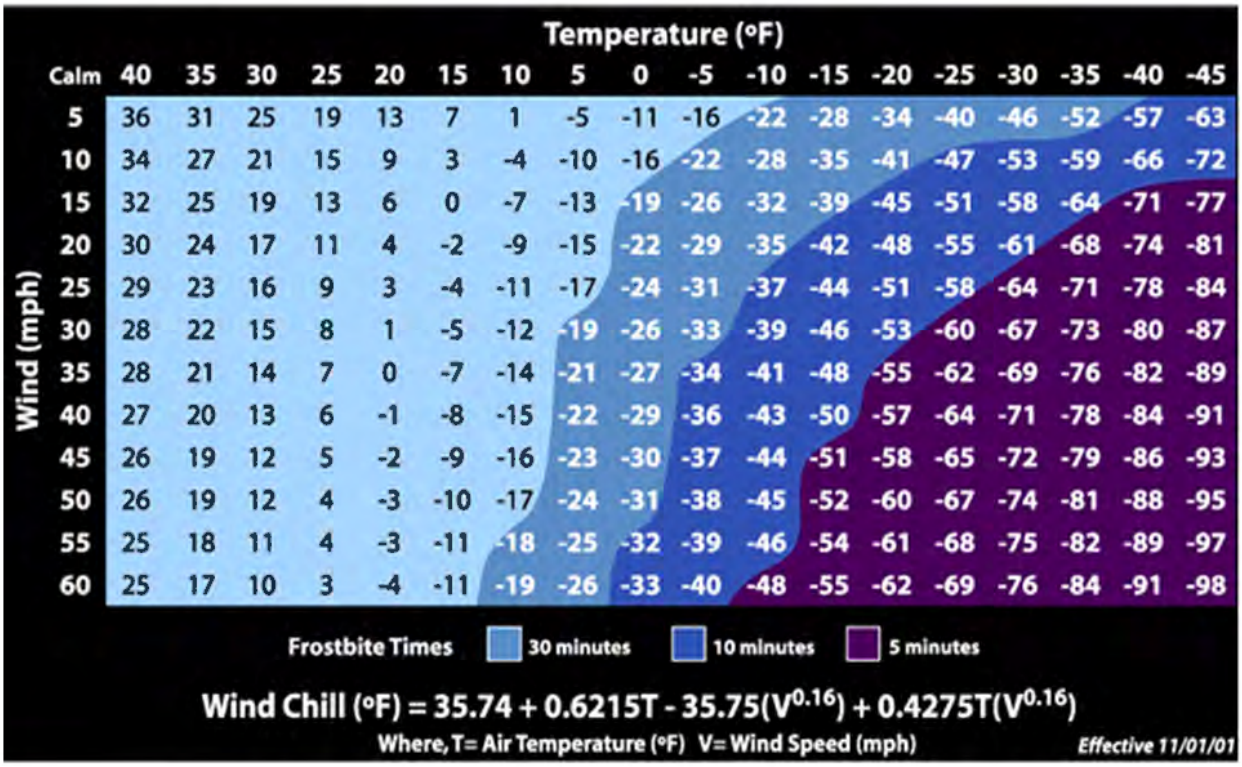
Extreme Cold

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.

In 2001, the NWS implemented an updated wind chill temperature index (see Figure 4-48). This index describes the relative discomfort or 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 4-48 National Weather Service Wind Chill Chart



Source: National Weather Service, www.nws.noaa.gov/om/windchill/index.shtml

A wind chill watch is issued by the NWS when wind chill warning criteria are possible in the next 12 to 36 hours. A wind chill warning is issued for wind chills of at least -25°F on the plains and -35°F in the mountains and foothills.

The Western Regional Climate Center reports data summaries from a station in the City of Cortez, at the Cortez Municipal Airport, the county seat in Montezuma County. Table 4-49 contains temperature summaries related to extreme cold for the station.

Table 4-49 Temperature Data from Cortez Municipal Airport (1911-2016)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (degrees Fahrenheit)												
Average Maximum Temperature	41.1	45.6	53.5	63.1	72.8	83.5	88.8	86.4	79.0	67.1	52.5	42.6
Average Minimum Temperature	13.2	18.4	24.6	30.9	38.6	46.4	54.3	53.0	44.7	33.9	23.0	15.3
Average Temperature	27.2	32.0	39.0	47.0	55.7	64.9	71.5	69.7	61.8	50.5	37.7	28.9
Extreme Temperatures (degrees Fahrenheit)												
Daily Extreme Minimum Temperature	-27 1/22/37	-31 2/8/33	-15 3/6/35	6 4/4/45	17 5/1/67	27 6/7/34	22 7/21/1915	29 8/6/1915	23 9/26/30	12 10/29/29	-14 11/24/31	-22 12/8/78
Average Number of Days												
Minimum Temperature below 32 degrees Fahrenheit	30.2	27.3	28.2	20.9	7.8	1.2	0.0	0.0	2.6	17.3	27.8	30.5
Minimum Temperature below 20 degrees Fahrenheit	21.6	15.2	9.9	2.6	0.1	0.0	0.0	0.0	0.0	1.5	12.3	23.2
Minimum Temperature below 0 degrees Fahrenheit	2.6	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7

Source: Western Regional Climate Center

Montezuma County receives varying amounts of snow throughout the area. Winter weather patterns flow from the southwest and west, usually avoiding the colder storms from the north that are typical in most parts of Colorado. While winter storms bring heavier snowfalls to the San Juan Mountains in the north, around Cortez snow typically melts away in a few days. The county receives approximately 58 inches of snow per year, with an average of 51 days per year with a snow depth of one inch or more. February and December are on average the snowiest months in the county. The City of Cortez, located in the mid-central portion of the county, receives approximately 25 inches of snow per year.

4.13.2 Past Events

A total of 639 winter weather events occurred in Montezuma County between 1996 and 2019. The event types include a combination of "Blizzard," "Extreme Cold/Wind Chill", "Heavy Snow," "Winter Weather," and "Winter Storm." Locations for the records are limited to one of National Center for Environmental Information-defined zones: "Southwestern San Juan Mountains," "Four Corners/Upper Dolores River Basin," "Southwestern San Juan Mountains/C E Dolores/San Juan/S Hinsdale/N La Plata/NE Montezuma/E N Archuleta," and "Four Corners/Upper Dolores River/Cortez and Vicinity." Table 4-50 shows the distribution of weather events throughout the county.

Table 4-50 Montezuma County Winter Weather Events (1996-2019)

Location	Event Type	Number of Events
Four Corners/Upper Dolores River Basin	Heavy Snow	21
	Winter Storm	29
	Winter Weather	80
	Extreme Cold/Wind Chill	1
Southwestern San Juan Mountains/C E Dolores/San Juan/ S Hinsdale/N La Plata/NE Montezuma/E N Archuleta	Heavy Snow	13
	Winter Storm	9
Southwestern San Juan Mountains	Blizzard	9
	Heavy Snow	57
	Winter Storm	189
	Winter Weather	213
Four Corners/Upper Dolores River/Cortez and Vicinity	Heavy Snow	12
	Winter Storm	6

Source: National Center for Environmental Information

Only one of the winter weather events resulted in property damage. The event was located in the southwestern San Juan Mountains on December 1, 2007 and was categorized as a blizzard and resulted in $10,000 damage. The storm began on November 30th and continued into December. The event narrative notes 12 to 40 inches of snow fell in the area in addition to strong wind with 40 to 60 mph gusts leading to white-out conditions from blowing snow.

According to the HMPC, after an above average snowfall (213%) a snow event in the winter of 2018-2019 resulted in several vehicle accidents and various road closures, in addition to school closures.

4.13.3 Location

The entire county is susceptible to severe winter storms; although severe winter weather is primarily found in the higher elevations of the county and in the San Juan Mountains in the northern portion of the county. State Highway 145 runs through the San Juan Mountains in the north and could cause hazardous conditions to motorists if blizzard or severe winter weather conditions occur. State Highway 145 is the major highway that runs through the Town of Dolores. Many portions of this road are narrow and curved and an accident on State Highway 145 can cause a major disruption in the flow of goods and services in and out of the county.

4.13.4 Frequency and Severity (Extent)

Severe winter storms happen nearly every year in Montezuma County and are thus considered highly likely, with nearly 100% chance of occurrence in any given year. Severe winter weather occurs most frequently in December, January, February and March. Overall, severe winter storm impacts could be limited, but the potential for heavy snow and blizzard events as defined by the National Weather Service are possible. County residents take the weather in stride as part of mountain living. Most property damages with winter storms are related to the heavy snow loads and vehicle accidents. The highest risk will be to travelers that attempt to drive during adverse conditions. Economic impacts occur because of power outages and closures of Highway 149 for snow removal and avalanche control, leaving residents and visitors stranded as well as interrupting the transport of supplies and services into the area for an extended period.

The annual rate of occurrence for the county is 25 events per year, however, the average loss expectancy is only $16/event for all 639 events that have occurred in Montezuma County between 1996 and 2019. Therefore, the annualized loss for winter weather is $435.

4.13.5 Warning Time

Meteorologists can often predict the likelihood of a severe winter storm; and forecasts usually come from the City of Cortez. When forecasts are available, they can give several days of warning time.

