Northeast Colorado Regional Hazard Mitigation Plan

Northeast Colorado Emergency Managers

December 2014

Cheyenne County
Kit Carson County
Lincoln County
Logan County
Morgan County
Phillips County
Sedgwick County
Washington County
Yuma County

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December 2014

(Updated from previously revised version approved December 2009)

Northeast Colorado Emergency Managers

NCEM

Developed by the **NCEM Planning Team**
Representing the counties of **Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington and Yuma**
With professional planning assistance from
Robert L. Wold Jr.,
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EXECUTIVE SUMMARY

This plan provides local officials with a tool to guide policies and actions that can be implemented to reduce risk and future losses from natural hazards. The original 2004 plan and subsequent updates (2009, 2014) were prepared through a partnership of member counties of the Northeast Colorado Emergency Managers (NCEM). As a result of these collaborative efforts, numerous preparedness and mitigation projects have been completed, resulting in improved public safety and greater awareness of protective measures that can be taken by individuals, families, schools, businesses and local governments. Formal approval of this plan by the Federal Emergency Management Agency (FEMA) also assures that participating jurisdictions will remain eligible for federal grant funding under FEMA's Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) program. Participation in the multi-hazard mitigation planning process also allows jurisdictions to earn planning credits for the National Flood Insurance Program's Community Rating System (CRS).

The counties of ***Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington and Yuma*** and their partners participated in the 2014 update of this document. The mitigation actions identified in this updated plan are based on an assessment of hazards and risks -- county-by-county and region-wide -- and the participation of a wide range of stakeholders and the public in the planning process. The planning process followed a methodology prescribed by FEMA, consisting of two levels of planning effort: (1) the **NCEM Planning Team**, comprised of the nine County Emergency Managers and responsible for coordinating and approving updates to the regional base plan, and (2) **County Planning Subcommittees**, comprised of "FEMA-eligible" applicants (governmental and private, nonprofit entities), stakeholders and partners within each county and responsible for updating County Planning Elements.

The planning process examined the recorded history of losses resulting from natural hazards, and analyzed the future risks posed to each county by these hazards. The largest disasters, in terms of one-time losses, were the 2013 flood that caused widespread impacts to people, infrastructure and property (Lincoln, Logan, Morgan, Sedgwick and Washington Counties), the 1997 flood that primarily impacted Sterling and Atwood (Logan County), and the 1990 tornado that devastated the downtown business district in Limon (Lincoln County). Impacts to agriculture account for the greatest losses from hazards across the entire planning area, with more than a half-billion dollars in insured losses over the six-year period 2008-2013. The prolonged drought across the planning region has not only resulted in impacts to crop and livestock production, but has also led to an increase in the number of wildfires, dust storms, tumbleweeds, and insect infestations.

The resulting mitigation strategy is based on overarching regional goals and objectives for the entire planning area and county-specific goals and objectives that are supported by recommendations for mitigation, based on the risk assessment, that are designed to reduce future losses. The 2014 update of this plan further demonstrates the region's commitment to reducing risks from hazards.

CHAPTER 1 INTRODUCTION

1.1 Purpose

The purpose of the Northeast Colorado Regional Hazard Mitigation Plan is to protect people and property in northeastern Colorado from the effects of natural and hazards by identifying and implementing measures for reducing and eliminating losses from hazard events. This plan provides local officials with a tool to guide policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. Formal approval of this plan by the Federal Emergency Management Agency (FEMA) also assures that participating jurisdictions will remain eligible for federal grant funding under FEMA's Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) program. Participation in the multi-hazard mitigation planning process also allows jurisdictions to earn planning credits for the National Flood Insurance Program's Community Rating System (CRS).

The original 2004 plan and subsequent updates (2009, 2014) were prepared through a partnership of member counties of the Northeast Colorado Emergency Managers (NCEM). As a result of these collaborative efforts, numerous preparedness and mitigation projects have been completed, resulting in improved public safety and greater awareness of protective measures that can be taken by individuals, families, schools, businesses and local governments. The mitigation actions identified in this updated plan are based on an assessment of hazards and risks -- county-by-county and region-wide -- and the participation of a wide range of stakeholders and the public in the planning process.

The counties of Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington and Yuma and their partners participated in the 2014 update of this document. Natural hazards affect all of these counties without respect for political boundaries. As a result, these nine counties routinely share resources during emergencies and maintain a strong tradition of cooperative planning. The 2014 update of this plan further demonstrates the region's commitment to reducing risks from hazards.

1.2 Background and Scope

The rising cost of natural disasters has sharpened interest in identifying effective ways to reduce vulnerability to hazards. 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 by implementing cost-effective hazard mitigation measures.

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." On average, each dollar spent on mitigation saves society an average of $4 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Sciences Multi-Hazard Mitigation Council 2005). The results of this 2005 study remain relevant and have resulted in an increased emphasis in many communities on promoting emergency preparedness, sustainability and resilience.

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. Hazard mitigation plans assist communities in reducing risk from hazards by identifying resources, information, and strategies for risk reduction. This plan documents the planning region's hazard mitigation planning process, identifies relevant hazards and risks, and identifies the strategies that each participating County and jurisdiction will use to decrease vulnerability and increase resiliency and sustainability.

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

Information in this plan is intended for use by local officials to help guide mitigation activities and inform decisions on local land use policy in the future. Nationwide, proactive mitigation planning has proven to help reduce the cost of disaster response and recovery to communities and property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. Northeastern Colorado is vulnerable to a variety of hazards and the collaborative work in support of the third revision of this plan provides evidence of the ongoing commitment to reducing future disaster impacts and maintaining eligibility for federal funding.

1.3 Plan Organization

The Northeast Colorado Regional Hazard Mitigation Plan is organized in alignment with the DMA planning requirements and the FEMA plan review crosswalk as follows:

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption, Implementation, and Maintenance
- Chapter 7: Introduction to the County Planning Elements
- County Planning Element Annexes
- Appendices

1.4 Multi-Jurisdictional Planning

This plan was originally prepared and subsequently updated as a regional, multi-jurisdictional plan. The planning region is comprised of nine counties of the 11-county Northeast All-Hazards Planning Region established by the Colorado Division of Homeland Security and Emergency Management (DHSEM). The counties participating in the 2014 plan updates are Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington, and Yuma Counties. Larimer and Weld Counties elected to not participate in the 2014 regional planning effort and instead to develop separate hazard mitigation plans at the county level. The decision whether or not to participate in this process was a local decision, based on local community needs. Communities may choose to prepare a stand-alone plan for their jurisdiction, participate in a countywide or multi-jurisdiction plan, or opt out of the process altogether.

For the 2014 update, all local units of government in the nine counties were invited to participate in the planning process. Figure 1.1 shows the nine county participants in the 2014 effort. Table 1.1 lists counties and their local governments that have opted to participate in the 2014 planning effort and seek FEMA approval of this 2014 version of this plan. Changes in participation since 2009 are noted. Additional detail about participation can be referenced in the County Planning Element Annexes and Appendix B.

Figure 1.1. Participating Counties, 2014 Northeast Regional Hazard Mitigation Update

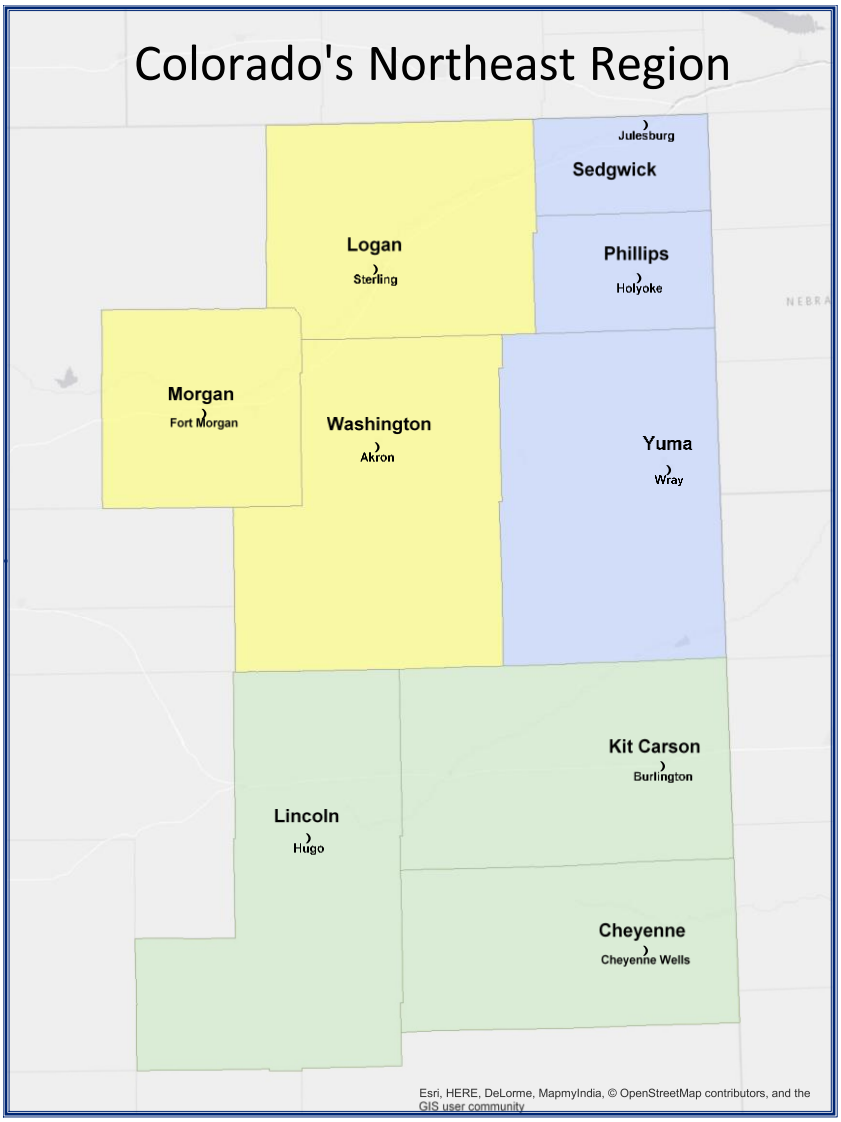


Table 1.1. Multi-Jurisdictional Participation, 2009 and 2014

Jurisdiction	Participation Status
Cheyenne County	**Continuing**
Cheyenne Wells	Continuing
Kit Carson	Continuing
West Cheyenne Fire Protection District	Continuing
Cheyenne County #1 Fire Protection District	Continuing
Kit Carson R-1 School District	Continuing
Cheyenne County School District RE-5	Continuing
Kit Carson County	**Continuing**

Jurisdiction	Participation Status
Bethune	Continuing
Burlington	Continuing
Flagler	Continuing
Seibert	Continuing
Stratton	Continuing
Vona	Continuing
Stratton School District	Continuing
Hi Plains School District	Continuing
Bethune School District	Continuing
Burlington School District	Continuing
Flagler-Arriba School District	New in 2014
Lincoln County	**Continuing**
Arriba	Continuing
Hugo	Continuing
Limon	Continuing
Northeast Lincoln Fire Protection District	Continuing
Limon Area Fire Protection District	Continuing
Logan County	**Continuing**
Sterling	Continuing
Sterling Rural Fire Protection District	Continuing
Crook Fire Protection District	Continuing
Buffalo School District	Continuing
RE-1 Valley School District	Continuing
RE-4J Merino Schools	Continuing
RE-5 Plateau School District	Continuing
Fleming School District	Continuing
Iliff Platte Valley Drainage District	Continuing
Logan County Water Conservancy District	Continuing
Highline Electric Association	New in 2014
Bravo Ditch Company	New in 2014
Farmer's Pawnee Canal Company	New in 2014
Spring Dale Ditch Company	New in 2014
Sterling Irrigation Company	New in 2014
North Sterling and Prewitt Reservoirs	New in 2014
Morgan County	**Continuing**
Brush	Continuing
Fort Morgan	Continuing
Hillrose	Continuing
Wiggins	Continuing

Jurisdiction	Participation Status
Quality Water District	Continuing
Brush School District	New in 2014
Morgan County Rural Electric Association	New in 2014
Lower South Platte Water Conservancy District	New in 2014
Phillips County	**Continuing**
Haxtun	Continuing
Holyoke	Continuing
Paoli	Continuing
Holyoke Fire Protection District	Continuing
Haxtun Fire Protection District	Continuing
Haxtun Public Schools	Continuing
Holyoke Public Schools	Continuing
Haxtun Hospital District	New in 2014
Haxtun Ambulance Service	New in 2014
East Phillips County Hospital District	New in 2014
Holyoke Ambulance Service	New in 2014
Sedgwick County	**Continuing**
Julesburg	Continuing
Ovid	Continuing
Sedgwick	Continuing
Julesburg Public Schools	Continuing
District RE1, Revere School District	Continuing
Washington County	**Continuing**
Akron	Continuing
Otis	Continuing
Woodlin School District	Continuing
Arickaree Public School	Continuing
Akron Fire Department	Continuing
Akron Public Schools	Continuing
Southwest Washington County Fire Protection District	Continuing
Yuma County	**Continuing**
Eckley	Continuing
Wray	Continuing
Yuma	Continuing
Yuma County Fire Protection District	Continuing
Yuma Rural Fire Protection District	Continuing

CHAPTER 2 COMMUNITY PROFILE

This section provides a brief overview of the geography and climate of the planning area. Additional geographic profiles of the participating counties are provided in the County Planning Elements.

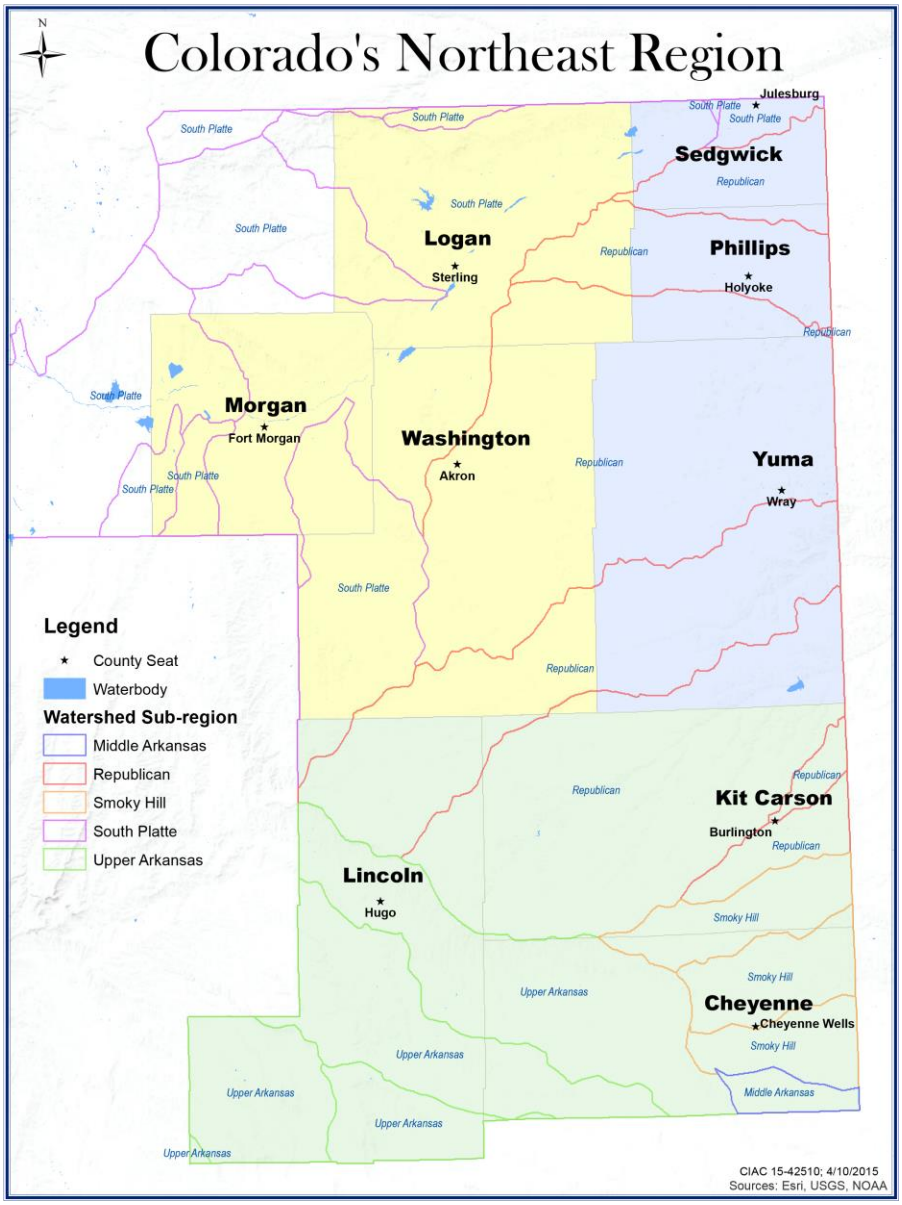
2.1 Geography and Climate

The planning region is comprised of nine counties of the 11-county Northeast All-Hazards Planning Region established by the Colorado Division of Homeland Security and Emergency Management (DHSEM). The counties participating in the 2014 plan updates are Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington, and Yuma Counties. This region of the state is generally characterized by the Great Plains, including rolling prairie, sand hills and several river valleys, long stretches of which are dry most of the time on the surface. The region covers 15,765 square miles and elevations range between 3,315 and 5,400 feet, which increases from east to west. The majority of the land mass is used for agricultural production, with more than 8.9 million acres devoted to farmland.[1] The major rivers in the region include the South Platte River, Arickaree River, Big Sandy Creek, and the South Fork of the Republican River. Major roadways include Interstate 70, Interstate 76, and State Highway 34.

The climate of this semi-arid region in northeastern Colorado is characterized by dry winters with occasional wind-blown snow and alternating periods of very cold temperatures followed by very warm days. Spring seasons are windy and highly variable, including the occasional blizzard, rapid and drastic temperature changes, and high levels of precipitation in the form of both snow and rain. Summers offer low humidity with hot days and cools nights. Large thunderstorms are common, often producing tornados, and some of the most ferocious hail storms on the entire continent occur in the region. The fall is cool and dry and provides the most stable weather conditions of any of the seasons.

[1] USDA, 2012 Census of Agriculture.

Figure 2.1. Northeastern Colorado Planning Region



2.2 Population

Table 2.1 describes the population and projected population levels for the planning region. Specific population counts for 2012 are located in the County Planning Elements. The State Demography Office (SDO) predicts that the overall region will grow at a relatively slow rate (0.5-1.5 percent/year) from 2000 through 2040. The 2012 estimated population for the entire planning region, according to the U.S. Census, is 87,220.

Table 2.1. Current and Projected Population in Planning Region

State, Region, County	2010 Census	2012 Census*	July 2015	July 2020	July 2025	July 2030	July 2035	July 2040
COLORADO	5,029,196	5,189,458	5,499,618	6,043,504	6,567,980	7,058,020	7,520,178	7,958.167
REGION	88,119	87,220	93,974	102,003	110,042	117,298	124,352	131,093
Cheyenne	1,836	1,888	1,948	2,085	2,156	2,214	2,265	2,306
Kit Carson	8,270	8,070	8,530	8,787	9,011	9,198	9,367	9.499
Lincoln	5,467	5,438	5,724	6,091	6,503	6,915	7,286	7,657
Logan	22,709	22,133	24,774	27,450	30,049	32,081	33,904	35,548
Morgan	28,159	28,206	30,667	34,516	38,571	42,619	46,842	51,047
Phillips	4,442	4,401	4,518	4,640	4,755	4,819	4,859	4,883
Sedgwick	2,379	2,355	2,500	2,621	2,733	2,823	2,907	2,990
Washington	4,814	4,706	4,877	4,938	4,991	5,008	5,009	4,987
Yuma	10,043	10,023	10,436	10,875	11,273	11,621	11,913	12,176

*Estimated 2012 U.S. Census Figures
Source: U.S. Census, State Demographics Office

Select Census 2010 demographic and social characteristics for the planning area are shown in Table 2.2 and listed by County. Economic characteristics are provided in Table 2.3.

Table 2.2. Demographic and Social Characteristics

Characteristic	Cheyenne	Kit Carson	Lincoln	Logan	Morgan	Phillips	Sedgwick	Washington	Yuma
Age									
Under 5 Years (%)	6.8	6.6	5.9	5.0	7.7	5.7	5.3	5.2	7.6
65 Years and Over (%)	17.7	17.2	17.1	15.1	15.0	20.6	23.8	20.4	16.9
Median Age	42.7	41.7	40.9	38.4	36.0	42.8	47.9	39.7	38.5
Special Considerations									
Disability Status (%)	19.2	16.4	18.4	13.2	10.7	13.8	14.5	12.6	7.4
Language other than English (%)	10.8	14.9	11.9	10.7	26.4	20.2	11.4	5.5	15.9
Individuals Below Poverty Level (%)	7.8	11.7	11.7	15.9	14.6	18.2	15.1	10.1	10.7
Other									
Average Family Size	2.89	2.98	2.90	2.91	3.23	3.04	2.76	3.08	3.06
Average Household Size	2.28	2.37	2.28	2.34	2.68	2.41	2.14	2.58	2.49
High School Graduate or Higher (%)	86.0	82.4	80.4	88.5	78.6	85.7	84.8	88.7	86.3
Bachelors Degree or Higher (%)	18.6	14.9	15.8	15.7	14.6	19.4	14.6	18.0	17.4

Source: U.S. Census Bureau, 2010, www.census.gov/

2.3 Economy

Select economic characteristics for the planning region from the 2010 Census are shown in Table 2.3. Characteristics are exhibited by County.

Table 2.3. Planning Area Economic Characteristics

Characteristic	Cheyenne	Kit Carson	Lincoln	Logan	Morgan	Phillips	Sedgwick	Washington	Yuma
Individuals below Poverty Level	143	967	552	3,610	4,111	808	359	486	1,075
Median Home Value (1999 $)	81,700	118,400	105,700	121,200	138,900	126,900	83,200	112,900	123,200
Median Household Income (1999 $)	50,357	42,832	43,807	41,369	42,829	45,339	38,401	43,925	45,003
Per Capita Income ($)	24,502	20,846	19,858	22,815	20,276	21,037	22,202	24,435	23,098

Population in Labor Force (%)	66.3	61.0	43.9	66.1	64.8	62.5	59.9	61.7	64.1
Unemployment (%)	1.6	2.8	2.5	6.6	4.8	3.4	4.6	1.8	1.9

Source: U.S. Census Bureau (2010), www.census.gov/

CHAPTER 3 THE PLANNING PROCESS

Requirements §201.6(b) and §201.6(c)(1): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1) **An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;**
2) **An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and**
3) **Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.**

[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

3.1 Background on Mitigation Planning in the Region

The initial Northeast Colorado Regional Hazard Mitigation Plan was developed in 2004 by the Northeast Colorado Emergency Managers (NCEM) with the assistance of a contractor. The Emergency Managers from the region formed a Planning Team to oversee development, review and implementation of the regional plan. Emergency Managers from each county provided representation on the NCEM Planning Team in addition to leading and coordinating planning efforts at the county level, principally the formulation of local mitigation strategies and preparation of the County Planning Elements. Overall management of the project was provided by the COEM Regional Field Manager and a consultant was hired to draft the regional base plan and to support county-level efforts.

To meet FEMA regulations requiring an update of the plan at least every five years, a similar methodology was employed in 2009 with the same project management structure, including a consulting planning firm to support the NCEM Planning Team. Updates in the 2009 plan were based on research from a wide variety of sources, historical perspectives, and future projections of vulnerability and resource capacity. Throughout the process, stakeholder and public participation played a key role in the development of goals and the identification of mitigation opportunities at the community level. As in 2009, the NCEM Planning Team guided the update process and assisted in the review and evaluation of all draft changes.

In anticipation of the 2014 update, the Northeast Regional Field Manager coordinated initial discussions among NCEM members, facilitated agreement on the planning approach, and

assisted NCEM with application for a Pre-Disaster Mitigation (PDM) grant to support the effort. For the 2014 plan update, the NCEM Planning Team is composed of Emergency Managers from each of the nine participating counties: Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington and Yuma. As with earlier efforts, Emergency Managers from these counties accepted the responsibility for review of draft updates to the base plan and revision of County Planning Elements (CPEs), including updated mitigation action items. Emergency Managers contacted each of the incorporated communities and other FEMA "eligible applicants" within their own counties, offering them the opportunity to participate in the 2014 update of the plan (as opposed to having to develop their own individual plans in order to maintain eligibility for relevant federal program grants).

In 2014, the services of a planning consultant were again secured to complete revisions to the base plan and integrate CPEs into the final planning document. Other tasks assigned to the consultant include:

- establishing and supporting a management organization for completing plan updates;
- facilitating the overall process; including revisions to the base plan:
- identifying data requirements and conducting the research and documentation necessary to integrate the most current data into plan revisions;
- developing and facilitating the public input process;
- producing the draft and final plan documents; and
- ensuring acceptance of the final plan by FEMA Region VIII.

The majority of funding for the planning assistance contract was provided to the NCEM member counties by FEMA through COEM in the form of a PDM grant. The required non-federal match was provided as an "in-kind" or "soft" match, primarily through the hours spent on this effort by planning team participants, partners and stakeholders, in addition to other eligible expenses such as facility use and copying/printing costs. Yuma County agreed to manage the PDM grant as fiscal agent in support of NCEM.

3.2 The 10-Step Planning Process

The planning process conforms to FEMA-s 4-phase DMA process and the 10-step process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance (FMA) programs, as shown in Figure 3.1.

Figure 3.1 Four Phase/Ten Step Process

FEMA's 4-Phase DMA Process	Modified 10-Step CRS Process
1) Organize Resources	
201.6(c)(1)	1) Organize the Planning Effort

201.6(b)(1)	2) Involve the Public
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies
2) Assess Risks	
201.6(c)(2)(i)	4) Identify the Hazards
201.6(c)(2)(ii)	5) Assess the Risks
3) Develop the Mitigation Plan	
201.6(c)(3)(i)	6) Set Goals
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
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan

3.2.1 2014 Update - Plan Section Review and Analysis

During the 2014 plan update, the NCEM Planning Team updated each of the sections of the previously approved plan to include new and updated data, incorporate accounts of recent disaster events, and eliminate outdated and unnecessary information. The NCEM Planning Team and its contractor analyzed each section of the 2009 plan using current state and federal guidance, including FEMA's Local Mitigation Planning Handbook (March 2013), to ensure that the plan met federal requirements. A concerted effort was also made to ensure that 2014 revisions were consistent with information in the Colorado Natural Hazards Mitigation Plan (December 2013), including the definition and detailed description of each hazard profiled in Chapter 4, Risk Assessment. Information and data from the 2009 plan that remained valid and up-to-date at the time of the 2014 updates have been carried forward in the 2014 plan. Appendix G, Summary of Changes to the Previously Approved Plan, highlights the significant changes, additions, and deletions to the previous (2009) document that were approved by the NCEM Planning Team during the 2014 update process.

3.2.2 Phase 1: Organize Resources

Step 1: Get Organized - Building the Planning Team

The planning organization and approach for the 2014 update of this plan are consistent with the process followed during original plan development in 2004 and revisions in 2009. The project management structure includes the following elements:

- NCEM Planning Team
- State OEM Regional Field Manager
- County Planning Subcommittees (Eligible Applicants, Stakeholders and Partners)

- Fiscal Agent – Yuma County
- NCEM Contractor

Weld County is the only county that participated in the 2009 plan update that elected to develop an independent county-level plan rather than participate in the 2014 regional plan. The nine counties in the Northeast Colorado All-Hazards Emergency Management Region that participated in the 2014 update of this plan include:

- Cheyenne County
- Kit Carson County
- Lincoln County
- Logan County
- Morgan County
- Phillips County
- Sedgwick County
- Washington County
- Yuma County

Entities that participated within each county can be referenced in each County Planning Element.