4.13.6 Related Hazards

Severe winter storms are often accompanied by high and strong winds, and often lead to avalanches. The most significant secondary hazards associated with severe winter storms are downed trees, and power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and constructed drainage systems, causing flooding. Prolonged snow melt could produce flooding, and overtopped culverts with ponded water on roads. Flooding and debris could further obstruct roads and bridges further isolating residents.

4.13.7 Climate Change Considerations

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.

The effects of climate change in Colorado have already been observed. The following climate change observations are noted in the 2018 Colorado State Hazard Mitigation Plan:

- Snowpack, as measured by April 1, 2018 snow-water equivalent (SWE), has been mainly below average since 2000 in all of Colorado's river basins, but long-term (30-year, 50-year) declining trends have been detected.
- The timing of snowmelt and peak runoff has shifted earlier in the spring by 1 to 4 weeks across the state's river basins over the past 30 years, due to the combination of lower SWE since 2000, the warning trend in spring temperatures, and enhanced solar absorption from dust-on-snow.

Dust-on-snow causes increased snowmelt because dust is darker than snow it absorbs more sunlight causing the snow underneath to heat up more rapidly. This is an emerging factor that could lead to substantial long-term reductions in Colorado's seasonal snow cover. The Center for Snow and Avalanche Studies (CSAS), operates the Colorado Dust-on-Snow program to study the effects of dust on Colorado's snowpack. The program has CSAS sensors at 11 mountain pass locations throughout the state to monitor the presence or absence of dust layers.

4.13.8 Vulnerability

The threat to public safety is typically the greatest concern when it comes to impacts of winter storms. But these storms can also impact the local economy by disrupting transportation and commercial activities. Winter storms are occasionally severe enough to overwhelm snow removal efforts, transportation, livestock management, and business and commercial activities. Travelers on highways in Montezuma County can become stranded, especially along the remote stretches of road, requiring search and rescue assistance and shelter provisions. The County can experience high winds and drifting snow during winter storms that can occasionally isolate individuals, particularly tourists that may not be familiar with winter weather in the San Juan Mountains. Extreme cold temperatures would stress heating systems and expose residents to hypothermia.

Population

It can be assumed that the entire planning area is exposed to some extent to severe winter weather events. Certain areas are more exposed due to geographic location and local weather patterns.

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. As noted in in the Hail, Lightning and Severe Wind vulnerability assessment subsection 4.10.4, of the Medicare Beneficiaries in the County, 13% rely on electricity-dependent medical equipment to be able to live independently in their homes. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe winter weather events and could suffer more secondary effects of the hazard. Commuters who are caught in storms may be particularly vulnerable. Stranded commuters may be vulnerable to carbon monoxide poisoning or hypothermia. Additionally, individuals engaged in outdoor recreation during a severe winter are also vulnerable to exposure to severe winter storm hazards.

Property

All property is vulnerable during severe winter weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse. Vulnerability is influenced both by architecture and type of construction material and should be assessed on a building-by-building basis. “Roof avalanches” are a possibility after heavy snowfall events although it is uncommon, it has occurred in other mountain communities in Colorado.

Critical Facilities and Infrastructure

All critical facilities and infrastructure in the County are potentially exposed to severe winter weather. The most common problems associated with this hazard are utility losses. Roads may become impassable due to ice or snow. Ice accumulation on roadways can create dangerous driving conditions. There are limited county roads that are available to move people and supplies throughout the region. Many of these roads are narrow and curved, particularly State Highway 145 that runs through the San Juan Mountains in the northern portion of the county.

Incapacity and loss of roads are the primary transportation failures resulting from severe winter weather. Snowstorms can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly. Prolonged obstruction of major routes can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Another common impact of blizzards and severe winter storms on the planning area is power loss. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. The weight of heavy continued snowfall and/or ice accumulating on power lines often brings them to the ground causing service disruptions for thousands of customers. This can cause a loss of community water and sewer services, as well as the supply of gasoline, as these services almost always require electrical pumps. In addition, prolonged power outages can mean loss of food to grocery stores and other facilities that provide feeding services.

Economy

Closure of Highway 145 during winter storms could temporarily isolate portions of the County and preventing the movement of goods and services into and out of the County. Depending on the length of

the closure it could also hinder the local economy which is dependent on tourism and out of county visitors.

Historic, Cultural and Natural Resources

Natural resources may be damaged by the severe winter weather, including broken trees and death of wildlife. Unseasonable storms may damage or kill plant and wildlife, which may impact natural food chains until the next growing seasons. Most of these impacts would be short-term.

4.13.9 Development Trends

All future development will be affected by severe storms. The vulnerability of community assets to severe winter storms is increasing through time as more people enter the planning area. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have all adopted building codes which are equipped to deal with the impacts of severe weather events. Land use policies identified in comprehensive plan within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

4.13.10 Risk Summary

- Heavy snow, ice, winter storms and blizzards are a common occurrence in Montezuma County, particularly in the higher elevations.
- Severe winter weather can isolate residents and travelers by closing roads into, out of the County.
- Severe winter storms could have many impacts, including structural damage and power outages and is considered a high significance hazard.

5 Mitigation Strategy

DMA Requirement §201.6(c)(3):	*[The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

This section describes the mitigation strategy process and mitigation action plan for the Montezuma County Multi-Hazard Mitigation Plan. It explains how the County and participating jurisdictions accomplished Phase 3 of FEMA's 4-phase guidance—Develop the Mitigation Plan—and includes the following from the 10-step planning process:

- Planning Step 6: Set Goals
- Planning Step 7: Review Possible Activities
- Planning Step 8: Draft an Action Plan

5.1 Mitigation Strategy: Overview

The results of the planning process, the risk assessment, the goal setting, the identification of mitigation actions, and the hard work of the Hazard Mitigation Planning Committee (HMPC) led to the mitigation strategy and mitigation action plan for this HMP update. As part of the plan update process, a comprehensive review and update of the mitigation strategy portion of the plan was conducted by the HMPC. As part of this process the original goals and objectives from the 2016 Plan were reviewed and reaffirmed. The HMPC thought the goals and objectives are still valid and were kept as originally written. The mitigation actions from 2016 Plan were reviewed and assessed for progress and evaluated for their inclusion in this plan update. Section 5.1.1 below identifies the updated goals and objectives of this plan and Section 5.3.1 details the progress on 2016 mitigation actions and summarizes the updated mitigation action plan.

5.1.1 Goals and Objectives

DMA 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, the HMPC has organized resources, assessed natural hazards and risks, and documented mitigation capabilities. A profile of the County's vulnerability to natural hazards resulted from this effort, which is documented in the preceding chapter. The resulting goals, objectives, and mitigation actions were developed based on this profile. The HMPC developed the new updated mitigation strategy based on a series of meetings and worksheets designed to achieve a collaborative mitigation planning effort, as described further in this section. The goals for this plan were developed by the HMPC based on the plan's risk assessment. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the HMPC to formulate planning goals and objectives and the mitigation strategy for Montezuma County.

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 for implementation, that is, implementation cost, schedule, and means are not considered. Goals are defined before considering how to accomplish them so that the goals 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.

Based upon the risk assessment review and goal setting process, the HMPC re-assessed the following goals and associated objectives developed from the 2016 Plan. These were revisited and validated by the HMPC during the 2020 HMP update process.

- **Goal 1:** Reduce or prevent the loss of life, personal injuries, property damage, environmental damage, and economic loss from hazard events by identifying, implementing, and maintaining mitigation strategies where resources are available.
    - **Objective 1.1:** Improve public awareness of hazards in general and at specific high-risk locations; and give people knowledge about measures they can use to protect themselves, their property and the community.
    - **Objective 1.2:** Identify additional and more comprehensive means of public alert and notification systems and processes.
    - **Objective 1.3:** Explore and examine county and municipality zoning, planning, ordinances, resolutions, and policies for areas where changes can prevent or reduce the effects of hazards.
    - **Objective 1.4:** Identify, seek resources, and implement structural and/or protection projects that reduce or prevent the effects of hazard events.
    - **Objective 1.5:** Identify, develop, and implement additional emergency operational plans and services for high risk areas.
    - **Objective 1.6:** Implement projects to mitigate hazard impacts to critical facilities and lifelines.
- **Goal 2:** Increase and maintain agency/jurisdictional collaboration on mitigation projects and include the community, non-governmental agencies, and businesses when appropriate.
    - **Objective 2.1:** Educate elected officials, agency administrators and directors on mitigation strategies and best practices.
    - **Objective 2.2:** Coordinate and conduct multi-jurisdictional meetings and workshops to include non-governmental organizations, businesses, and the public.
    - **Objective 2.3:** Conduct outreach to businesses on best practices to enable businesses to be more resilient during and after hazard events.
- **Goal 3:** Improve government and public response to hazard events.
    - **Objective 3.1:** Enhance public information and education by implementing best practices from other jurisdictions, learning from other jurisdictions' after action reports, improving the training and knowledge of elected officials and employees from all local jurisdictions.
    - **Objective 3.2:** Improve first responders' response capabilities and implement a collaborative approach between agencies.
    - **Objective 3.3:** Improve training of all first responders and other organizations/personnel who would respond during hazard events.
    - **Objective 3.4:** Improve collaboration between agencies, jurisdictions, non-governmental organizations and businesses on emergency operation plans and recovery plans.