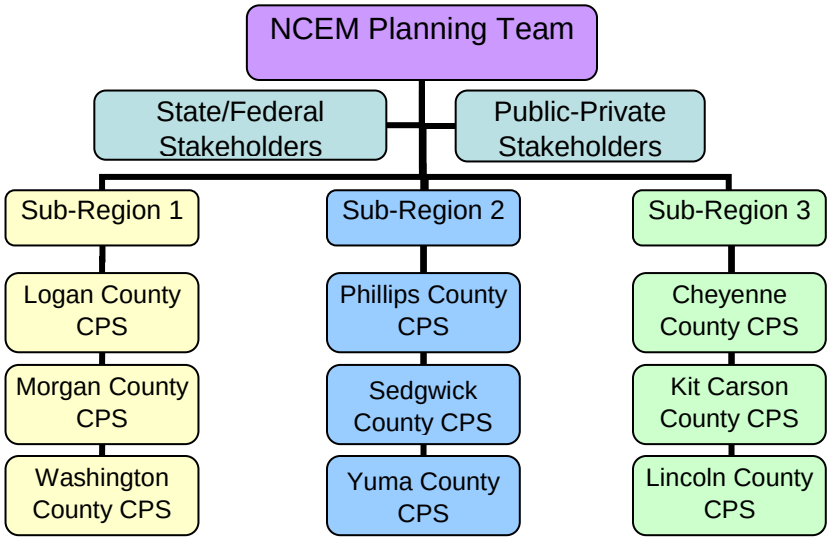
Figure 3.2 2014 NCEM Planning Team

Each of the nine counties established its own County Planning Subcommittee, or CPS. The County Emergency Manager chaired each CPS, with representatives of various county departments, incorporated communities, other "eligible applicants," and other participants comprising its membership. Although membership varied from county to county, representatives to the CPS typically included elected officials, law enforcement, fire services, building officials, public works, planning departments, assessor's offices, and public health agencies. Other stakeholders and partners invited to participate in CPS activities included local business and agricultural interests, volunteer and nonprofit organizations, electric utility providers, ambulance services, community hospital representatives, regional area trauma councils, groundwater management districts, food distributors, and operators of critical facilities. Lists of participants are provided at the beginning of each of the nine County Planning Elements (CPE) that are annexes to this plan. Each CPS met multiple times, including two sets of formal review meetings, one at the mid-project point and another at the final draft stage. The formal reviews were conducted in June 2014 and August 2014 with meetings structured to include three counties per session broken down as follows:

- Sub-Region 1 – Logan, Morgan and Washington Counties
- Sub-Region 2 – Phillips, Sedgwick and Yuma Counties
- Sub-Region 3 – Cheyenne, Kit Carson and Lincoln Counties

These sub-regional groupings were based on factors such as proximity to each other and history of collaboration (e.g. and Lincoln, Cheyenne, and Kit Carson). Weld County was its own sub-region due to its size and number of jurisdictions. The sub-regional grouping helped consolidate the number of CPS meetings held during the update process. Figure 3.3 below represents the NCEM planning structure for this DMA plan.

Figure 3.3 Regional Planning Structure



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

- Participate in the planning process,
- 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 Northeast Colorado Multi-Hazard Mitigation Plan, "participation" means:

- Attending and participating in the NCEM Planning Team meetings, CPS meetings, or individual meetings with the County Emergency Manager,
- Providing available data requested by the NCEM Planning Team,
- 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.

Northeastern Colorado has a number of small, rural jurisdictions with limited resources. In some counties, the County Emergency Managers are authorized to participate in planning efforts on behalf of these small communities. This "authorized representation" model is a method that is endorsed in FEMA's multi-jurisdictional planning guidance, and was utilized for certain counties and jurisdictions in this plan. These specific instances are noted in the respective County Planning Element.

During the planning process, the NCEM Planning Team communicated by a number of means, including planning meetings, formal briefings, email correspondence, and the readynortheast.org website. This updated plan is a result of planning team input provided through a combination of data collection tools, comments on draft planning elements, and information gathered during planning meetings.

Numerous planning meetings with the NCEM Planning Team, its contractor, and the nine CPSs were held during the plan's development between April and August 2014. The meeting schedule and topics are listed in the following table. Sign-in sheets from these meetings are included in Appendix F. Agendas and minutes of these meetings can be referenced in a planning process reference notebook on file with each County and the Northeast Colorado COEM Regional Field Manager.

Table 3.1 2014 Hazard Mitigation Planning Meetings

Meeting	Date(s)	Purpose
Northeast Colorado Emergency Managers	April 8, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule

Meeting	Date(s)	Purpose
Monthly Meeting, Fort Morgan, CO		• Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Review contractor responsibilities
Northeast Colorado Emergency Managers Monthly Meeting, Greeley, CO	May 13, 2014	• Review Contractor Work Plan • Discuss approach for public involvement • Confirm participating jurisdiction requirements • Discuss CPE status/needs • Review meeting schedule
Northeast Colorado Emergency Managers Monthly Meeting, Hugo, CO	June 10, 2014	• Review/approve Public Involvement Plan • Discuss data collection needs • Review and update identified hazards • Review potential mitigation actions
Logan County Public Health (ESF-8) Committee, Sterling, CO	June 20, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Identify potential mitigation actions
Mid-Project Review Phillips, Sedgwick and Yuma Counties	June 26, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of CPS/participation requirements • Discuss Public Involvement Plan • Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Discus potential mitigation actions
Mid-Project Review Cheyenne, Kit Carson and Lincoln Counties	June 26, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of CPS/participation requirements • Discuss Public Involvement Plan • Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Discus potential mitigation actions
Mid-Project Review Logan, Morgan and Washington Counties	June 27, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of CPS/participation requirements • Discuss Public Involvement Plan • Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Discus potential mitigation actions
Northeast Colorado Emergency Managers Monthly Meeting, Yuma, CO	July 8, 2014	• Review draft chapters 1-4 • Discuss remaining data collection needs • Finalize approach and schedule for public meetings • Review potential mitigation actions • Discuss the review and comment period
Washington County Local Emergency Planning Committee (LEPC)	July 9, 2014	• Review Disaster Mitigation Act planning requirements, scope of work, and schedule • Review role of NCEM Planning Team/CPSs • Discuss project timelines, milestones and process • Identify potential mitigation actions
Final Review of 2014 Draft Updates/Formal Public Meetings 9 Total (1 per county)	*Aug 30 – Hugo *Sept 4 – Ft. Morgan *Sept 9 – Cheyenne Wells *Sept 10 – Burlington	• Review final draft plan • Review CPEs and recommended action plans • Identify public comment period • Identify process for submitting comments on draft

Meeting	Date(s)	Purpose
	*Sept 10 – Akron *Sept 11 – Yuma *Sept 12 – Sterling *Oct 7 – Julesburg	CPEs/regional plan • Identify contacts and process for recommending action items

Step 2: Plan for Public Involvement – Engaging the Public

The NCEM Planning Team adopted the following Public Involvement Plan for the 2014 plan update process.

Public Involvement Objectives

- Create broad awareness of plan updates and provide an opportunity for stakeholders and the general public to review and comment on the final draft prior to its adoption.
- Inform interested citizens about the purpose and benefits of hazard mitigation planning.

Stakeholders/Target Audience

- Governmental Organizations (Counties, Cities, Towns, Special Districts)
- Business Interests
- Agricultural Interests
- Educational Interests
- Property Owners (in 100-year floodplain or identified hazard zones)
- General Public

Plan Update Timeline

- Phase 1 – Research, Organization, Initial Plan Updates (May 2014)
- Phase 2 – Update Risk Assessment (June 2014)
- Phase 3 – Update Mitigation Strategy (July/August 2014)
- Phase 4 – Formal Plan Approval and Adoption (September 2014 – March 2015)

  Note: Public comment period two-to-four weeks.

Public Involvement Activities

- Nine (9) formal public meetings, one in each participating county to be conducted in the August-September timeframe.
- Opportunities for interested citizens to participate in updates of County Planning Elements (CPEs).
- Information posts on readynortheast.org and county websites. Updated draft CPEs will be posted on County websites and draft updates to the base plan will be posted on the regional website ReadyNortheast.org.
- News releases advertising plan update, public meetings and comment period for local newspapers and ReadyNortheast.org website.
- Placement of hard copies of final draft at community locations like libraries.
- Interviews and presentations by the NCEM Planning Team and its contractor.

Draft Public Meeting Agenda

- Brief Overview of Federal Requirements
- Overview of Regional Process
- County Requirements
- Review of County Planning Element
- Regional Plan Update Highlights
- Public Review/Comment Period and Procedures

Planning Team Tasks

- Identify public meeting dates, times and locations.
- Post news release on county web pages and ReadyNortheast.org.
- Inform public on how comments can be submitted.

Contractor Tasks

- Draft language for news releases/web pages.
- Develop agenda and presentation materials for public meetings.
- Facilitate nine public meetings.
- Develop public comment form for meeting and for download at ReadyNortheast.org.

Step 3: Coordinate with other Departments and Agencies

The NCEM Planning Team consulted a variety of state, federal, nonprofit and university agencies to collect data required for the update of this plan. Many of these agencies regularly participate in the NCEM monthly meetings.

- Colorado Division of Homeland Security and Emergency Management
    - Colorado Office of Emergency Management, Mitigation Section
    - Colorado Division of Fire Safety
- Colorado Department of Agriculture
- Colorado Department of Corrections
- Colorado Division of Wildlife
- Colorado Medical Reserve Corps
- Colorado Oil and Gas Conservation Commission
- Colorado State Forest Service
- Colorado State University Agricultural Extension
    - Golden Plains Extension Service
    - Lincoln County Extension Service
- Colorado State University (APHIS)
- Colorado State University Golden Plains
- Colorado Water Conservation Board (CWCB)

- Colorado 211
- Environmental Protection Agency (EPA), Region VIII
- Federal Emergency Management Agency (FEMA)
- National Weather Service (NWS), Boulder, CO and Goodland, KS
- Northeast Colorado All Hazards Region
- Northeast Colorado Health Department
- Northern Colorado American Red Cross
- 137th Colorado Air National Guard
- U.S. Department of Agriculture, Farm Service Agency (FSA)
- U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)

Stakeholders and Partners

In addition to the organizations above that contributed to plan updates, the planning process included the involvement of multi-jurisdictional Private Nonprofit Utilities such as Rural Electric Cooperatives, in addition to a number of business and industry partners. These entities participated in planning meetings and provided feedback on draft County Planning Elements.

Table 3.2 Private Sector and Private Nonprofit Stakeholders and Partners

Industry/Enterprise	Name of Business or Organization	
Communications	Century Link	Eastern Slope Rural Telephone Association
	Verizon Wireless	Viaero Wireless
Agricultural	Kugler Company	Stratton Equity Coop
Energy/Power Generation	Black Hills Energy	Nexterra Energy Resources
	Duke Energy	Shell Pipeline
	Weipking-Fullerton Energy	Tri-State Power Generation and Transmission
	Nighthawk Energy	
Rural Electric Associations	Highline Electric Association	K. C. Electric
	Mountain View Electric Asoc.	Y-W Electric Association
Health and Medical	Sterling Regional Medical Center	Kit Carson Memorial Hospital
	Keefe Memorial Hospital	Limon Community Hospital
	Lincoln Community Hospital	Centennial Mental Health Center
	East Morgan Community Hospital	Washington County Mental Health
	Plains-to-Peaks RETAC	
Railroads	Kyle Railroad	Burlington Northern Santa Fe
		Union Pacific
Corrections		Corrections Corporation of America (Kit Carson County Correctional Facility)
Civic and Community Organizations	Burlington Rotary Club	Fort Morgan Chamber of Commerce
	Catholic Charities of Colorado	Washington County CERT
		Washington County Senior Citizens
		Cheyenne Manor
Special Districts	Julesburg Irrigation District	Yuma County Pest Control District

Other Information Sources

In addition, the NCEM Planning Team and its contractor utilized the resources of the following agencies in the development of this plan:

- The U.S. Geological Survey (USGS)
- The U.S. Department of Agriculture (USDA), and its subsidiary organizations:
    - The Farm Service Agency (FSA);
    - The Natural Resource Conservation Service (NRCS) and it's predecessor, the Soil Conservation Service (SCS); and
    - The National Crop Insurance Service (NCIS)
- The U.S. Department of Homeland Security (DHS)
- The Colorado Department of Public Health and Environment (CDPHE)
- The Colorado Department of Natural Resources, Office of the State Engineer
- The Colorado Geological Survey (CGS)
- Colorado State University (CSU), and
- The Office of Archaeology and Historic Preservation, Colorado Historical Society.

Other Community Planning Efforts and Hazard Mitigation Activities

Other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment, and capability assessment. Coordination with other community planning efforts is also important 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. The region uses a variety of mechanisms, such as comprehensive 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.

3.2.3 Phase 2: Assess Risks

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

This 2014 update of the Northeast Colorado Regional Hazard Mitigation Plan builds on an exhaustive research effort during the 2009 update to identify and document all hazards that have, or could, impact the planning area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. County Planning Subcommittees conducted hazard and capability assessment meetings to revisit 2009 data and update current county and regional capabilities to mitigate risk and vulnerability from natural hazards. By collecting information about existing government programs, policies, regulations, ordinances,

and emergency plans, the NCEM Planning Team 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 Risk Assessment. All information in the CPEs was updated as part of the 2014 update, including the hazard/risk assessment, vulnerability assessment, updated maps, and an updated capabilities assessment building off of information from the previous plan. Combining the risk assessment with the capability assessment results in "net vulnerability" to disasters and more accurately focuses the goals, objectives, and proposed actions of this plan. Jurisdictional capabilities are noted in each respective CPE. An analysis of each jurisdiction's ongoing and continued compliance with the NFIP was included in each CPE. Updated information in the regional base plan includes revised GIS maps and a new assessment of how the risk from identified hazards varies across the planning area from county to county.