5.2 Identification and Analysis of Mitigation Actions

DMA 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.*

In order to identify and select mitigation measures to support the mitigation goals, each hazard identified in Section 4: Risk Assessment was evaluated. The HMPC analyzed a comprehensive set of viable mitigation alternatives for both new and existing buildings and infrastructure that would support identified goals and objectives. Each HMPC member was provided with the following list of categories of mitigation measures, which originate from the NFIP 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.

The HMPC members were also provided with several lists of alternative multi-hazard mitigation actions for each of the above categories via email and at a mitigation strategy webinar in June 2020. Another reference handout document titled "Mitigation Ideas" developed by FEMA was distributed to the HMPC via an online link. This reference provides four categories of mitigation actions that were discussed at the HMPC meeting in addition to the NFIP/CRS categories. These include:

- Plans and Regulations
- Structure and Infrastructure Projects
- Education and Awareness
- Natural systems protection

Other alternatives discussed on the webinar include the four 'A's' of mitigation:

- Alter the physical nature of the hazard
  - Such as wildfire defensible space and fuels treatments, snow fences etc.
- Avert the hazard away from people, buildings, and infrastructure
  - Can include engineered solutions, drainage, and channel improvements, floodproofing, fuel breaks
- Adapt to the hazard
  - Through land use planning, building codes and design standards, warning systems etc.
- Avoid the hazard

- Natural systems protection, open space, acquisition, or relocation of properties out of hazardous areas

To facilitate the brainstorming process, the HMPC referred to a matrix of typical mitigation alternatives organized by CRS category for the hazards identified in the plan, in addition to a handout that explains the categories and provided examples. These materials are included in Appendix F. HMPC members were encouraged to develop mitigation alternatives that would protect future, as well as existing, development from hazards per the DMA 2000 regulations. A facilitated discussion then took place to examine the existing actions in the 2016 plan and analyze the other possible mitigation alternatives. With an understanding of the alternatives, a brainstorming session was conducted to generate a list of preferred mitigation actions. The result was new and updated project ideas with the intent of meeting the identified goals and mitigating identified hazards.

5.2.1 Prioritization Process

Once the mitigation actions were identified, the HMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria STAPLEE, sustainable disaster recovery criteria, and others, to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE stands for the following:

- **S**ocial: Does the measure treat people fairly?
- **T**echnical: Will it work? (Does it solve the problem? Is it feasible?)
- **A**dministrative: Is there capacity to implement and manage the project?
- **P**olitical: Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support the project?
- **L**egal: Does your organization have the authority to implement? Is it legal? Are there liability implications?
- **E**conomic: Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development? Does it reduce direct property losses or indirect economic losses?
- **E**nvironmental: Does it comply with environmental regulations or have adverse environmental impacts?

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining project priority (the 'economic' factor of STAPLEE). Other criteria used to recommend what actions might be more important, more effective, or more likely to be implemented than another included:

- Does action protect lives?
- Does action address hazards or areas with the highest risk?
- Does action protect critical facilities, infrastructure, or community assets?
- Does action meet multiple objectives (Multiple Objective Management)?

At the mitigation strategy webinar, the HMPC reviewed and discussed the STAPLEE considerations to determine which of the identified actions were most likely to be implemented and effective. Prioritization of previous mitigation actions identified in the 2016 HMP that are continuing in the updated plan were revisited during a HMPC meeting. New actions identified in 2020 also were prioritized based on the group discussion with the STAPLEE considerations in mind.

5.3 Mitigation Action Plan

DMA 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 updated 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.

5.3.1 Progress on Previous Mitigation Actions

A review of 2016 mitigation actions progress reports indicates that Montezuma County and the participating jurisdictions have been successful in implementing actions identified in the 2016 HMP Mitigation Strategy, thus, working diligently towards meeting the 2016 plan goals. Table 5-1 indicates the details for each 2016 mitigation action items that have been completed.

The 2016 mitigation strategy contained 50 separate mitigation actions. As of June 2020, 10 of these actions have been completed, 6 are ongoing, 10 are considered continuing-in process, 17 have not yet been started due to a variety of reasons such as changes in priorities or lack of funding but are continuing projects. Many of the ongoing actions include actions that are implemented on a regular or annual basis that contribute to the goals of this plan that will continue to be needed into the future. These include outreach campaigns using social media to disseminate information to the public about natural hazards and personal and family preparedness. One action from the 2016 mitigation strategy was deleted, which was a proposed project to bury powerlines (old action ID #18) in the Town of Mancos. This was considered not practical or cost effective and was thus not carried forward in this plan.

Table 5-1 Completed Mitigation Actions

Jurisdiction	2016 Action ID	Hazard(s) Mitigated	Mitigation Action Title	Priority	Comments
Montezuma County	2	Flood	Community Outreach and Education on Natural Hazards for Businesses, Ranchers, and Farmers	Medium	CSU education on Dolores River flooding 2019
	7	All	Develop a Multi-Agency Coordination (MAC) Group within Montezuma County	Medium	COVID 19 response has created a MAC Group with 4 policy group, 10 EOC staff and 57 ESF personnel. Classroom Training is to come.
City of Cortez	2	Lightning	Lightning Awareness Campaign	Medium	National Lightning Awareness information used to share information.
	5	Wind	Severe Wind Alert	High	Alerts through Nixle

Jurisdiction	2016 Action ID	Hazard(s) Mitigated	Mitigation Action Title	Priority	Comments
	8	Drought	Waterwise Landscaping Demonstration Plots (Education)	Low	Demonstration implemented North of the Police Department
Town of Dolores	2	All	Implement IPAWS System	Low	Connected Nixle (Everbridge)
Town of Mancos	4	Drought	Build Raw Water Reservoir to Serve Town	Low	Added new water tank. Replacing the original water tank in 2021/2022 per Town CIP.
	6	Drought	Institute Watering Restrictions	Medium	MMC has watering restriction ordinance in place.
	8	Flood	Strengthen Flood Zone Limitations on Future Building	Medium	Adopted in 2019 LUC update
	16	All	Invest in Additional Equipment	High	Added new water tank, purchased grader, new MMO vehicles with 4WD, all PW equipment have snowplows

5.3.2 Continued Compliance with the National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1% annual chance flood (or 100-year flood) and the 0.2% annual chance flood (or 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRM), which are the principle tool for identifying the extent and location of the riverine flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Montezuma County and all of the participating jurisdictional communities participate in the NFIP program. Structures permitted or built in the county before 1989 when the county (and Dolores and Mancos) joined the NFIP (1977 for Cortez) are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." Post-FIRM structures built in compliance with the floodplain regulations are mitigated to withstand floods up through the 100-year event. The insurance rate is different for the two types of structures, as pre-FIRM are at higher risk of flooding. The effective date for the current

countywide FIRM is September 26, 2008. The county and participating communities are currently in good standing with the provisions of the NFIP. Compliance is monitored by FEMA regional staff. Maintaining compliance with the NFIP is an important component of flood mitigation and risk reduction.

Given the flood hazard and risk in the planning area and recognizing the importance of the NFIP in mitigating flood losses, an emphasis is placed on continued compliance with the NFIP by Montezuma County and all NFIP participating jurisdictions including Cortez, Dolores and Mancos. As NFIP participants, these communities have and will continue to make every effort to remain in good standing with NFIP. This includes continuing to comply with the NFIP's standards for updating and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance.

5.3.3 Updated Action Plan

The results of the project identification and prioritization exercise are summarized in Table 5-2. These projects detail specific actions for reducing future hazard-related losses within Montezuma County. The projects are organized by jurisdictions and included notes about the department and partners necessary to implement the project. Table 5-2 provides more details on the mitigation actions, including the mitigation action description estimated cost, potential funding sources, timeline, indication of the goal(s) that the projects primarily align with and are marked with their relative level of priority high, medium, and low. The following table also provides status/implementation notes that describe progress made on the actions so far, using the following categories, and, where applicable, notes if there were changes in the priority level from the previous plan:

- Action ongoing toward completion: 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 HMPC agreed to carry over the action into the updated plan.
- New in 2020: The action is new to this plan update; little to no work has been completed

Many of these mitigation actions are intended to reduce impacts to existing development. Those that protect future development from hazards, as required per the DMA 2000 regulations, are indicated by an asterisk '*' in the action identification number. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations.

Specific to new identified actions during the 2020 plan update process, upon review the jurisdictions noted that several actions from the previous plan that had not been completed were still relevant and still addressed the priority hazards. Cortez and Mancos both have prioritized completing these existing actions as opposed to adding a number of new ones. Each jurisdiction has identfied one new action. During the 2020 update, the significance of the wildifire hazard increased for the City of Cortez per the risk assessment update, which spurred the development of a new wildfire mitigation action for the City.

Table 5-2 Montezuma County Updated Mitigation Action Plan

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
Montezuma County Mitigation Actions									
MC - 1	Goal: 1 Objective : 1.1	Multi-Hazard: Extreme Heat, Flood, Hail, Tornado, Wildfire and Winter Storm	**Community outreach and education on natural hazards and personal/ family preparedness.** The Montezuma Office of Emergency Management already conducts numerous outreaches by speaking with senior groups, Leadership Montezuma, high school groups, FireWise, and other organizations. This action will be a continuing effort.	County OEM	<$10,000	County, SWRAHAC, EMPG, Private Sector	High	Ongoing	Action ongoing toward completion. CSU My Personal Preparedness Initiative (Mypi) program. Continuing every year.
MC-2	Goal: 1 Objective :1.2	All Hazards	**Develop a County/ Multi-Jurisdictional Comprehensive Emergency Alert Plan.**	County OEM, County SO, City of Cortez, Town of Dolores, Town of Mancos	<$10,000	County, City, Town, 911 Funds, SWRAHAC, EMPG	High	Short Term	Action ongoing toward completion. A plan has been developed but is still in draft form.
MC-3	Goals: 1, 2 Objectives: 1.2, 2.2	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris	**Improve Doppler Radar for Region.** Montezuma County along with the other four counties and two tribes have identified insufficient weather radar coverage as one of its biggest deficiencies. Work with other partners in the Four Corners area (including the three bordering states, other tribal governments, the state, and the National Weather Service, and others) to find funding and support to place another Doppler radar tower in the area to increase weather predictions and warnings.	OEM, Counties of: La Plata, Dolores, San Juan, Archuleta, and Ute Mountain. Ute Tribe, Southern Ute Tribe, National Weather Service, State of Colorado	>$100,000	Counties, Tribes, State, National Weather Service, Colorado Department of Labor Grant	High	Long Term	Action ongoing toward completion. Temporary radar was implemented for 2 separate years. Permanent radar is being worked on by DOLA and CWCB in Blackridge in La Plata County southwest of Nighthorse Reservoir, with a

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm							completion goal of 2021. Project will also benefit Montezuma County.
MC-4*	Goal: 1 Objective : 1.3	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm	**Change, and Implement Planning, Zoning, Ordinances, and Codes to Prevent or Reduce Effects of Natural Disasters.** The county leadership will continue to review ordinances, policy, codes, etc. for areas where government-directed mitigation make sense for the county and are politically acceptable to the residents of Montezuma County.	BOCC, Planning Dept., and Planning Commission	<$10,000	Montezuma County	Low	Short Term	Continue-Not Completed.
MC-5	Goals: 1, 2, 3	Multi-Hazard: Avalanche, Dam/Levee	**Improve sheltering capabilities.** 1. Identify county staff who would not have essential duties during an	OEM, County Social Services, Red Cross	>$100,000	Montezuma County, DOLA, NGOs,	Low	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
	Objectives: 1.4, 1.5, 2.2, 3.4	Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm	emergency to be trained in shelter operations. 2. Work collaboratively with the Red Cross and other organizations such as faith-based NGOs to identify more shelter options both physically and for staffing. 3. Identify prominent shelter locations and pursue grants to equip those facilities with shelters and other necessities such as air conditioning.			Schools, Faith-Based, Private Sector			
MC-6	Goal: 1 Objective: 1.4	Multi-Hazard: Dam/Levee Failure, Drought, Erosion and Deposition, Extreme Heat, Flood, Hail, Lightning, Wind, Tornado, Wildfire, Winter Storm	**Generators for Critical Infrastructure.** Research and design generator installation at several key critical infrastructure locations to include: 1. County Administration and District Court House 2. County Annex 3 (Health Department, Senior Services, District Attorney, Public Transportation, Veteran Services, Emergency Management, County Maintenance) 3. County Annex 2 (Assessor, Treasurer, IT, Clerk) 4. Fairgrounds 5. Road & Bridge Department	OEM, County Administration	>$100,000	Montezuma County, DOLA Grants, Homeland Security Grants	High	Long Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
MC-7	Goal: 1 Objective : 1.2	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm	**Electronic Signs for Highways when Entering County.** Research, procure, and install electronic billboards on main highways which can be used during emergencies to notify citizens and tourist of impending or occurring events.	OEM, County Administration Road & Bridge Dept.	>$100,000	Montezuma County, DOLA Grants, Homeland Security Grants	High	Short Term	Action ongoing toward completion. CDOT signage located east of the county and county fairgrounds. More is needed west of the county
MC-8	Goal: 1 Objective : 1.2	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide,	**Develop MOUs and MOAs Between the County, Municipalities, and Special Districts within the County and the Southwest Region.** Develop MOUs, MOAs and IGAs. Increase awareness, planning, discussions and preparedness with all partners at the table.	OEM, County Administration Road & Bridge Dept.	<$10,000	Montezuma County, DOLA Grants, Homeland Security Grants	Low	Short Term	Action ongoing toward completion. Developed MOUs with SUIT, BLM, IGA with BIA but more are needed. Priority changed from medium to low.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm							
MC-9	Goals: 1, 2 Objectives: 1.1, 1.4, 2.2	Multi-Hazard: Erosion and Deposition, Expansive Soils, Extreme Heat, Flood, Landslide, Mud/Debris Flow, Rockfall, Wildfire	**Wildfire mitigation of McElmo Creek Watershed.** The High Desert Conservation District would work with private landowners to educate and find partners to support funding/grants to do wildfire mitigation within the canyon/watershed. This could include best practices to preserve the beauty of the canyon while thinning the fuels that currently exist.	High Desert Conservation District, FireWise, OEM, Cortez, Fire Protection District	>$100,000	FEMA, USDA, State Forestry and Private Funding	Low	Short Term	Continue-Not Completed.
MC-10	Goals: 1, 2, 3 Objectives: 1.3, 1.4, 1.5, 2.2, 3.1, 3.2, 3.4	Multi-Hazard: Dam/Levee Failure, Earthquake, Extreme Heat, Flood, Hail, Severe Wind, Tornado, Wildfire,	**Improve Access and Egress in Areas of High Risk.** Work with various stakeholders to identify communities that have a larger number of citizens in high risk areas with limited access and egress. Identify/create safer or secondary means of entry/exit.	Road & Bridge Dept., OEM, CDOT, First Responder Agencies within County	>$100,000	Montezuma County, CDOT, Other Agencies and Private Landowners	Medium	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Winter Storm							
MC-11*	Goals: 1, 3 Objectives: 1.3, 1.5, 3.4	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm	**Continue to Improve GIS Mapping Capabilities.** As areas of the county are surveyed for risk/hazard identification, flood mapping changes, etc. incorporate that information/data to the GIS mapping system for the county.	County GIS Dept.	<$10,000	Montezuma County	High	Short Term	Action ongoing toward completion. Ongoing updates. Priority upgraded from medium to high.
MC-12	Goals: 1, 2, 3 Objectives: 1.1, 2.1, 2.2, 3.4	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Expansive	**Continue to Partner with NGOs Which Provide Support Prior to and During Emergencies.** NGOs, such as FireWise and Red Cross, are huge resources that provide services and support for mitigation work as well as support during emergencies. Partnering with, and where feasible supporting them makes sense for the county.	BOCC, OEM	$10,000 to $100,000	Montezuma County, Various Grants	High	Short Term	Action ongoing toward completion. Priority changed from low to high.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Soils, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Wind							
MC-13	Goal: 1 Objective: 1.4	Multi-Hazard: Avalanche, Hail, Winter Storm	**Improve snow removal capabilities.** Research grants to buy additional and more adequately equipped machinery to allow for heavier snow removal.	Road and Bridge Dept.	>$100,000	Montezuma County, Various Grants	High	Short Term	Action Ongoing toward completion. Priority changed from low to high.
MC-14	Goal: 1 Objective: 1.4	Flood and Erosion/ Deposition	**Dolores River Flood Protection/Prevention.** This project would include streambank stabilization along key sections of the Dolores River near residential areas east of the Town of Dolores in the unincorporated County. There are many areas that have eroded during the 2019 flood season. Need more specifics on locations, properties impacted etc. Benefits will include avoid loss of life, prevent property damages.	County, Division of Water Resources/ USACE	>$100,000	CWCB, FEMA, NRCS	High	Short Term	New in 2020.
MC-15	Goal: 3 Objective: 3.2	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood,	**Enhance First Responder Communication.** Currently unable to fully communicate due to gaps in 800 MHz & VHF coverage. This project would identify and build out 2 tower locations in the county to fill in our 800 MHz communication gaps. Possibly in areas along Hwy 145. Benefits include protecting responders.	SWRCC with Public safety in the County & OIT with state	>$100,000	State Leg & DOLA	High	Long Term	New in 2020.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm							
MC-16	Goal: 3 Objective: 3.2, 3.3, 3.4	Hazardous Materials	**Air Disaster.** Review response capabilities of all responders and determine equipment and personnel for such a disaster. How would residents be notified? How would the mental and physical trauma be handled? Is the hospital or coroner able to handle the number of casualties? Are the hazardous materials teams capable of handling chemical, biological and possibly radiological hazards along with the wreckage? Final approach patterns for the airport allow for direct flight paths above populated areas. In the event of an air disaster, mass casualties could possibly occur along with a large amount of damage from the aircraft, chemical contents and biological debris. Multiple federal agencies would be dispatched, but in the meantime, even a small aircraft would challenge the limits of the local first responders due to the physical and mental stresses placed on them.	FAA, airport County, EPA,	<$10,000	FAA, State Grants	Low	Short Term	New in 2020.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
MC-17	Goals: 1, 2 Objectives: 1.1, 1.4, 2.2	Wildfire	Update of the County Community Wildfire Protection Plan. The plan was originally developed in 2005 and last updated in 2011. An updated plan would include prioritized fuels reduction and other wildfire mitigation actions.	OEM, Wildfire Adapted Partnership, FireWise, FAC, Cortez Fire Protection District, Other fire protection districts	$10,000 to $100,000	FEMA, USDA, State Forestry and Private Funding	Medium	Short Term	New in 2020
MC-18	Goals: 1, 2 Objectives: 1.4, 1.6, 2.2	Dam and Levee Failure	Summit Main Dam Rehabilitation Investigation. This action would entail coordination with the Summit Reservoir and Irrigation District, the owner oelf the Summit Main and Summit South dams, to discuss the State Engineer's review and conditional storage limitations to determine appropriate mitigation needed to address the dam safety concerns (refer to discussion in Section 4.4.2).	OEM, County SO, CO DWR – Dam Safety, Summit Reservoir and Irrigation District	<$10,000	FEMA HHPD	Low	Long Term	New in 2020
MC-19	Goals: 1, 2 Objectives: 1.4, 1.6, 2.2	Dam and Levee Failure	Summit South Dam Rehabilitation Investigation. This action would entail coordination with the Summit Reservoir and Irrigation District, the owner of the Summit Main and Summit South dams, to discuss the State Engineer's review and conditional storage limitations to determine appropriate mitigation needed to address the dam safety	OEM, County SO, CO DWR – Dam Safety, Summit Reservoir and Irrigation District	<$10,000	FEMA HHPD	Low	Long Term	New in 2020