3.2.4 Phase 3: Develop the Mitigation Plan

Steps 6 and 7: Set Goals and Review Possible Activities

The NCEM Planning Team and the County Planning Subcommittees facilitated brainstorming and discussion sessions that described the purpose and the process of developing updated planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. The results of this collaborative process are captured in Chapter 5 Mitigation Strategy. Each CPE provided the recommended action item details, including a description of the action, who is responsible for implementing it, and a timeframe for completion. Each CPE also includes a status report on action items identified in the 2009 plan, including achievements and challenges to implementing action items that were not completed, These actions were updated and revised as necessary and are carried forward in this plan, where applicable. Progress on each objective is noted in each CPE. Where progress has been made and a project completed, these have been preserved in the plan as record of progress. Since 2004, several counties in the planning region have received "Storm Ready" designation and experienced increases in NFIP participation and flood insurance policies. Additionally the region has been active in public awareness campaigns and with projects related to outdoor warning sirens, flood control, shelters, NOAA all-hazards radio repeaters, NOAA radios, and the use of the readynortheast.org website for public information. These success stories are discussed in more detail in Chapter 5, with additional detail on the process for tracking progress.

Step 8: Draft an Action Plan

Based on input from the NCEM Planning Team and CPSs regarding risk assessment results and the goals and activities identified in Planning Steps 6 and 7, a complete first draft of the plan was prepared and distributed for review and comment. Other agencies were invited to

comment on this draft as well. NCEM Planning Team, CPS and agency comments were integrated into the final draft, which was advertised and distributed to collect public input and comments. The NCEM contractor integrated comments and issues from the public, as appropriate, along with additional internal review comments and produced a final draft for the Colorado Office of Emergency Management and FEMA Region VIII to review and approve, contingent upon final adoption by the governing boards of each participating jurisdiction.

3.2.5 Phase 4: Implement the Plan and Monitor Progress

Step 9: Adopt the Plan

In order to secure the formal commitment of participants 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, Plan Adoption. Following conditional approval by FEMA Region VIII of the 2014 updated plan the participating jurisdictions will again re-adopt this plan.

Step 10: Implement, Evaluate, and Revise the Plan

The primary benefit of mitigation planning is the effective implementation of specific mitigation projects and action items. Each mitigation action recommended in this update of the plan includes a description of the problem and recommended solution, a lead/responsible agency, project priority, cost estimate, and possible funding sources. An overall implementation strategy is described in Chapter 6 Plan Adoption, Implementation, and Maintenance.

There are numerous organizations within the region 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 the region and is addressed further in Chapter 6. A plan update and maintenance schedule and a strategy for continued public involvement are also included in Chapter 6.

4 RISK ASSESSMENT

***44 CFR Requirement 201.6(c)(2): [The plan shall include] a risk assessment that provides the factual basis for activities proposed in the strategy to reduce the losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.**

As defined by the Federal Emergency Management Agency (FEMA), risk is the potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets. Hazards are natural processes, such as tornadoes and earthquakes. The exposure of people, property, and other community assets to natural hazards can result in disasters depending on the impacts. Impacts are the consequences or effects of the hazard on the community and its assets.

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

This process is consistent with the Hazard Identification and Risk Assessment (HIRA) process followed in the Colorado Natural Hazards Mitigation Plan (2013) and conforms to the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses* (2002), which breaks the assessment down to a four-step process:

1) Identify Hazards
2) Profile Hazard Events
3) Inventory Assets
4) Estimate Losses

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

- **Section 4.1 Hazard Identification** identifies the hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.
- **Section 4.2 Hazard Profiles** discusses the nature of each hazard, describes previous occurrences of hazard events and the likelihood of future occurrences, and estimates past and potential impacts to the planning area.
- **Section 4.3 Vulnerability Assessment** provides an overview of the region's total exposure to natural hazards, considering assets at risk. This section includes an overview of methodologies for estimating potential losses for the hazards, and how future development trends may increase or decrease vulnerability.

- **Section 4.4 Capability Assessment** provides a summary of capabilities across the planning region, based on the results of county-level capability assessments that are included in each County Planning Element.
- **County Planning Elements** included in this plan discuss each participating county's individual natural hazard summary, hazard history, and overall exposure to natural hazards based on an asset inventory. The NCEM Planning Team also conducted a mitigation capability assessment, which inventoried existing mitigation activities and existing policies, regulations, and plans pertaining to mitigation and affecting net vulnerability. The County Planning Elements provide an estimate of losses related to the more significant hazards in each county (e.g., flooding, wildfire, dam failures, or severe winter storm.

4.1 Hazard Identification

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

During the initial planning process and subsequent updates, the NCEM Planning Team identified the hazards that present the greatest threat to the planning area, modified and updated information in the hazard profiles, and incorporated new data based on events that occurred in the previous five years. The hazard identification process involved a review of technical studies and reports, an assessment of hazards on a regional scale, and gathering feedback from each of the County Planning Subcommittees (CPS).

4.1.1 Results and Methodology

For the 2014 update, NCEM Planning Team revalidated the list of hazards from the 2009 plan with a few modifications. The list was evaluated based on recent events, historical frequency, and potential for causing significant human and/or monetary losses in the future. As a result of the 2014 review, dust storms were added to the list as a hazard category separate from straight-line winds and the magnitude/severity rating for two hazards was increased to "critical" (flooding and tumbleweeds). The following hazards, listed alphabetically, were identified and investigated for the 2014 Northeast Colorado Regional Hazard Mitigation Plan update:

- Biological Hazards
- Blizzards and Severe Winter Storms
- Dam Failures and Levee Failures
- Drought
- Dust Storms
- Earthquake
- Flooding
- Fog
- Hailstorms
- Land Subsidence
- Landslide
- Lightning

- Noxious Weeds/Tumbleweeds
- Straight-Line Winds
- Temperature Extremes
- Tornadoes
- Wildland/Grassland Fires

Table 4.1. Northeast Colorado Regional Hazard Analysis Worksheet 2014

Hazard	Geographic Extent	Probability of Future Occurrences	Magnitude/Severity	Significance
Biological Hazards				
Pestilence	Extensive	Occasional	Limited	Medium
Plague*	Limited	Highly Likely	Limited	Medium
Blizzards & Severe Winter Storms	Extensive	Highly Likely	Critical	High
Dam Failures & Levee Failures	Significant	Occasional	Limited	Medium
Drought	Extensive	Likely	Critical	High
Dust Storms	Significant	Likely	Limited	Medium
Earthquake	Limited	Occasional	Limited	Low
Flooding	Significant	Likely	Critical	High
Fog	Significant	Likely	Negligible	Low
Hailstorms	Extensive	Highly Likely	Critical	High
Landslides	Limited	Occasional	Negligible	Low
Lightning	Extensive	Highly Likely	Limited	Medium
Noxious Weeds/Tumbleweeds	Extensive	Highly Likely	Limited	Low
Straight-Line Winds	Extensive	Highly Likely	Critical	High
Temperature Extremes	Extensive	Highly Likely	Limited	Low
Tornadoes	Significant	Highly Likely	Critical	High
Wildland & Grassland Fires	Extensive	Highly Likely	Limited	High

***** Some zoonotic hazards have higher or lower ratings than those reflected here, based on individual datasets.

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

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

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability
Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4.1 (above) was completed, based in part on the risk assessment, to identify and rate the significance of a variety of possible hazards. Significance was measured in general terms, focusing on key criteria such as the likelihood of the event, past occurrences, spatial extent, and damage and casualty potential. The worksheet reflects the regional assessments. Individual county assessments are located in each county planning element, and may reflect higher or lower assessments, based on the particular exposures, geography, and vulnerabilities of the area. Only the more significant hazards (high or medium) have a more detailed hazard profile and are analyzed further in Section 4.3 Vulnerability Assessment.

4.1.2 Disaster Declaration History

Federal and/or state disaster declarations histories help document past occurrences of hazards within the planning area. Disaster declarations are granted when the magnitude and severity of impacts caused by the event surpasses the ability of the affected local government to respond and recover. Most disaster assistance programs are supplemental and require a local cost-sharing match. When the response capacity of an affected jurisdiction is exhausted, a state disaster declaration may be issued, allowing for the provision of state assistance, usually for the purpose of covering the costs of state assets committed to response operations. Should the severity of the disaster event surpass both the local and state government response capacity, a federal emergency or disaster declaration may be issued, allowing for the provision of federal disaster assistance. Generally, the federal government issues disaster declarations through FEMA. However, federal assistance may also come from the U.S. Department of Agriculture (USDA), the Small Business Association (SBA), or other government programs such as the Fire Management Assistance Grant Program. FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

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

The Fire Management Assistance Grant Program provides funding for the mitigation, management, and control of fires on public and private forests or grasslands that pose a threat to people and property on the scale of a major disaster. The quantity and types of damages, as well as the type of event, determine the source of federal aid.

Table 4.2 provides information on federal and state declared emergencies and disasters declared in the nine NCEM-member counties between 1965 and 2014. The FEMA website also offers a list of Fire Management Assistance Declarations, with county-specific information available for the majority of the declarations listed.

Table 4.2. Northeast Colorado All-Hazards Region Disaster and Emergency Declarations, 1965-2014 (Cheyenne, Kit Carson, Lincoln, Logan, Morgan, Phillips, Sedgwick, Washington and Yuma Counties)

Year	Declaring Jurisdiction	Counties Affected	Disaster Type
2014	USDA	All but Morgan	Drought
2013	Federal-Major Disaster	Lincoln, Logan, Morgan, Sedgwick, Washington	Severe Storms and Flooding
2013	USDA	All	Drought
2012	USDA	Cheyenne, Kit Carson, Lincoln, Washington	Drought
2011	USDA	Lincoln	Drought
2010	USDA	Yuma	Drought
2009	State	All	Blizzard, Severe Winter Weather
2008	USDA	Cheyenne, Kit Carson, Lincoln, Logan, Washington	Drought
2008	USDA	Kit Carson	Drought, Excessive Heat, Hail, High Winds
2008	USDA	Lincoln	Hail
2008	USDA	Yuma	Drought Conditions and Grasshopper Infestations
2007	Federal-Emergency	Cheyenne, Washington	Snow
2005	Federal-Emergency	All	Hurricane Katrina Evacuation
2003	Federal-Emergency	Morgan	Snow
2002	Federal-Major Disaster	Cheyenne, Kit Carson, Lincoln, Washington, Yuma	Wildfires
2001	Federal-Major Disaster	All but Kit Carson	Severe Storms
1997	Federal-Major Disaster	Morgan, Logan	Flooding
1990	USDA	Kit Carson, Phillips, Sedgwick, Washington, Yuma	Drought
1990	State	Lincoln	Tornado
1981	State	Morgan, Phillips, Sedgwick, Washington, Yuma	Grasshopper Plague
1980	State	Morgan, Phillips, Sedgwick, Washington	Grasshopper Plague
1969	Federal	Sedgwick, Washington, Yuma	Flooding
1965	Federal	Cheyenne	Flooding

Sources: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management); U.S. Department of Agriculture.

4.1.3 Hazards Not Included

Other hazards were considered by the NCEM Planning Team and CPS groups but ultimately not included in this plan. Thunderstorms are not profiled as individual hazards, but are instead recognized for the contributing role in the flood, lightning, hail, and windstorm hazards, and addressed accordingly in those hazard profiles. Other hazards identified in the FEMA guidance were excluded because they do not occur in the planning region and include avalanche, coastal erosion, coastal storms, hurricanes, tsunamis, and volcanoes. Additionally, potential man-made or technological hazards such as hazardous materials, terrorism, airplane crashes, or damage to gas or oil pipelines are not profiled in this plan. Although not addressed in this plan, other man-made hazards faced by many communities in the planning area include the potential of fire or explosions in grain elevators and train derailments and associated spills and fires. While biological hazards are included, pandemic flu, including viruses such as the H1N1, are not since they are addressed under alternative planning efforts, such as the ongoing pandemic flu planning efforts in the state and region.

4.2 Hazard Profiles

Requirement §201.6(c)(2)(I): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

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

4.2.1 Profile Methodology

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

Description

This subsection gives a generic description of the hazard and associated problems, followed by details on the hazard specific to each county in the planning area.

Geographic Extent

This subsection discusses which areas of the planning area are most likely to be affected by a hazard event. The extent or location of the hazard within or near the regional planning area is also included here.

- **Limited**—Less than 10 percent of planning area

- **Significant**—10-50 percent of planning area
- **Extensive**—50-100 percent of planning area

Previous Occurrences

This subsection contains an overview of information on historic incidents, including major incident impacts where known. Information provided by the NCEM Planning Team is included here along with information from other data sources. Each County Planning Element contains more detail on the previous hazard occurrences.

Probability of Future Occurrences

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

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

The frequency, or chance of occurrence, was calculated, where possible, based on existing data. Frequency was determined by dividing the number of events observed by the number of years and multiplying by 100. This gave the percent chance of the event happening in any given year. Example: Three droughts over a 30-year period equates to a 10 percent chance of that hazard occurring in any given year.

Magnitude/Severity

This subsection summarizes the magnitude and severity of a hazard event based largely on previous occurrences and specific aspects of risk as it relates to the planning area. Magnitude and severity are classified in the following manner:

- **Catastrophic**—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
- **Critical**—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
- **Limited**—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability

- **Negligible**—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid.

Overall Hazard Significance

Overall vulnerability and potential impact of each hazard is summarized in this subsection, based on probability of future occurrence, magnitude of previous occurrences, and assessments of public safety risk and threat to property and infrastructure.