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
			concerns (refer to discussion in Section 4.4.2).						
City of Cortez Mitigation Actions									
C-1*	Goal: 1 Objective: 1.3	Multi-Hazard: Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Expansive Soils, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Subsidence, Tornado, Wildfire, Winter Storm	**Construction and Development Standards.** All proposed development will be subject to plan review based on minimum design standards applicable to our area. This would include minimum snow load, seismic zone, flood-prone areas, and high wind potential. Also includes fire and life safety metrics.	Planning and Building	<$10,000	General Fund, Permit and Application Fees	High	Ongoing	Action ongoing toward completion.
C-2	Goal: 1 Objective: 1.4	Lightning	**Lightning Detectors.** Partner with the National Weather Service to implement lightning awareness campaigns during the spring and throughout the monsoon season warning citizens about the	OEM	<$10,000	General Funds	Medium	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
			dangers of outdoor activities during lightning events.						
C-3	Goal: 1 Objective: 1.5	Multi-Hazard: Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Expansive Soils, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Subsidence, Tornado, Wildfire,	**Shelter Emergency Power.** Purchase and install a generator for emergency power at the Recreation Center.	OEM	$10,000 to $100,000	Department of Homeland Security Grants	Medium	Short Term	Continue-Not Completed.
C-4	Goal: 3 Objective: 3.2	Winter Storm	**Snow Removal Policy Update.** Rewrite the city's snow removal policy to identify key routes for first clearance and identify location for storage of excess snow.	Public Works	<$10,000	General Funds	High	Short Term	Continue-Not Completed.
C-5	Goal: 1 Objective: 1.4	Drought	**Upgrade water meters.** Replace older water meter with ARM meters for quicker, more accurate reading.	Public Works	>$100,000	HMA Grants	Low	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
C-6	Goal: 1 Objective: 1.4	Drought	**Water Sensors in the Parks.** The city will be adding water sensors in the park to determine if there is a need to water the grass on a specific day.	Parks and Recreation	$10,000 to $100,000	HMA Grants	Low	Short Term	Continue-Not Completed.
C-7	Goal: 1 Objective: 1.4	Wildfire	**Wildfire Mitigation.** The City of Cortez has over 358 acres of open space areas that are in need of fire mitigation. These areas include pinion, juniper and sage brush that would jeopardize many homes if these areas were to catch fire. The areas in questions are spread throughout the City and would be tackled one area at a time. The City would need to hire contactors to complete the work. Benefits include: Reduce potential damage to the community and ecosystems for the area that could be threaten by wildland fires due to dead trees, trash, etc.	City of Cortez/Cortez Fire Department	$150,000	HMA Grants	High	Short Term	New in 2020.
Town of Dolores Mitigation Actions									
D-1	Goals: 1, 3 Objectives: 1.2, 1.4, 1.5, 3.2	Multi-Hazard; Dam/Levee Failure, Flood, Landslide, Mud/Debris Flow, Rockfall, Wind	**Install a Remote Flow Meter at the West Fork of the Dolores River.** Install a hard wired flow meter that would signal the assigned personnel to begin the response event for flood stage water ahead of downstream flooding.	OEM, Town of Dolores	<$10,000	Collaborated Spending with Other Agencies	Low	Short Term	Continue-Not Completed.
D-2*	Goals: 1, 2, 3	Multi-Hazard:	**Update Building Code Ordinances as Needed.** Review current ordinances and	Town Administration	<$10,000	Budget	High	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
	Objectives: 1.3, 2.1, 3.1	Dam/Levee Failure, Earthquake, Erosion and Deposition, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wildfire, Winter Storm	codes, adopt best practices, and include mitigation as a factor when considering new codes and ordinances.	Town Board of Trustees					
D-3*	Goal: 1 Objective: 1.3	Multi-Hazard: Flood, Dam/Levee Failure, Erosion and Deposition	**Flood Damage Prevention Ordinances.** Adopt codes through town ordinance.	Town Administration	<$10,000	Budget	Medium	Ongoing	Continue-Not Complete. In process as part of 2020 LUC update.
D-4	Goals: 1, 3 Objectives: 1.4, 3.1, 3.4	Multi-Hazard: Avalanche, Dam/Levee Failure, Earthquake, Erosion and Deposition, Flood, Hail, Lightning, Wind, Wildfire,	**Bury Electric Supply Lines Feeding Dolores.** Form partnerships with Empire Electric to bury existing power line system to prevent damage from natural disasters.	Town of Dolores	>$100,000	FEMA and Other Grants	Medium	Long Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Winter Storm							
D-5	Goal: 1 Objective: 1.4	Multi-Hazard: Earthquake, Extreme Heat, Lightning, Wind, Wildfire, Winter Storm	**Generators for Critical Infrastructure.** Research and design generator installation at several key critical infrastructure locations to include: Town Hall, Community Center, and Water and Sewer Treatment Facilities	Town Administration	>$100,000	Town Funds	Medium	Long Term	Continue-Not Completed.
D-6	Goals: 1, 2, 3 Objectives: 1.1, 2.1, 2.2, 2.3, 3.4	Multi-Hazard: Avalanche, Dam/Levee Failure, Drought, Earthquake, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Wildfire, Winter Storm	**Emergency Preparedness Information Campaign.** Develop an emergency preparedness campaign that could include handouts, brochures, community meetings, social media, newspapers, radio, etc. that would keep the public, businesses, and tourists informed of best practices on being personally prepared during disasters.	County OEM, Town of Dolores	>$100,000	DOLA Grants	High	Long Term	Continue-Not Completed.
D-7	Goals: 1, 3 Objective	Multi-Hazard:	**Town Evacuation Plan.** As part of the Town EOP develop a Town Evacuation Plan that could be implemented quickly	Town of Dolores, County OEM, County	<$10,000	Homeland Security Grants	High	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
	s: 1.5, 3.2, 3.4	Avalanche, Dam/Levee Failure, Drought, Earthquake, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Wildfire, Winter Storm	and controls the flow of people out of town.	Sheriff's Office, Dolores Fire Protection District					
D-8	Goal: 1 Objectives: 1.4	Rockslide	**Rockslide Mitigation.** Identify and properly remove hazard rocks on the slope on the north side of Dolores from west town limits to mile post 1.1 on County Road 31.	County, Town of Dolores, CDOT (Engineer Experts)	$10,000 to $100,000	DOLA, CO DHSEM, CDOT, other State and Federal Funding	High	Short Term	New in 2020.
D-9*	Goal: 1 Objectives: 1.3	Multi-Hazard: Rockfall, Fire, Flooding	**Land Use Code Update.** The Town is in process of updating the Land Use Code and in the section on hazards specifically will be updated. The town already participates in the National Flood Insurance Program and will be reviewing and searching for any new information that FEMA may have. The Rockfall section requires a significant upgrade as does the Wildfire section. The town does need advice on best practices for the Hazards section.	Town of Dolores	$10,000 to $100,000	Staff Time	High	Short Term	New in 2020.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
D-10	Goals: 1, 2 and 3 Objectives: 1.1, 2.2, 3.4	Wildfire	**Partner with Wildfire/Dolores Watershed Resilient Forest Collaborative.** The Dolores Watershed Resilient Forest Collaborative (DWRF)is a not for profit organization whose mission is to Promote forest, community, and watershed resilience through collaboration. The DWRF has developed wildfire risk assessments of every property in Dolores. The project would help property owners implement the assessment recommendations. Funding is needed for the mitigation.	Town of Dolores	>$10,000	Staff Time HMA Grants, CSFS Grants	High	Short Term	New in 2020.
Town of Mancos Mitigation Actions									
M-1*	Goal: 1 Objective: 1.4	Multi-Hazard: Dam/Levee Failure, Flood	**Purchase flood-prone property.** Identify and purchase properties in flood zones; purchase properties to prevent future construction.	Administration	>$100,000	HMA Grants	Low	Long Term	Continue-Not Completed
M-2	Goal: 1 Objective: 1.1	Dam/Levee Failure	**Public education on dam failure.** Implement public education campaign to general public, and those residents in potential path.	Marshal's Office, Building and Zoning, Administration	$10,000 to $100,000	Staff Time	Medium	Short Term	Continue-Not Completed
M-3	Goal: 1 Objective: 1.4	Dam/Levee Failure	**Increase dam inspections and fortification.** Work with regulatory agencies for water district to increase dam safety, inspections and fortification.	Jackson Reservoir District	$10,000 to $100,000	Staff Time	Medium	Short Term	Continue-Not Completed.
M-4	Goal: 1 Objective: 1.1	Drought	**Institute water saving incentives.** Public education to ensure residents have information to participate. Create programs.	Administration	<$10,000	Town Funds	High	Short Term	Action ongoing toward completion. Currently adopting water wasting restrictions, have

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
									lowered base gallons allowed and increased base water and overage rates to encourage conservation. Priority changed from medium to high.
M-5	Goal: 1 Objective : 1.3	Flood	**Create and implement storm drainage plan.** Work with engineer to create plan and seek funding to implement.	Public Works/ Admin	$10,000 to $100,000	Grants/Town Funds	High	Short Term	Action ongoing toward completion. The storm drain master plan included in 2020 CIP budget. Now postponed until 2021 or 2022 due to COVID-19 pandemic. Priority changed from medium to high.
M-6	Goal: 1 Objective : 1.1	Hail	**Reduce Impacts of Hail Damage Through Public Education.** Public information campaign to property owners on weather concerns.	Administration	<$10,000	Town Funds	Low	Ongoing	Action ongoing toward completion.
M-7	Goals: 1, 3 Objective : 1.2, 3.4	Hail	**Collaborate with National Weather Service to Improve Early Warnings.** Online, print, and telephone systems. Announcements and warnings to public.	Town/NWS	<$10,000	Town Funds	High	Ongoing	Action ongoing toward completion.
M-8*	Goal: 1 Objective : 1.3	Hail	**Review building regulations to harden against hail damage**. Using consultant, review building codes to harden facilities (e.g., roof) against hail damage.	Building and Zoning	<$10,000	Town Funds	Low	Short Term	Continue-Not Completed.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
M-9*	Goals: 1, 2 Objective: 1.3, 2.1	Wildfire	**Reduce wildfire damage by implementing fire codes.** Board to adopt fire code in risky areas.	Building and Zoning	<$10,000	Staff Time	Low	Short Term	Continue-Not Completed.
M-10*	Goal: 1 Objective: 1.4	Wildfire	**Create defensible spaces around properties.** Provide incentives for property owners to create defensible space around properties.	Administration Fire Dept	$10,000 to $100,000	Town Funds/Staff Time	High	Ongoing	Action ongoing toward completion.
M-11	Goals: 1, 3 Objective: 1.2, 3.1, 3.2, 3.3, 3.4	Wildfire	**Increase early warning system capability.** Collaborate across agencies and increase system capacity.	Administration Fire Dept.	<$10,000	Staff Time	High	Short Term	Action ongoing toward completion. Utilizes Nixle and Facebook.
M-12	Goal: 1 Objective: 1.1	Multi-Hazard: Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire,	**Provide Public Education on Preparedness.** Public information campaign on personal preparedness and shelter-in-place.	Administration and Marshal's Office	<$10,000	Town Funds	High	Ongoing	Action ongoing toward completion. Utilize Facebook and public outreach related to natural hazards dependent on season

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
		Winter Storm							
M-13*	Goal: 1 Objective: 1.3	Winter Storm	**Reduce Impacts of Winter Storm by Review of Codes.** Review snow loads, roofing materials, etc.	Building and Zoning	<$10,000	Town Funds	Low	Short Term	Action ongoing toward completion. Updated LUC and working to adopt current building regulations
M-14*	Goal 1 Objective: 1.3	Multi-Hazard: Dam/Levee Failure, Drought, Earthquake, Erosion and Deposition, Extreme Heat, Flood, Hail, Landslide, Mud/Debris Flow, Rockfall, Lightning, Wind, Tornado, Wildfire, Winter Storm	**Incorporate Hazard Mitigation Plan into Comprehensive Plan Update.** Adopt HMP by reference in the Manco's Town Comprehensive Plan review and update. The Town's current Comprehensive Plan was adopted in 2011. While the 2011 Plan acknowledges flood, geologic and wildfire hazards it does not integrate the risk information into Plan. The Town will consider the risk assessment results and vulnerability analysis from the 2020 plan and will incorporate findings into the Town's Comprehensive Plan Update to help lessen the impacts of certain hazards through policies and principles put forth in the Comprehensive Plan Update.	Building and Zoning, Administration	<$10,000	Town Funds	Medium	Short Term	New in 2020.
Cortez Fire Protection District									

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
CFPD -1	Goal 1 Objective : 1.1	Wildfire	**Public Education.** Provide education to our community on the best way to help your local fire district. Keep it clean, Keep it trim. Remove un-necessary combustibles from around your property. Keep all grass and brush fuels cut and cleared. Social media, flyers, handouts, banners, sign boards. Benefits include engaging the community with helping reduce the severity of fire. Less fires or fewer big fires means less risk to the community.	Cortez Fire District, Montezuma County, City of Cortez, Private property owners,	$100,000	Donations, DOLA, State, Federal grants	Medium	Long Term	New in 2020.
CFPD -2	Goal 3 Objective :3.4	Wildfire	**Property Addressing.** Provide address signs for every property in the fire district: private or public. Benefits include Reduce delays in response. Reduce Risk, as well as assisting in Recovery.	Cortez Fire District, Montezuma County, City of Cortez, Private property owners,	$250,000	Donations, grants, DOLA	Medium	Short Term	New in 2020.
CFPD -3	Goal 1 Objective : 1.4	Wildfire	**Fuels Mitigation.** Reduce the grass, brush, pinon, juniper and other natural fuels density in private property lands that directly pose a threat to public lands. Benefits include: Reducing the fuel load is the first step in wildfire mitigation. Reduced fuels will provide for a healthier woodland and forest.	Private property owners, Montezuma County, BLM, Ute Mtn Ute Reservation, Mesa Verde National Park, City of Cortez, Cortez Fire District	Overall cost initial est. 1 million dollars for the first four(4) years	DOLA, Energy Impact funds, Grants for wildfire mitigation	High	Long Term	New in 2020.
CFPD -4	Goal 1 Objective : 1.4	Wildfire	**Medium/ Large capacity water storage systems.** Large capacity above/underground water storage systems in rural non-hydrated areas.	Cortez Fire District, County, Private property owners	$250,000	DOLA, State, Energy impact grants	Medium	Long Term	New in 2020.

ID	Related Goal(s)	Hazard(s) Mitigated	Action Title and Description	Lead Agency and Partners	Cost Estimate	Potential Funding	Priority	Timeline*	Status/ Implementation Notes
			Establish MOU's with land owners for water storage systems on private property. Obtain grants to develop storage systems						

*Timeline: Short Term – To be completed in 1 to 5 years, Long Term – To be completed in greater than 5 years, Ongoing – Currently being funded and implemented under existing programs

6 Plan Adoption, Implementation, and Maintenance

6.1 Plan 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 Montezuma County 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 E: Plan Adoptions and Approval.

6.2 Plan Implementation

DMA Requirement §201.6(c)(4)(ii):

[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, the participating jurisdictions 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 mitigation action in Table 5-2 in Section 5 Mitigation Strategy, and through pervasive efforts to network and highlight the multi-objective, win-win benefits of each project to the Montezuma County community and its stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits to each program and the Montezuma County community and its stakeholders. This effort is achieved through the routine actions of monitoring agendas, attending 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.

Simultaneously 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, should grants be pursued. When funding becomes available, the participating jurisdiction's will be in a position to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, special district budgeted funds, state and federal earmarked funds, and other grant

programs, including those that can serve or support multi-objective applications. The Montezuma County Office of Emergency Management will have lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all planning partnership members and agencies identified as lead agencies in the mitigation action plans.

6.2.1 Role of the Hazard Mitigation Committee in Implementation and Maintenance

With adoption of this plan, Montezuma County, City of Cortez, Town of Dolores, Town of Mancos and the Cortez Fire Protection District will be tasked with plan implementation and maintenance. The participating jurisdictions, led by the Montezuma County Emergency Manager, agree to:

- 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;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Maintain a 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 the Board of County Commissioners, municipal councils, and other partners; and
- Inform and solicit input from the public.

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 the County and Town website and in the local newspaper.

6.3 Plan Maintenance/Monitoring Strategy

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 required or as progress, roadblocks, or changing circumstances are recognized. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

6.3.1 Maintenance/Monitoring Schedule

In order to track progress and update the mitigation strategies identified in the action plan, the HMPC will revisit this plan at the following times or occurrences:

- Annually, to assess if projects have been completed;
- Following a significant hazard event;
- Following a disaster declaration;
- Any other time the HMPC sees it is prudent or necessary.

County emergency management will facilitate these reviews.

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. Efforts to begin the update should begin no later than June 2024. The County will monitor planning grant opportunities from the Colorado Division of Homeland Security and Emergency Management (DHSEM) and FEMA for funds to assist with the update. This may include submitting a Pre- Disaster Mitigation planning grant application. This grant should be submitted in 2023, as there is a three-year performance period to expend the funds, and there is no guarantee that the grant will be awarded when initially submitted. This allows time to resubmit the grant in subsequent years, if needed. Updates to this plan will follow the most current FEMA and DHSEM planning guidance. The next plan update should be completed and reapproved by DHSEM and FEMA Region VIII by January 2025. The HMPC members and those entities identified in Appendix A, will be reconvened for this process by Montezuma County Emergency Management.