4.2.2 Biological Hazards

Description

Biological hazards encompass a wide range of potential hazards, including rodents and insect infestations (pestilence) and the zoonotic diseases spread by insects or wildlife (plague). Pestilence hazards impact crops and the economic revenues derived from them, as well as causing secondary impacts on livestock (by damaging food sources) and on property and materials by spreading disease, polluting water sources, or sometimes damaging machinery and infrastructure. Plague hazards impact both human and animal populations, and may result in permanent injury, disability, or death. Some diseases, when documented in a livestock population, require the destruction of the entire to prevent transmission to humans. This has an enormous financial impact on the ranching and livestock industries. Additionally, people that are impacted by disease are unable to work for periods of time, which has a secondary fiscal impact on the area.

Pestilence

Rodent and insect infestations threaten crops, which is one of the primary industries in the planning region. Rodents, such as mice and rabbits, damage crops in all stages of the production process. Young plants are vulnerable to the rodents, who feed on them. Harvested and stored crops may be contaminated by rodents burrowing into storage units, either to feed on the materials or create nests during winter months. The nature of the infestations makes tracking statistical data nearly impossible. Variables include the geographic distribution of the rodents and the crops, the number of rodents in the area, and the reproduction rates relative to the amount of natural food resources available. The presence of predators, such as foxes, snakes, and hawks, also impacts the potential datasets. As such, historical recollection provides the majority of the hazard profile's content.

Insect plagues also cause significant damage to crops in the region. Most losses occur in the fall because of freezing temperatures. Grasshoppers move from the range into the crop. The last major grasshopper infestation in the United States occurred in the 1930s. Following that disaster, it was decided that local control of grasshopper outbreaks were insufficient and that

regional coordination was required. The 1934 Congress charged the U.S. Department of Agriculture (USDA) with controlling grasshoppers on federal rangeland. Later, in 1987, the Animal and Plant Health Inspection Service (APHIS), which is part of the USDA, created the Grasshopper Integrated Pest Management (GHIPM) Project to develop new technologies for managing grasshopper populations. Similar insect hazards are posed by locusts, aphids, and bark beetle plagues.

Devastating grasshopper infestations in the 1950s, 1980s, and persistent infestations during the 2000s underscore the importance of mitigating this insect-driven hazard. In addition to rangeland forage, vegetable crops are a favorite target of grasshoppers, with lettuce, carrots, beans, sweet corn and onions on top of the list. Grasshoppers usually hatch in late May and June. Early scouting is important because treatments are most effective when grasshoppers are small. The goal of scouting is to get an estimate of grasshoppers per square yard, as well as their stage of development. The economic threshold for grasshoppers in rangeland is 15-20 grasshopper nymphs per square yard. This number is equivalent to eight to ten adult grasshoppers per square yard (however, the economic importance of an infestation is affected by factors such as range condition, cattle prices, and treatment costs). Treatment options for grasshopper management are based on the Reduced Agent and Area Treatment (RAAT) strategy, which results in untreated swaths and swaths treated with reduced chemical rates. According to CSU Extension Services, using lower rates and leaving untreated areas reduces treatment costs by as much as 50 percent while preserving biological control. Since grasshoppers move constantly, RAAT control methods are as effective as complete coverage applications. Large infestations can be treated aerially.[1]

Plague

In the predominately agricultural region that makes up the planning area, zoonotic diseases are also a significant hazard to the population and livestock of the area. Zoonotic diseases are those which can be transmitted from animals and humans. The Colorado Department of Public Health and Environment (CDHPE) indicates that the most common of these diseases in Colorado are hantavirus, plague, rabies, tularemia, West Nile Virus (WNV) (and other mosquito borne diseases) and various tick-borne diseases. It is important to realize that this plan does not examine pandemic contingencies, either of these diseases or of other potentially pandemic outbreaks, but instead focuses on examining the risk of a normal hazard occurrence.

Hantavirus is spread through the saliva, urine, and feces of the deer mouse and is caused by the Sin Nombre virus. Contamination is only possible when humans come into direct contact with the rodents or dust and feces contaminated by the mice. Hantavirus was initially identified in the Four Corners region of the United States in 1985. Mitigation of the disease includes

[1] Colorado State University Extension, *2014 Grasshopper Populations and Potential Infestations in Colorado*, Gebre-Amlak, Assefa.

adequate sanitation and use of respiratory and eye protection when working in areas where exposure may occur, including barns, hay lots, basements, and attics.[2]

Plague is a rodent disease transmitted to humans by flea bites, and is widespread in the western United States. Plague may also infect felines. The disease has epidemic histories, most famously as the "Black Death" plagues of the Middle Ages. The disease is easily mitigated through improved sanitation and rat control; and when detected early, the plague can be treated. However, the disease may still prove fatal if not treated quickly enough.[3]

Tularemia is commonly called "rabbit fever," though it occurs in over a hundred species of wild animals, birds, and insects. Transmission is most common when ticks bite infected animals, particularly rabbits and rodents, and then transfer the disease via human bites. The bacteria may also be inhaled or ingested via the consumption of infected meat or food and water contaminated with the urine from infected animals. Tularemia is not currently transmissible via human-to-human contact, but the disease is easily aerosolized. For this reason, the disease is considered a potential bioterrorism agent and falls under national pharmaceutical stockpile regulations. Tularemia is easily mitigated through appropriate hygiene, limitation of contact between human and rodent populations, and appropriate sanitation of water and food supplies, particularly local garden produce.[4]

Of all the zoonotic diseases affecting the northeastern region of Colorado, the most recent, and one of the most deadly, is the West Nile Virus (WNV). The disease, which is spread through mosquito bites, can be contracted by birds, humans, horses, cattle, and other livestock. Symptoms may include headaches, fever, malaise, encephalitis, and death, although not all infected individuals exhibit symptoms. There is no treatment for the virus except supportive care.[5] The Colorado Mosquito-Borne Virus Surveillance Program, local health departments, and the Colorado Department of Public Health and Environment have conducted WNV surveillance since 2001.[6] Many resources exist for local communities to mitigate the risk of WNV. Online resources include the "Fight the Bite" website (www.fightthebitecolorado.com), which provides tips and tools for local homeowners to mitigate mosquito populations on private property. Other mitigation efforts include spraying, use of personal pesticide sprays, avoiding outdoor

[2] Colorado Department of Public Health and Environment, *Hantavirus Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/hantavirus (last accessed July 17, 2014).
[3] Ibid. Plague *Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/plague (last accessed July 17, 2014).
[4] Ibid. *Tularemia Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/tularemia (last accessed July 17, 2014).
[5] Ibid, *West Nile Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/westnilevirus (last accessed July 17, 2014).
[6] Ibid.

activities during dawn and dusk, and draining ponds or other bodies of water that have little or no circulation.

Geographic Extent

Pestilence

Rodents such as mice, rats, and rabbits, are found across the entire planning region, as are insects. The presence of the rodents and insects is a consistent feature, with normal population density flows following the seasonal patterns. However, when density of these populations exceeds the capacity of the ecosystem, agricultural industries such as crops and the health of livestock are threatened. Grasshoppers are a common pest in Colorado, where more than 100 species exist. Four of the species present the biggest problems for farmers, however, including the differential, migratory, two-striped and red-legged grasshopper (CSU Extension Service).

During large grasshopper infestations, it is likely that significant portions of the planning region will be impacted simultaneously, though the degree of severity may vary. Therefore, pestilence hazards have a geographic extent rating of **extensive**. Annually-updated grasshopper hazard maps based on surveys by USDA-APHIS-PPQ can be found at http://1.usa.gov/LmzKyYH. The 2014 grasshopper map shows that there will be low populations of grasshoppers in northeastern Colorado in 2014.

Plague

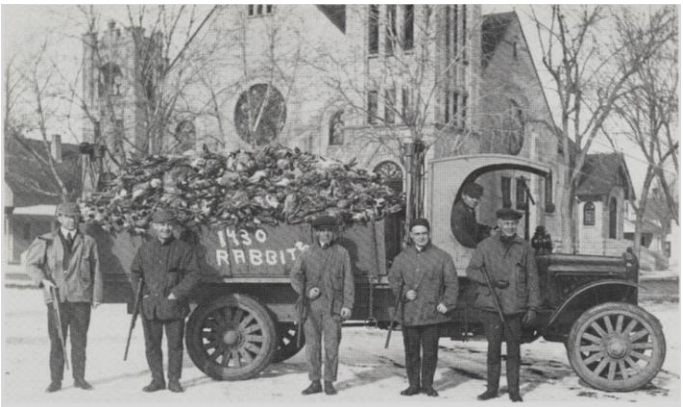
Each of the zoonotic diseases discussed in this profile have a global incidence history. The Colorado Department of Public Health and Environment considers the specifically profiled diseases to be the most common in the State. Diseases are difficult to categorize based on geographic extent alone. The entire planning area is at risk to an occurrence of any of the diseases, alone or in concurrence with other outbreaks. The affected population will rarely be uniform, however, as the current epidemiologic record indicates. Therefore, the geographic extent rating for plague is **limited**.

Previous Occurrences

Pestilence

On December 29, 1924, the Colorado Governor declared a “Hunt Day” targeting the rabbits that were causing devastating damage to crops across the planning area. In one day, 125,000 rabbits were killed in a six-county area (and 4,000 were shipped to Denver to feed the needy). In 1935, 15,000 rabbits were killed in Sedgwick County alone. Photos of pick-up trucks piled high with the bounty still adorn the walls of local historic societies, barbershops, and drug stores. There is some documentation of similar hunts in earlier years (around 1900) that were organized to rid the fields of roving bands of coyotes.

Figure 4.1. Historical Photograph of a Rabbit Hunt's Yield



Source: Unknown.

Two state disaster declarations were made for grasshopper plagues and the impact on agriculture in 1980 and 1981. In 1931, 1937, and 1958 the sugar beet crop in the community of Ovid was completely lost to grasshoppers.

Grasshopper Infestations 2009-2014

In 2009, the planning area experienced the highest grasshopper infestation since 2002-2003. Timely rains and aggressive spraying ultimately helped mitigate the impacts. Protecting crops from grasshoppers was difficult again in 2010 when a second hatch had ideal conditions for growth. Once grasshoppers reached the numbers and growth stage requiring direct action, sprays, dusts and baits were used to provide the quickest means of control (Western Farmer-Stockman, September 23, 2010). During the summers of 2011 and 2012, Colorado again experienced substantial infestations with grasshoppers numbering as many as 17 per square yard in test areas, according to the U.S Department of Agriculture. Timely spraying and other field management methods were employed to help limit the damages to crops and rangeland. Scientists and farmers expected the trend to continue in 2013, but a cold, wet spring promoted bacteria that limited grasshoppers to an estimated 3 per square yard (Denver Post, July 11, 2013). Based on surveys conducted by USDA-APHIS in 2013, it is estimated that there will be low populations of grasshoppers in northeastern Colorado in 2014.

Plague

Between January 1985 (when the disease was first documented) and November 2013, only three cases of hantavirus have been reported in the planning area. All three cases were non-fatal, and there is not a correlation between the manifestation of the disease in the patient and the location of exposure. Statewide, there were 50 total cases confirmed between January 1,

2003 and November 7, 2013, 18 of which were fatal.[7] Bubonic plague records are only available on a statewide basis. Only three cases of plague were reported in 2013, none in the planning area.[8] Between 1970 and 2012, there were more than 40 confirmed or probable cases of plague, mostly in the southwestern part of the state.[9] Statistics for tularemia cases are only available on a statewide basis. Between 2003 and 2012, 18 cases of tularemia were reported in Colorado.[10] In 2013, an estimated 20 cases of West Nile Virus were confirmed in the planning area, mostly in Morgan County.[11]

Probability of Future Occurrences

Pestilence

While the population of rodents and insects in the region is a yearly occurrence, this alone cannot describe the probability of future occurrences. These populations are part of the natural ecosystem of the region and are expected in certain quantities each year. The presence of such populations only becomes a hazard when the population number reaches a number greater than the surrounding ecosystem can support, driving the rodents and/or insects to severely damage crops and/or livestock. It is difficult to quantify when this may become an issue, as the data for tracking such events is not always available. Based on the information collected in this plan, their probability is **occasional**, as the events have recurrence interval that falls between 10 and 100 years.

Plague

The diseases profiled here are naturally occurring in the populations of animals that reside in the region. Rather than addressing the pandemic potential of these diseases, this plan examines when these diseases manifest in severe injury or fatalities among humans. The probability of future occurrence for each of the profiled diseases is estimated below:

Hantavirus: The occurrence rating is 12.5%, with 0 documented fatalities in the planning region, and merits a probability rating of **occasional**.

[7] Colorado Department of Public Health and Environment, *Hantavirus Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/hantavirus (last accessed July 17, 2014).
[8] CDPHE, *Plague Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/plague (last accessed July 17, 2014).
[9] Centers for Disease Control and Prevention webpage. Available online at www.cdc.gov/plague/ (last accessed July 17, 2014).
[10] Centers for Disease Control and Prevention webpage. Available online at www.cdc.gov/tularemia/ (last accessed July 17, 2014).
[11] CDPHE, *West Nile Webpage*. Available online at http://www.colorado.gov/pacific/cdphe/westnilevirus (last accessed July 17, 2014).

Bubonic Plague: The occurrence rating for the state is 100%, with at least 5 expected cases per year, and the fatal occurrence rating is 17.6%. The probability rating for illness, then, is **highly likely**. The probability rating for a fatal case in a given year is **likely**. Region-specific statistics are not available.

Tularemia: The occurrence rating for the state is 100%, with an expected 6.5 cases per year. No fatality statistics are available. Therefore, the probability rating is **highly likely** on a statewide basis. Region-specific statistics are not available.

West Nile Virus: The occurrence rating for the region is 100%, and results in a probability rating of **highly likely**.

Combining the occurrence ratings of the four profiled diseases results in a probability rating of for plague in the region of **highly likely**.

Magnitude/Severity

Pestilence

Without better data to evaluate the damages caused by infestations of insects and rodents, it is difficult to assess the magnitude and severity of the hazard. The NCEM Planning Team provided estimates of potential damages, ranging from historical accounts with 100% loss of crops, to more limited damages that fall between a 10 and 25% damage ratio. No fatalities or serious injuries are generally associated with these events; however, the long-term economic impacts may have secondary impacts on health and population trends. Based on this discussion, the most reasonable rating of magnitude and severity is **limited**, with the knowledge that extreme events may cause **catastrophic** damage. Further studies on these hazards should be conducted in the future to better assess the potential severity of the events.

Plague

Usually, disease does not directly cause property damages or losses. Some zoonotic diseases may impact livestock, which may have a significant impact on the economics of the industry. Other diseases impact the human population, which may have secondary impacts on the production of materials, goods, and services while the population is ill. The most common method of evaluating the magnitude and severity of a disease, however, is to examine how many people are likely to fall ill, and of those, how many are likely to die. In a non-pandemic setting, the majority of the illnesses discussed in this profile are rated as **limited**, because they affect a smaller portion of the population and are usually very treatable (the exception is West Nile Virus which is not easily treated but normally not fatal).

Overall Hazard Significance

Pestilence

The impact of infestations on crops and livestock has a **catastrophic** potential, though the more common occurrences are generally milder and more **limited**. The mitigation responses to these hazards range in cost and effectiveness. The events are considered **occasional** hazards, though they have an **extensive** geographic impact. While the hazards should be considered and mitigated where possible, they are probably not the highest priority for the region, and are assigned a **medium** rating.

Plague

Similar to the infestation ratings, plagues hold a **critical** potential risk to both livestock and human lives under **limited** occurrence ratings. However, at a yearly occurrence (or **highly likely** rating), the diseases generally manifest at a significantly lower magnitude and severity rating of **limited**. The geographic distribution of the diseases are driven more by the animal carriers and transmissibility of the agent than of the location of ill populations, which indicates the rating is **extensive**. For the more common occurrences, standard mitigation measures reduce the number of cases. Many of the diseases are treatable, and often entirely avoidable. Therefore, the risk and vulnerability levels of the events are fairly low. While mitigation considerations should continue, these hazards are probably not the highest priorities for the region, and are assigned a **medium** rating.

4.2.3 Blizzards and Severe Winter Storms

Description

Heavy snow, ice, severe winter storms, and blizzards are common occurrences in Colorado. These hazards have caused more state and federal disaster declarations than any other hazard in the Northeastern Colorado region. The National Weather Service Glossary defines common winter storm characteristics as follows:[12]

- **Blizzard:** A blizzard means that the following conditions are expected to prevail for a period of 3 hours or longer:
  - Sustained wind or frequent gusts to 35 miles an hour or greater; and
  - Considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than ¼ mile).
- **Heavy Snow**: This generally means:

[12] National Weather Service "National Weather Service Glossary Website." Available online at w1.weather.gov/glossary/ (last accessed July 17, 2014).

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

- **Ice Storm**: An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater.

Blizzards and severe winter storms in northeastern Colorado are often exacerbated by high winds that frequently blow across the relatively flat landscape. It is often the blowing and drifting snow, more than snow depths, which causes problems in the planning region.

Geographic Extent

Winter storms are a yearly feature of the Colorado climate and occur across the entire state. The size of events varies and may range from isolated (impacting only a portion of a county) to statewide. Generally, severe winter storm events are considered to be a regional occurrence, impacting multiple counties simultaneously and for extended time periods. As a result, the geographic extent rating is categorized as **extensive**.

Previous Occurrences

The National Climatic Data Center (NCDC) maintains local records of the number of blizzards, which are characterized by sustained winds and blowing snow, and the number of winter storms, characterized by heavy snow and significant ice, dating to 1996. Between 1996 and 2013, NCDC records indicate that the nine counties participating in this plan experienced the following number of blizzard and winter storm events:

• Cheyenne County	9 Blizzards	12 Winter Storms
• Kit Carson County	14 Blizzards	16 Winter Storms
• Lincoln County	20 Blizzards	19 Winter Storms
• Logan County	13 Blizzards	17 Winter Storms
• Morgan County	9 Blizzards	17 Winter Storms
• Phillips County	8 Blizzards	7 Winter Storms
• Sedgwick County	12 Blizzards	10 Winter Storms
• Washington County	17 Blizzards	15 Winter Storms
• Yuma County	15 Blizzards	14 Winter Storms

According to the NCDC data, a total of 244 blizzards and winter storms (117 blizzards/127 winter storms) occurred over a 17-year period in the region (the data for blizzards and winter storms are distinct and not double-counted as part of the same event). At a regional level, the numbers are inflated since many of these events impacted most if not all of the nine counties. The numbers are not a perfect representation of events, as the storms are often regional and impact several counties simultaneously. Specific storms which may have had an unusually high impact on a single county are located in the County Planning Elements.

Table 4.3 below provides data on winter storm events in the region over a longer period of time, 1960-2013, along with the deaths, injuries, and damages to property and crops attributed to the events over the study period.

Table 4.3. Winter Storm Events, Deaths, Injuries and Damage in Northeastern Colorado by County, 1960-2013

County	Events	Deaths	Injuries	Property Damage	Crop Damage	Total Damage
Cheyenne	56	1	1	$1,256,486	$1,283,045	$2,539,531
Kit Carson	70	2	2	$1,495,056	$283,207	$1,778,263
Lincoln	62	2	2	$1,278,899	$283,045	$1,561,944
Logan	72	0	1	$1,454,409	$423,178	$1,877,587
Morgan	63	0	4	$7,564,953	$427,235	$7,992,188
Phillips	69	0	1	$1,449,523	$423,178	$1,872,701
Sedgwick	69	1	1	$1,449,523	$423,178	$1,872,701
Washington	74	0	3	$1,471,909	$423,178	$1,895,087
Yuma	73	0	1	$1,476,076	$5,423,478	$6,899,254
Total	608	6	16	$18,896,834	$9,392,722	$28,289,256

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Historic Winter Storms

The planning area is subject to periodic severe winter weather events, including blizzards, heavy snowfall and ice storms. One of the first events of record was the 1913 snowstorm that buried most of north and northeastern Colorado, with snow depths along the Front Range from Denver to Wyoming that still stand as records in many locations. Notable winter storms also occurred back in 1931 and 1946, but possibly the worst blizzard to ever hit Colorado took place in January 1949.

The 1949 Blizzard is one of the most severe blizzards of record across a broad area of the Great Basin, middle Rockies and Great Plains. In northeastern Colorado, bitter cold and high winds accompanied by modest snowfall resulted in seven fatalities, blocked roads, stranded travelers, isolated towns and farms, and heavy livestock losses across the region. Snowdrifts from 10 to 30 feet high isolated communities and animals, requiring an airlift of medical supplies for people and hay for starving animals.

Other historic winter weather events in the region include a serious ice storm in 2001 and blizzard events in 1977, 1980, 1982, 1989, 2006 and 2007.

Figure 4.2. Blizzard of 1949, Logan County, Colorado

Significant Winter Storms 2009-2013

In February 2012, a slow-moving and powerful storm system brought heavy snow to the Front Range and blizzard conditions to northeastern Colorado. Snow and blowing snow forced closures of I-70 in eastern Colorado, U.S. 40 between Limon and Eads, and State Highway 71 from Last Chance to Limon to Ordway. Snow accumulation totaled 13 inches 11 miles east-southeast of Holyoke, 11 inches four miles north of Arriba, 10 inches six miles west-northwest of Otis and Woodrow, 9.5 inches near Amherst, 6.5 inches in Sterling, 6 inches in Brush, and 5.5 inches in Karval.

In April 2013, a strong upper-level Jetstream moved over northern Colorado and produced bands of very heavy snow north of I-70 and extending from the mountains to the northeastern

plains of Colorado. On April 15 the snow fell at rates of 2-3 inches per hour. Snowfall totals included seven inches near Crook and six inches near Fort Morgan.[13]

Probability of Future Occurrences

Using either set of data – NCDC or Colorado Natural Hazards Mitigation Plan -- to calculate incident frequency, the likelihood of any of the nine counties experiencing a severe winter weather event (blizzard, ice storm, heavy snowfall) in a given year is at or near 100%; therefore, the estimated probability of future occurrence rating is **highly likely**.

Magnitude/Severity

The damages caused by severe winter storms and blizzards vary and are dependent on several factors: the duration of the storm; the geographic extent; the time of year; and advance warning of the storm. Impacts from the storm dictate the magnitude of the event, but snow amounts do not always correlate with the impacts of the storm on people and property. Damaged power lines and dangerous or impassable roadways may forestall the delivery of critical services such as medical and emergency assistance, the delivery of food supplies and medications, or even the provision of basic utilities such as heat and running water. With enough warning time, it is possible to pre-mitigate the effects of insufficient supply levels or to pre-test emergency generators, which may prevent some of the previously described impacts from occurring. Unanticipated storms increase the number of people stranded, both in cars and at public locations, which may increase the number of injuries and deaths attributed to the event (often caused by exposure) and place uneven and unanticipated strains on public sheltering capacities. The weight of the snow, driven by the water content of the snowfall, often determines the level of damages to structures, trees and utility lines. Lighter snow accompanied by extreme cold temperatures may increase risks to livestock, agriculture and landscaping due to freezing conditions. Winter storms that involve a thaw-freeze cycle can prolong dangerous icy conditions, increasing the likelihood of frozen and damaged water pipes, impassable or dangerous roadways, damaged communication lines, or more extensive damages to infrastructure and structures caused by seepage under roofs, porches, patios, and sidings.

Severe winter storms can paralyze much or all of the planning region by isolating communities, stranding motorists, disrupting emergency and medical services, stopping the flow of supplies, and downing trees and power lines. Blizzards and heavy snowfall events can damage homes and businesses and result in serious impacts to agricultural operations, including loss of livestock. Based on this, a magnitude severity rating of **critical** seems most appropriate.

[13] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (3-123).

Overall Hazard Significance

Blizzards and snow storms are expected components of the Colorado climate. Severe manifestations of these storms, however, are a significant hazard to the planning region. The events may impact any portion of the region and, more often than not, impact the majority of the region simultaneously. The geographic extent of these events is clearly **extensive**. Severe events are a yearly occurrence so the probability of occurrence is considered **highly likely**. The damages caused by the storms also vary, but are often debilitating for a community or county, or several combinations thereof, for several days. In severe instances, effects may extend for days or weeks, and overstretch local capabilities very quickly. The magnitude and severity of severe winter storms is **critical**, and this hazard should be considered a **high** priority for the planning region. Communities in northeastern Colorado should be prepared for winter storm emergencies by identifying mass care facilities, ensuring generators and emergency supplies are available, and making provisions in advance for snow clearance and removal,

4.2.4 Dam and Levee Failures

Description

A dam safety incident is an impending or actual sudden uncontrolled release or excessive controlled release of water from an impounding structure. The release may be caused by damage to or failure of the structure, flood conditions unrelated to failure, or any condition that may affect the safe operation of the dam. The release of water may or may not endanger human life, downstream property, or the operation of the structure. When people live in an area that could be affected by the operation or failure of a dam, there is the potential for an emergency related to a dam safety incident.[14]

Dam failures result in a unique source of flash flooding, when a large amount of previously detained water is suddenly released into a previously dry area due to a failure in some way of the dam. Dams are classified into four classes. The 2013 Colorado Natural Hazards Mitigation Plan defines Class I (High Hazard) dams structures that, in the event of a failure, would be expected to cause loss of life and/or significant property damage within the flood plain areas below the dams. Class II (Significant Hazard) dams as those rated based on expected significant damage, but not loss of human life.[15] Significant damage refers to structural damage where humans live, work, or recreate; or public or private facilities exclusive of unpaved roads and picnic areas. Damage refers to making the structures uninhabitable or inoperable.

[14] *Federal Guidelines for Emergency Action Planning for Dams*, FEMA P-64 (July 2013), Federal Emergency Management Agency (p I-2).
[15] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-48).