6.3.2 Hazard Mitigation Planning Committee

The HMPC is a total volunteer body that oversaw the development of the plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the HMPC's position that an implementation committee with representation similar to the initial HMPC should have an active role in the plan maintenance strategy. Therefore, it is recommended that the HMPC remain a viable body involved in key elements of the plan maintenance strategy. The HMPC should strive to include representation from the planning partners, as well as other stakeholders in the planning area.

The principal role of the new implementation committee in this plan maintenance strategy will be to review the annual progress report and provide input to the Montezuma County Emergency Manager on possible enhancements to be considered at the next update. Future plan updates will be overseen by a HMPC similar to the one that participated in this plan development process, so keeping an interim HMPC intact will provide a head start on future updates. Completion of the progress report is the responsibility of each planning partner, not the responsibility of the HMPC. It will simply be the HMPC's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

6.3.3 Maintenance Evaluation Process

The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to evaluate whether the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation

The planning team has created a template to guide the planning partners in preparing a progress report (see Appendix F). The HMPC will provide feedback to their respective local government leadership on items included in the template. The HMPC will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Montezuma County Office of Emergency Management website page dedicated to the hazard mitigation plan
- Provided to the local media through a press release

- Presented to planning partner governing bodies to inform them of the progress of initiatives implemented during the reporting period

Updates to this plan will:

- Consider changes in vulnerability due to project implementation,
- A comprehensive review of plan goals and objectives
- 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,
- Document hazard events and impacts that occurred within the five-year period,
- Incorporate new data or studies on hazards and risks,
- Incorporate new capabilities or changes in capabilities,
- Document continued public involvement
- Document changes to the planning process, which may include new or additional stakeholder involvement
- Incorporate growth and development-related changes to building inventories,
- Incorporate new project recommendations or changes in project prioritization,
- Include a public involvement process to receive public comment on the updated plan prior to submitting the updated plan to DHSEM/FEMA, and
- Include re-adoption by all participating entities following DHSEM/FEMA approval.

The 2016 maintenance evaluation process was not followed during the annual review but during the 2020 Plan Update the templates for annual status meetings/mitigation action status created in 2016 were useful in gaining information on the status of 2016 actions.

6.3.4 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Montezuma County Office of Emergency Management's website and by providing copies of annual progress reports to the media. The Montezuma County Office of Emergency Management will maintain the hazard mitigation plan website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Copies of the plan will be distributed to the public library system in Montezuma County Library. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Steering Committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

6.3.5 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Montezuma County Comprehensive Land Use Plan and the comprehensive plans of the partner cities/towns are considered to be integral parts of this plan. The county and partner municipalities, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided the county and the cities/towns with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual comprehensive plans. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans

Specific opportunities for integration include:

- Update of the Town of Dolores Land Use Code in 2020 (see mitigation action D-9)
- Update of the Montezuma County Community Wildfire Protection Plan (see mitigation action C-16)
- Update of the City of Cortez Comprehensive Plan in 2020-2021
- Update of the Town of Mancos Comprehensive Plan in 2021 (see mitigation action M-14)
- Risk information will be used to inform Public Education efforts from the Cortez Fire Protection District. (see mitigation action CFPD-1)

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms the HMPC will be responsible for integrating the findings and recommendations of this plan with these other plans, as appropriate. The mitigation plan can be considered as a "hub on the wheel" with spokes radiating out to other related planning mechanisms that will build from the information and recommendations contained herein. that can enhance this plan, that information will be incorporated via the update process.

Appendix A: Acronyms and Definitions

APPENDIX A: ACRONYMS AND DEFINITIONS

ACRONYMS

%g	Percentage of gravity
°C	Degrees Celsius
°F	Degrees Fahrenheit
ACOE	Army Corps of Engineers
ACS	American Community Survey
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOCC	Board of County Commissioners
BRIC	Building Resilient Infrastructure and Communities
CAIC	Colorado Avalanche Information Center
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CFPD	Cortez Fire Protection District
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CGS	Colorado Geological Survey
COVID-19	Coronavirus Disease 2019
CO-WRAP	Colorado Wildfire Risk Assessment Program
CRS	Community Rating System
CSAS	Center for Snow and Avalanche Studies
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWPP	Community Wildfire Protection Plan
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Maps
DHSEM	Department of Homeland Security and Emergency Management
DMA	Disaster Mitigation Act
DOLA	Department of Local Affairs
DWR	Colorado Division of Water Resources

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DWRF	Dolores Watershed Resilient Forest
EAP	Emergency Action Plan
EF	Enhanced Fujita
EMPG	Emergency Management Performance Grant
EOP	Emergency Operations Plan
EPA	U.S. Environmental Protection Agency
EPR	Health Department Emergency Preparedness and Response
ESA	Endangered Species Act
ESF	Emergency Support Function
FAA	Federal Aviation Administration
FACO	Fire Adapted Colorado
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flooding Mitigation Assistance
FoCAIC	Friends of the Colorado Avalanche Information Center
GIS	Geographic Information System
GPS	Global Position System
HAZMAT	Hazardous Materials
Hazus-MH	Hazards, United States-Multi Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPC	Hazard Mitigation Planning Committee
HIRA	Hazard Identification and Risk Assessment
IBC	International Building Code
ICC	International Code Council
LAL	Lightning Activity Level
LPR	Local Plans and Regulations

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LUC	Land Use Code
ML	Local Magnitude Scale
MM	Modified Mercalli Scale
Mph	Miles per Hour
M_W	Moment Magnitude
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NEHRP	National Earthquake Hazards Reduction Program
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NICB	National Insurance Crime Bureau
NID	National Inventory of Dams
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NREL	National Renewable Energy Laboratory
NRP	Natural Resource Protection
NSSA	National Storm Shelter Association
NWS	National Weather Service
OEM	Office of Emergency Management
OTA	Congressional Office of Technology Assessment
PDI	Palmer Drought Index
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
PHDI	Palmer Hydrological Drought Index
PIO	Public Information Officer
SBA	Small Business Administration
SFHA	Special Flood Hazard Area
SIP	Structure and Infrastructure Project

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SPI	Standardized Precipitation Index
SWCCOG	Southwest Colorado Council of Governments
SWE	Snow-water equivalent
SWRCC	Southwest Regional Communication Center
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WRCC	Western Regional Climate Center
WUI	Wildland Urban Interface

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1% annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the NFIP are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit/cost analysis of proposed

mitigation measures, benefits are limited to specific, measurable risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

Legal and regulatory capability

Administrative and technical capability

Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic or water reactive materials.

Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.

Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events.

Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.

Government facilities.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65%.

Disaster Mitigation Act of 2000 (DMA): The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

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Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's FIRM. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A FIRM identifies most, but not necessarily all, of a community's floodplain as the SFHA.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1% chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour [mph]) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes, and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Initiatives (or Mitigation Actions): Mitigation initiatives are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal.

APPENDIX A: ACRONYMS AND DEFINITIONS

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

Four or more paid flood losses in excess of $1000.00; or

Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or

Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a FIRM. The SFHA is mapped as a Zone A in riverine situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams, and drains where banks have been eroded, sloughed, or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds.

On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: Wildfire refers to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B: REFERENCES

APPENDIX B: REFERENCES

Ahrens, Marty. Lighting Fires and Lighting Strikes. 2013. National Fire Prevention Association Fire Analysis and Research Division.

American Community Survey Statistics for Summit County. 2014-2018. U.S. Census Bureau. 2020.

Atkins, Dale. A History of Colorado Avalanche Accidents, 1859–2006. International Snow Science Workshop 2006 Proceedings. 2006.

City of Cortez Comprehensive Plan, August 5, 2008.

Colorado Dust-On-Snow Program. Center for Snow and Avalanche Studies (CSAS). 2019.

Colorado Avalanche Information Center (CAIC). 2020.

Colorado State Demography Office. Department of Local Affairs. https://demography.dola.colorado.gov/

Colorado Department of Labor and Employment. https://www.colorado.gov/cdle

Colorado Department of Natural Resources, Division of Reclamation, Mining, and Safety, Inactive Mine Reclamation Program. https://mining.state.co.us/Programs/Abandoned/Pages/impwelcomepage.aspx

Colorado Division of Homeland Security & Emergency Management. http://www.coemergency.com/.

Colorado Earthquake Information. Colorado Geological Survey. 2020. http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/

Colorado Geological Survey. http://coloradogeologicalsurvey.org/

Colorado State Hazard Mitigation Plan. 2018.

Colorado Wildfire Risk Assessment Portal (CO-WRAP). Colorado State Forest Service. 2020. https://csfs.colostate.edu/wildfire-mitigation/cowrap/

Community Rating System (CRS). Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP). https://www.fema.gov/national-flood-insurance-program-community-rating-system

Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies. Federal Emergency Management Agency. FEMA 386-3. 2003. https://www.fema.gov/media-library/assets/documents/4267

Directory of Colorado State Register Listed Properties. Colorado Historical Society Office of Archeology and Historical Preservation. https://www.historycolorado.org/national-state-register-listed-properties

Drought Impact Reporter. National Drought Mitigation Center. http://droughtreporter.unl.edu/

Farm Service Agency. U.S. Department of Agriculture. 2020.