Privately-owned Class I and II dams are required by Colorado regulations to have Emergency Action Plans (EAPs) in place.[16] Federally-owned Class I dams are also required to have EAPs by Federal Regulations.[17] According to the 2013 State Hazard Mitigation Plan, all high-hazard dams in Colorado have EAPs in place, which provide for the emergency response procedures in the event of a dam emergency event. According to the Colorado Division of Water Resources, there are a total of 373 Class I dams in Colorado (federal and non-federal) and 333 Class II dams (federal and non-federal) in the state.[18]

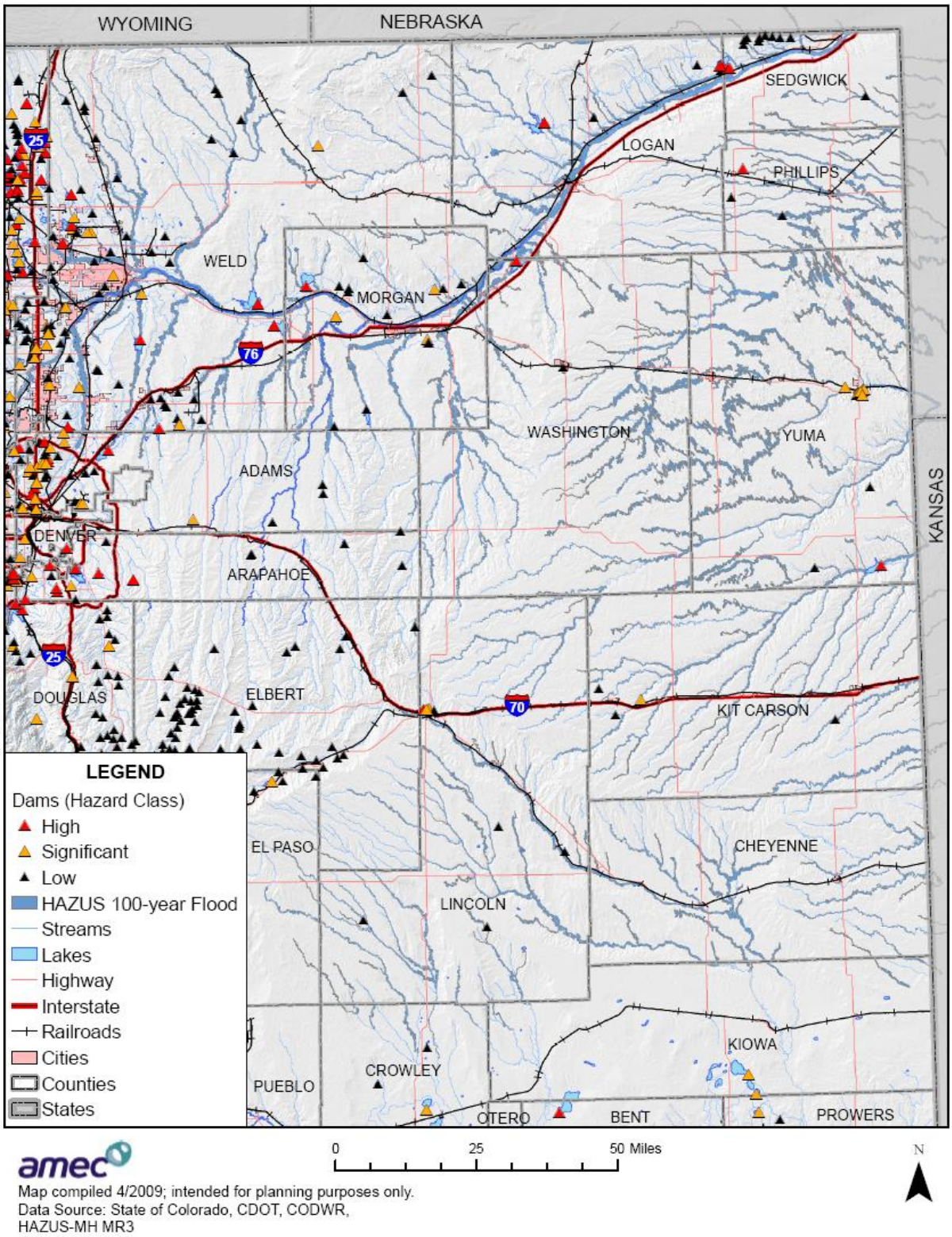
Levees are defined by the Army Corps of Engineers as "earthen embankments whose primary purpose is to furnish flood protection from seasonal high water for a few days or weeks a year. Levees are broadly classified as either urban or agricultural because of different requirements from each."[19] Levee failures can occur when a flood occurs that exceeds the designed level of protection. In this case the levee may fail or be overtopped. Levees that are not maintained are at risk from failure due to erosion, rodent activity, or piping along roots from vegetation growing on the levee.

Geographic Extent

The map below displays the location of Class I (High Hazard) and Class II (Significant Hazard) dams within and adjacent to the planning area.

[16] Further information regarding the regulations governing dams in the State of Colorado can be found in the "Guide to Construction and Administration of Dams in Colorado" (March 2010) available online at http://water.state.co.us/DWRIPub/Documents/damguide.pdf.
[17] Dam Operations Management Policy, ER 1130-2-419.
[18] Colorado Division of Water Resources, *State Engineer's 27th Annual Report on Dam Safety to the Colorado General Assembly* (April 2013).
[19] U.S. Army Corps of Engineers, *Levees Website.* Available online at www.usace.army.mil/Missions/CivilWorks/LeveeSafetyProgram.aspx (last accessed July 20, 2014).

Figure 4.3. Class I and Class II Dams in Northeast Colorado



Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

The table below depicts the number of Class I and Class II dams in each county of the planning region.

Table 4.4. Class I and Class II Dams in the Planning Region

County	Number of Class I Dams	Number of Class II Dams
Cheyenne	0	0
Kit Carson	1	0
Lincoln	1	2
Logan	3	0
Morgan	0	6
Phillips	0	0
Sedgwick	3	0
Washington	1	0
Yuma	1	7
Total	**10**	**15**

Source: National Inventory of Dams Associated with HAZUS MH MR3.

Dams outside of the planning region may also have a significant impact on the area if a catastrophic failure were to occur, although the locations of the dams themselves are significantly outside the nine-county area. The counties and communities in the South Platter River floodplain are most at risk to dam failure hazards. These include Logan, Morgan, Sedgwick and Washington Counties. The downstream distance of these counties from hazardous dams is great enough that advance warning and lead time should allow for evacuations of populated areas. The two closest high hazard dams – Riverside and Empire – are located along the S. Platte River in Weld County immediately upstream from Morgan County and the planning region. The geographic extent rating for the area of the planning region that could be impacted by a dam failure is considered **significant.**

The table below indicates the number of Class I and Class II dams along the major tributaries that flow into the planning region. Not all of these dams are located in the planning region, but the potential impacts from a catastrophic dam failure along one of these tributaries is likely to impact the planning region.

Table 4.5. Class I and Class II Dams along Major Tributaries Outside of the Region

River Name	Number of Class I Dams	Number of Class II Dams
South Platte River	17	6
Cache La Poudre	20	9
Big Thompson River	11	8
St. Vrain Creek	4	5
Boulder Creek	9	6

Clear Creek	8	5
Cherry Creek	2	1
Total	71	40

Source: National Performance of Dams Programs Multi-Attribute Dams Directory Query.

There are only two small levees in the planning area, based on levees that are mapped on Flood Insurance Rate Maps (see Table 4.6). Both levees are in the City of Wray in Yuma County. This levee inventory is not complete, as portions of the planning region have not been mapped by the NFIP, and many of the existing maps are over 20 years old. Smaller levees or embankments that do not provide 100-year flood protection would not be captured in this inventory. Morgan County has levees protecting the communities of Weldona and Wiggins.

Table 4.6. Levees in the Planning Area

Levee ID	Levee Type	County	Community	Flooding Source	Length	Protected Flood Zone	Protected Area Zone Type	Unprotected Area Flood Zone	Area
783	Riverine	Yuma	City of Wray	North Fork Republican River	0.1 miles	Zone C or Zone X	D	Zone A	0.5
784	Riverine	Yuma	City of Wray	North Fork Republican River	0.1 miles	Zone C or Zone X	D	Zone A	0.5

Source: Colorado Levee Report from FEMA Levee Information System.

A geographic distribution of levees is difficult to calculate based on this data, as it may be incomplete and offers no means of assessing potential damages due to a levee failure. However, based strictly on the distribution of known physical structures, the geographic extent is **limited**.

Previous Occurrences

A search of the NPDP database identified 10 historic dam-related incidents in the region, reflected in the table below. According to this table there have been five dam failures in the planning region and four of the five failures were associated with low hazard dams. No specific information about the dam failures was available from this database.

Table 4.7. Dam Incidents in Planning Area

Dam ID	Name	Date of Incident	Description of Incident	Nearest Town	County	Class	Waterway	Failure?
CO00009	Empire	1909	Unknown	Orchard	Morgan	High	South Platte	No
CO00382	Jumbo	1910	Seepage	Sedgwick	Sedgwick	Low	South Platte	Yes
CO00112	Riverside	1910	Reservoir – Wind Waves	Orchard	Morgan	High	Sanborn Draw	Yes
CO00384	Point of Rocks	1915	Reservoir- Wind Waves	Iliff	Logan	Low	Cedar Creek	Yes
CO00393	Sand Creek	1915	Piping	Venango, NE	Lincoln	Low	Sand Draw	Yes
CO0009	Empire (East Embankment)	9/20/1994	Inadequate Spillway Capacity	Orchard	Morgan	High	South Platte	No
CO00112	Riverside	12/15/1994	Inadequate Spillway Capacity	Orchard	Morgan	High	Sanborn Draw	No
CO00390	Frenchman Creek	6/4/1995	Piping	Holyoke	Phillips	Low	South Fork Frenchman Creek	Yes
CO00016	Jackson Lake	4/15/1999	Reservoir Incident (High Winds/Wave Damage)	Goodrich	Morgan	High	South Platte River	No
CO00529	Karval	5/6/1999	Seepage/Slide	Las Animas	Lincoln	Low	Adobe Creek	No

Source: National Performance of Dams Programs Dam Incident Query.

Probability of Future Occurrences

Within the planning area there have been five dam failures between 1907 and 2013, a 106-year period. This equates to a failure recurrence rate of 4.7% and a rating of **likely**. However, dam incidents may indicate that failures were possible; therefore, counting both serious dam incidents and dam failures may provide a more reliable probability of future occurrence rating. In that case, there have been 10 reported incidents and the rate is 9.4%, also in the **likely** range for recurrence. This only accounts for documented incidents inside of the planning area.

Magnitude/Severity

The severity and magnitude of a given dam or levee failure is best assessed on a county basis and case-by-case basis. This information is contained in the emergency action plans for the high hazard dams in the state. Some generalizations, however, are also useful for comparing dam failure hazards to other hazards in the planning region. The 2013 Colorado Natural Hazards Mitigation Plan indicates that property damage due to dam failures is very high statewide, though few lives have been lost. More information on the Class I and II dams, and an estimate of relative impacts from a failure of them, can be referenced in the County Planning Elements for Kit Carson, Lincoln, Logan, Sedgwick, Washington and Yuma Counties. Additional estimates of levee failure impacts are discussed in the Morgan, Logan and Yuma County Planning Elements. Dams are classified based on the potential damages and potential for loss of life.

Class I dams, by definition, would merit a magnitude/severity rating of **catastrophic**, whereas Class II dams rate as **critical** and low hazard dams fall into the **limited** rating. Certified levees would fall along a similar distribution. Given the low overall number of incidents involving dams and levees in the planning region and that the majority of dam failures in the region were for low-hazard dam classifications, the most appropriate general rating for the hazard is **limited**.

Overall Hazard Significance

The geographic distribution of dams may be measured either by how many dams are in a given area, or by how much area may potentially be impacted by a failed dam. The general evaluation of such for this plan estimates the geographic distribution for dams to be **significant**. The probability of future occurrences is measured based on past incident history. The probability for documented, in-region dam failures is **occasional**, when examining all incidents, including failures, for dams just within the region. The factors of dams outside the planning region should also be considered. The magnitude/severity rating for the hazard is considered **limited**, mostly due to the low number of Class I dams and historic events involving dams and levees in the planning region. In the future, previously lower-classified dams may pose greater risks, which could elevate their hazard classification. Variables that could lead to a reclassification include the age of the dam, location relative to a waterway, relative location to other structures, and reservoir capacity. Based on all of these factors, a significance rating of **medium** is appropriate for this hazard in the planning region.

4.2.5 Drought

Description

Drought is a natural part of the climate in the semi-arid region of northeastern Colorado. The most significant impacts associated with drought in the planning region are related to agriculture. These impacts are compounded the longer the drought lasts, as water levels in reservoirs and groundwater basins are depleted.

According to the 2013 Colorado Drought Mitigation and Response Plan, "Drought is a complex and a gradual phenomenon in Colorado. Although droughts can be characterized as emergencies, they differ from other emergency events in that most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts typically occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends."[20]

[20] Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan*, August 2013 (p. 19).

In its simplest terms, drought can be defined as a period of time where the amount of water available is insufficient to meet the demands on that water supply. Scientists and researchers also evaluate drought impacts on a regional basis and according to the types of impacts. Meteorological drought involves degrees of dryness when actual precipitation is less than expected or normal amounts.

Meteorological drought is usually defined by a period of below average precipitation. *Agricultural* drought occurs when there is an inadequate water supply to meet the needs of agricultural operations, based on soil moisture deficiencies relative to water demands of crops and rangeland. *Hydrologic* drought refers to deficiencies in surface and subsurface water supplies and is measured as streamflow, snowpack, reservoir, and groundwater levels. *Socioeconomic* drought occurs when a drought impacts health, well-being, and quality of life, or when drought effects start to have an adverse economic impact on a region.[21]

Droughts are of particular concern in regions that rely on water supplies for agriculture growth and development. The majority of the planning region is considered agricultural, and therefore has a higher exposure to drought events than other areas of the state. Depending on the stage of plant development, even short-term droughts of only a few weeks can adversely affect crop production. Drought also leads to less vegetative cover and more exposed soil, which in turn can lead to crop-damaging dust storms.

According to the 2013 Colorado Natural Hazards Mitigation Plan, "Available crop insurance data indicates over $644 million has been paid to the region's agricultural landowners in insurance claims between 1980 and 2007. It is reasonable to assume that a significant amount of this is due to drought-related losses."[22]

Geographic Extent

According to the 2013 Colorado Drought Mitigation and Response Plan, the nine counties in the planning region are subject to moderate to major impacts from drought. Droughts are regional events on a national level, impacting multiple states simultaneously. Since historical drought records indicate that long-term climate patterns are fairly constant in the region, it is reasonable to assume that counties in the planning region will continue to face drought conditions in the future and the hazard is assigned a geographic extent rating of **extensive**.

[21] Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan*, August 2013 (p. 19).
[22] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p 3-32).

Previous Occurrences

The planning area has experienced seven multi-year droughts since 1893, with the most devastating taking place in the 1930s and 1950s. The following chart is from the *Colorado Drought Mitigation & Response Plan (August 2013).*

Figure 4.4. Historical Dry and Wet Periods in Colorado

Date	Dry	Wet	Duration (Years)
1893-1905	X		12
1905-1931		x	26
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
2010-2012	x		2

Source: 2013 Colorado Drought Mitigation and Response Plan (Colorado Water Conservation Board).