Federal Disaster Declarations. FEMA. 2020. https://www.fema.gov/disasters

FEMA Data Visualization: Disaster Declarations for States and Counties. FEMA. 2020. https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

FEMA Community Lifelines Information Sheet – National Response Framework (Fourth Edition). U.S. Department of Homeland Security. 2020. https://www.fema.gov/media-library-data/1544469177002-251a503b3717f0d6d483bae6169f4106/Revised_Community_Lifelines_Information_Sheet.pdf

Flood Insurance Study: Montezuma County, Colorado and Incorporated Areas. Federal Emergency Management Agency (FEMA). September 26, 2008.

GeoMAC Wildland Fire Support – Geospatial Multi-Agency Coordination Database. U.S. Geological Survey. 2020. https://www.geomac.gov/

Getting Started: Building Support for Mitigation Planning. Federal Emergency Management Agency. FEMA 386-1. 2002.

Hazard Mitigation Planning and Hazard Mitigation Grant Program. Federal Register. Interim Final Rule. February 26, 2002.

Hazard Mitigation Grant Program. 2019. FEMA. December 17, 2019. https://www.fema.gov/hazard-mitigation-grant-program

Hazus 4.2. Federal Emergency Management Agency (FEMA). https://www.fema.gov/hazus

Historic American Engineering Record. National Park Service. www.nps.gov/history/hdp/haer/.

Mancos Comprehensive Plan. Town of Mancos, November 16, 2011.

Meldrum, James, Hannah Brenkert-Smith, Pamela Wilson, Patricia Champ, Christopher Barth, and Angela Boag. "Living with Wildfire in Montezuma County: 2015 Data Report." United States Department of Agriculture Forest Service, March 2019.

Mimiaga, Jim. "Cortez Breaks Five Heat Records; Durango Ties Four." The Journal, September 6, 2019. https://the-journal.com/articles/151316.

Montezuma County, Colorado Community Wildfire Protection Plan." Montezuma County, 2011.

Montezuma County Comprehensive Plan. Montezuma County, January 6, 1997.

Multi-Hazard Mitigation Planning Guidance under the Disaster Mitigation Act of 2000. Federal Emergency Management Agency.

Multi-Jurisdictional Mitigation Planning. Federal Emergency Management Agency. FEMA 386-8. 2006.

National Environmental Policy Act and/or the National Historic Preservation Act Review – Grants. National Endowment for the Arts. 2018. Accessed December 2019 from view-source:https://www.arts.gov/grants-organizations/nepa-nhpa-review

National Flood Insurance Program (NFIP). Federal Emergency Management Agency (FEMA). http://www.fema.gov/national-flood-insurance-program.

National Interagency Fire Center. Lighting Fires. 2018. https://www.nifc.gov/fireInfo/fireInfo_stats_lightng-human.html

National Register of Historic Places. National Park Service. https://www.nps.gov/subjects/nationalregister/index.htm.

National Weather Service Lightning Safety. https://www.weather.gov/safety/lightning.

National Weather Service. Beaufort Wind Scale. https://www.spc.noaa.gov/faq/tornado/beaufort.html

Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. National Institute of Building Science Multi-Hazard Mitigation Council. 2005. www.nibs.org/MMC/mmcactiv5.html.

Purtell, Joe. "Acres of Destruction Left by Colorado's Historic Avalanche Season Are Also Delivering Climate Change Evidence." The Colorado Sun, July 15, 2019. https://coloradosun.com/2019/07/15/climate-research-avalanche-tree-rings/.

Robert T. Stafford Disaster Relief and Emergency Act. Public Law 93-288, as amended, 42 U.S.C. 5121-5207. June 2007.

State of Colorado Drought Mitigation and Response Plan. 2018.

State of Colorado Natural Hazards Mitigation Plan. Colorado Division of Emergency Management. 2011.

Storm Events Database. National Centers for Environmental Information (NCEI). National Oceanic and Atmospheric Administration (NOAA). 2020. https://www.ncdc.noaa.gov/stormevents/

Thompson, Andrea. Lighting May Increase with Global Warming. November 13, 2014. Scientific American. https://www.scientificamerican.com/article/lightning-may-increase-with-global-warming/

Threatened and Endangered List. Colorado Parks and Wildlife. 2020. https://www.fws.gov/endangered/.

Town of Dolores Comprehensive Plan. Town of Dolores, September 8, 1997.

Understanding Your Risks: Identifying Hazards and Estimating Losses. Federal Emergency Management Agency. FEMA 386-2. 2001.

Ute Mountain Ute Tribal Mitigation Plan, February 2019.

USACE National Inventory of Dams. 2019.

U.S. Drought Monitor Archives. University of Nebraska-Lincoln.

U.S. Geological Survey. http://www.usgs.gov/.

USGS. "StreamStats." USGS StreamStats, n.d. https://streamstats.usgs.gov/ss/.

U.S. Seasonal Drought Outlook. National Weather Service Climate Prediction Service.

Western Regional Climate Center. www.wrcc.dri.edu/.

APPENDIX D: MITIGATION ALTERNATIVES AND PRIORITIZATION

Example Mitigation Action Items

Alternative Mitigation Actions	Dam Incident	Floods	Human Hazards: Pandemic Flu; Transportation Accident. Terrorism	Avalanches; Landslide/ Debris Flow/ Rockfall; Erosion; Expansive soils; subsidence	Weather Extremes: (drought, hail, lightning, wind and tornado, temps)	Earthquakes	Wildfire	Severe Winter Storm
PLANS and REGULATIONS								
Building codes and enforcement		■		■	■	■	■	■
Comprehensive Watershed Tax		■						
Density controls	■	■		■			■	
Design review standards		■		■		■	■	
Easements		■		■			■	
Environmental review standards		■		■		■	■	
Floodplain development regulations	■	■						
Hazard mapping	■	■		■			■	
Fluvial Hazard Zone mapping and regulations		■		■				
Floodplain zoning	■	■						
Forest fire fuel reduction							■	
Housing/landlord codes					■			
Slide-prone area/grading/hillside development regulations				■			■	
Manufactured home guidelines/regulations		■			■	■		
Multi-Jurisdiction Cooperation within watershed	■	■						
Open burning regulations							■	
Open space preservation	■	■		■			■	
Performance standards	■	■		■	■	■	■	■
Special use permits	■	■		■			■	
Stormwater management regulations		■						

Alternative Mitigation Actions	Dam Incident	Floods	Human Hazards: Pandemic Flu; Transportation Accident. Terrorism	Avalanches; Landslide/ Debris Flow/ Rockfall; Erosion; Expansive soils; subsidence	Weather Extremes: (drought, hail, lightning, wind and tornado, temps)	Earthquakes	Wildfire	Severe Winter Storm
Subdivision and development regulations	■	■		■		■	■	
Surge protectors and lightning protection					■			
Tree Management					■		■	■
Transfer of development rights		■		■			■	
Utility location		■		■	■		■	■
STRUCTURE AND INFRASTRUCTRE PROJECTS								
Acquisition of hazard prone structures	■	■		■			■	
Facility inspections/reporting	■	■				■		
Construction of barriers around structures	■	■	■					
Elevation of structures	■	■						
Relocation out of hazard areas	■	■	■	■			■	
Structural retrofits (e.g., reinforcement, floodproofing, bracing, etc.)		■		■	■	■	■	■
Channel maintenance		■		■				
Dams/reservoirs (including maintenance)	■	■						
Levees and floodwalls (including maintenance)		■						
Safe room/shelter					■	■		■
Secondary containment system								
Site reclamation/restoration/revegetation		■		■				
Snow fences								■
Water supply augmentation					■			
Debris Control		■		■				
Defensible Space							■	
Stream stabilization		■		■				
EDUCATION AND AWARENESS								
Flood Insurance	■	■						

Alternative Mitigation Actions	Dam Incident	Floods	Human Hazards: Pandemic Flu; Transportation Accident. Terrorism	Avalanches; Landslide/ Debris Flow/ Rockfall; Erosion; Expansive soils; subsidence	Weather Extremes: (drought, hail, lightning, wind and tornado, temps)	Earthquakes	Wildfire	Severe Winter Storm
Hazard information centers	■	■	■	■	■	■	■	■
Public education and outreach programs	■	■	■	■	■	■	■	■
Real estate disclosure	■	■		■	■	■	■	■
Crop Insurance					■	■		
Lightning detectors in public areas					■			
NATURAL SYSTEMS PROTECTION								
Best Management Practices (BMPs)		■		■	■		■	
Forest and vegetation management	■	■		■	■		■	■
Hydrological Monitoring	■	■		■	■			
Sediment and erosion control regulations	■	■		■				
Stream corridor restoration		■		■				
Stream dumping regulations		■						
Urban forestry and landscape management		■		■	■		■	■
Wetlands development regulations		■		■			■	
EMERGENCY SERVICES								
Critical facilities protection	■	■	■	■	■	■	■	■
Emergency response services	■	■	■	■	■	■	■	■
Facility employee safety training programs	■	■	■	■	■	■	■	■
Hazard threat recognition	■	■	■	■	■	■	■	■
Hazard warning systems (community sirens, NOAA weather radio)	■	■	■	■	■	■	■	■
Health and safety maintenance	■	■	■	■	■	■	■	■
Post-disaster mitigation	■	■		■	■	■	■	■
Evacuation planning	■	■	■	■			■	