On a statewide basis, 2002 was the most intense single year of drought in state history. An extremely dry year imbedded in a longer dry period (2000-2006), conditions in 2002 resembled those of 1934, the worst of the Dust Bowl years between 1931 and 1941. The magnitude of drought conditions in 2002 was rated as "exceptional" by the U.S. Drought Monitor, making 2002 the most severe drought in the state since the 1930s.[23]

Summary of Drought Impacts 2009-2013

The 2011-2013 drought also resulted in widespread agricultural losses in the planning region and around the state. In 2012, soil moisture was low on the plains during the spring planting season and temperatures were unusually high, giving crops little chance to establish themselves. A thin snowpack and lower-than-normal runoff meant less water availability for summer irrigation diversions. June temperatures were consistently above 100°F on the eastern plains, comparable to temperatures observed during the historic drought years of 1934 and 1954. According to the 2013 Colorado Drought Mitigation and Response Plan, "A majority of pasture and rangeland areas were classified as poor or very poor by August of 2012. Hay was

[23] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-22).

hard to come by due to production decreasing to 10% to 50% of average and limited supplies from neighboring states also impacted by drought. This caused prices to drastically increase, necessitating trucking hay in from northern Montana and Idaho, and even as far away as the Carolinas."[24]

The hot, dry conditions also contributed to an extended grass fire season. Prairie fires typically occur in the spring, but the record- and near-record temperatures in June and July 2012 primed grass and rangeland areas for fast-moving, late summer fires. In the Last Chance Fire, 45,000 acres were scorched in a matter of days, destroying 23 structures, including five homes.

Probability of Future Occurrences

Counting the 2011-2013 drought, Colorado has experienced seven significant droughts since 1893, equating to a recurrence interval of experiencing a drought once every 17 years, or a rate of occurrence of 5.78%. This expected recurrence rating coincides with a probability rating of occasional; however, the extended nature of the events qualifies the hazard for a **likely** occurrence rating. This is supported by taking the number of "dry" years, rather than the number of droughts, divided by the total number of years on record. Using this methodology, the probability of future occurrence is 34%.

Magnitude/Severity

The severity of a drought depends on the duration and its relative impact on agriculture, water supply, revenues derived from water industries and agriculture. For the purposes of this plan, droughts are not considered to cause human fatalities directly. Extreme temperatures that may be associated with droughts are profiled later in this plan. In addition, drought does not usually directly impact critical infrastructures such as roads, bridges or buildings housing communications, EMS, fire, police and medical personnel. Drought may cause more than 50% damage to agricultural lands, depending on scope and severity. Drought can have cascading adverse effects on agricultural production. The loss of an initial crop is a financial impact directly, but from there, additional damages may include the loss of seed for the next growing season, the loss of fodder for livestock, or the loss of personal food supplies intended to supplement or even replace a grocery budget. As more crops are lost, the cost of replacements also increases, which exponentially impacts the overall costs to farmers. Livestock owners are also impacted by drought, as natural food resources from livestock herds may be scarce or unavailable during a drought, which may result in unhealthier herds, force the rancher to sustain lower inventory levels of animals, or incur additional expenses when feed for the animals must be purchased. Water rights battles are also exacerbated during drought conditions, where the costs of water rises while the availability of water decreases. The best

[24] Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan*, August 2013 (p. 45).

reflection of magnitude and severity for drought is **critical**, because the planning region is predominately agricultural. It is important to note this rating is higher than it might be for a more metropolitan area and may be evaluated differently on a more local level.

Overall Hazard Significance

The economic implications of drought are severe and are as variable as the event itself. The geographic rating is **extensive** as droughts are regional and may impact multiple states, not just multiple counties. The probability of drought is **likely** and the magnitude and severity of an event in the heavily agricultural region is **critical**. Overall, a drought is a prolonged and serious hazard to the region, though individual communities and sections of the region may have different assessments based on particular mitigation efforts and experiences. Regional emphasis on mitigation projects is important. The hazard is considered of **high** significance.

4.2.6 Dust Storms

Description

Dust storms are giant walls of dust created from high winds, usually as cold air in front of a thunderstorm rushes downward at a very high rate and lifts massive amounts of dust and sand into the air. Dust storms can effectively block out the sun, making it impossible to see even a few feet. Dust storms also effect air quality for days following a large event, posing health risks to people with respiratory problems. Dust storms are also referred to as "haboobs," an Arabic word.[25]

According to the National Weather Service, an official dust storm event occurs when visibility in a localized or widespread area falls below locally/regionally established values (usually 1/4 mile or less), and results in a fatality, injury, damage, or major disruption of transportation. Some dust storms may be due to winds meeting or exceeding locally/regionally defined high wind warning criteria.

Fatalities and injuries can occur if people are asphyxiated due to high dust/sand content in the air, hit by flying debris, blown off a road by the strong winds, or involved in vehicular accidents caused by reduced visibility or by debris left on a road after a dust storm has passed.

Geographic Extent

Dust storms are closely correlated with drought, in much the same way that wildfires and tumbleweed outbreaks increase during dry cycles. Drought leads to less vegetative cover and more exposed soil, which in turn can lead to crop-damaging dust storms. All nine counties in

[25] ABC15 Arizona News. Available online at www.abc15.com/weather/monsoon/haboobs (last accessed July 30, 2014).

the planning region are subject to moderate to major impacts from drought, including occasional dust storms. Since historical drought records indicate that long-term climate patterns are fairly constant in northeastern Colorado, counties in the planning region will continue to face drought conditions in the future. The drought hazard is rated extensive but, due to the fact that drought alone cannot trigger dust storms without accompanying downdraft wind conditions, the hazard is assigned a geographic extent rating of **significant.**

Previous Occurrences

Colorado Preservation, Inc. captures the misery of the Dust Bowl days in the following description, "Dust was not uncommon in the semi-arid areas of Colorado when the high plains winds blew, so no one was really surprised to see a few "dusters" in eastern Colorado in 1931. They came back the next year with more vigor, and by 1933 the dust storms were so intense that everyday life became almost impossible for both people and livestock. One storm, beginning on May 9, 1934 and lasting for several days, was estimated to have removed 300 million tons of fertile top soil off of the Great Plains. The storms actually increased overall in numbers and intensity as the "dirty thirties" continued, with 1937 being the worst on record. Colorado's black blizzards of the 1930s were different in many ways from those of previous years. These were more intense, lasted for days, and returned nearly every year during the "dirty thirties." The storms destroyed millions of farmland acres and caused mental and physical anguish to residents. Towns had to turn on their street lights during the day; dust sifted into buildings, causing people to put wet sheets over doors and window to try to stop the infiltration. They ate meals under a tablecloth and had to wear goggles or masks of wet towels while outdoors. Dust covered roads, fences, and cars, piling as high as snow drifts; rail traffic was stopped."[26]

Dust storms have been experienced with greater frequency in the planning region over the last five years, not coincidentally corresponding to the prolonged drought over the same period. Southeastern Colorado has so far been the location of some of the worst dust storm events, but the southern and eastern portions of the planning region, including Cheyenne, Kit Carson, Lincoln and Yuma Counties, have also been the target of dust storms in the last few years. The photo below was taken near Lamar in Prowers County in June 2013.

[26] Colorado Preservation, Inc. Available online at www.coloradopreservation.org/ (last accessed August 4, 2014).

Figures 4.5 and 4.6. Historic and Contemporary Dust Storms

Source: Unknown

Source: Denver Post, June 9, 2013

Probability of Future Occurrences

Given that dry cycles and drought conditions are expected features of northeastern Colorado's climate, the associated dust storm hazard has a recurrence rating of **likely**.

Magnitude/Severity

Agricultural processes can be effected by dust storms, including crop damage and wind erosion that displaces precious topsoil and turns fields into barren spaces overtaken by noxious weeds. Farmers in dust storm-prone areas may be force to change cropping and management practices and different field working techniques and crop rotations. Narrowing and ridging of fields, wind strip cropping, and wind breaks as near as perpendicular to the direction of the wind during critical erosion periods are effective way of mitigating the effects of wind erosion.[27]

People living in cities and towns can also suffer adverse impacts from dust storms, primarily to the health of individuals with asthma and other respiratory problems. Dust storms can lead to power outages, utility disruptions and business losses. Computers and communications equipment can be damaged by dust buildup.

Overall Hazard Significance

Dust storms have become a more common occurrence in northeastern Colorado. With a geographic rating of **significant** for possibility of events, any location is considered vulnerable, though not all counties in the planning region have experienced large dust storms in the recent past. The probability of future occurrences is **likely**, though any single event is not likely to impact the entire region. Dust storms can pose substantial risks to public safety, especially for motorists on highways and county roads, although extensive property damages have been not

[27] University of Texas at El Paso, Center for Environmental Research and Management. Available online at www.research.utep.edu/ (last accessed August 4, 2014).

documented. Since the potential exists for large dust storms to damage communications and computer equipment, disrupt utilities and adversely affect commerce, the magnitude and severity rating is **limited.** Out of concern that the dust storm hazard may be a growing threat in northeastern Colorado, the NCEM Planning Team included dust storms in this Hazard Profile section for the first time with the 2014 update and assigned the hazard a **medium** significance rating.

4.2.7 Earthquake

Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. The amount of energy released during an earthquake is usually expressed as a Richter magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface as felt by humans and defined in the Modified Mercalli scale (see Table 4.8).

Table 4.8. Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors, by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Federal Emergency Management Agency.

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Other damage-causing effects of earthquakes include surface rupture, fissuring, settlement, and permanent horizontal and vertical shifting of the ground. Secondary impacts can include landslides, seiches, liquefaction, fires, and dam failure. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Colorado is considered a region of minor earthquake activity. Geologic studies indicate there are about 90 potentially active faults in Colorado with documented movement within the last 1.6 million years. Potentially active faults, which represent the highest earthquake hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 15,000 years).

Geographic Extent

At this time, only three counties in the planning region exhibit known faults that are suspected to be potentially active, with one additional county under investigation for fault lines, which is a fairly **limited** distribution of potential. However, the magnitude of an event may extend the impacts to **significant** or **extensive** proportions. The faults within the region are the Cheraw Fault (Kit Carson and Cheyenne Counties) and the High Plains Graben fault (Cheyenne, Kit Carson, Washington, Lincoln, Yuma counties). The High Plains Graben Fault was investigated by the Colorado Geological Survey, but no evidence of geologically recent movement was found so it is not considered a threat. There is also potential for earthquakes to occur on faults outside of the region along the Colorado Front Range that could produce shaking large enough to cause damage within the planning region. Based on the history of previous occurrences, as documented below, there is also indication that counties without known, active faults are at risk for earthquakes. No geographically extensive earthquakes have occurred in the planning region, but the potential remains. Based on known events, the geographic extent rating for this hazard is probably **limited**, with the understanding that the available data is incomplete.

Previous Occurrences

Information on historic earthquakes in the planning region is scarce, but according to best available sources, three documented earthquakes occurred in the region over a 123-year period (1870-1993). Those events are documented in the table below.

Table 4.9. Known Occurrences Documented as of 1993

County	Location	Timeline	Magnitude
Cheyenne	East of Kit Carson, South of 50	1962-1993	2.0-2.9
Kit Carson	Southeast of Burlington	1962-1993	3.0-3.9
Lincoln	Near the Lincoln/Crowley County line	1870-1961	Unknown

Sources: Colorado Office of Emergency Management; Colorado Earthquake Project (1999).

The U.S. Geological Survey Earthquake Hazards Program keeps a list of historical earthquakes by state. Only three earthquakes of historical significance are listed for Colorado. Of these, two may have been felt within the planning area, but likely did not cause much damage. These include an estimated M6.2 that occurred near Estes Park in 1882, and an M5.3 near the Rocky Mountain Arsenal northeast of Denver.

Probability of Future Occurrences

The historical record of previous occurrences indicates that events of any magnitude are fairly infrequent, and no serious earthquake events have been recorded in the planning region. It is reasonable to assume a probability rating of **occasional**.

Magnitude/Severity

According to the 2013 Colorado Natural Hazards Mitigation Plan, the seismic hazard in Colorado is rated low to moderate, but the risk may have been underestimated. "Colorado's earthquake hazard and risk has historically been rated lower than most knowledgeable scientists in the state consider justified. As a result, local emergency managers are generally unaware of the size and consequences of an earthquake that could occur in the state. HAZUS 99 gave a probabilistic Annualized Earthquake Loss (AEL) of $5.8 million which ranked Colorado 30th in the nation. In early 2013, the Colorado Geological Survey ran a series of deterministic scenarios for selected faults around the state using HAZUS MH. The earthquake magnitudes used for each fault were the "Maximum Credible Earthquake" taken from the USGS Quaternary Fault and Fold Database or from the USGS National Earthquake Hazard Map. The results demonstrate that the probabilistic AEL value of $5.8 million does not begin to convey the size of the loss that would occur in the event of a strong earthquake on any of these faults."[28]

Table 4.10 below summarizes the total losses and number of earthquake-related casualties estimated for each county in the planning region, based on the results of FEMA's HAZUS MH

[28] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-159).

loss estimation methodology. The earthquake magnitudes used were the "Maximum Credible Earthquake" taken from the USGS Quaternary Fault and Fold Database or from the USGS National Earthquake Hazard Map.

Table 4.10. Northeast Colorado Fault Lines by County

County	Fault	Estimated Casualties	Estimated Total Damages	Previous Events
Cheyenne	Cheraw	0	$4.23 million	
Kit Carson	None	2	$43.74 million	May 27, 1984 Burlington
Lincoln	Cheraw	2	$65.05 million	
Logan	None	0	$16.41 million	
Morgan	None	0	$25.41 million	
Phillips	None	0	$0.22 million	
Sedgwick	None	0	$0.05 million	
Washington	None*	0	$1.66 million	
Yuma	None*	0	$23.71 million	

Source: Colorado Natural Hazards Mitigation Plan (December 2013).

Overall Hazard Significance

Earthquakes in the region are considered a fairly uncommon event. The geographic extent is considered **limited**, based on the historical records, although a severe earthquake may impact a larger area. The probability of occurrence, which is estimated due to a limited historical record of previous occurrences, is **occasional**. The magnitude and severity ratings of the hazard are tied to the extent and intensity of an event. HAZUS modeling indicates events may reach **catastrophic** scales for small portions of the planning region. Overall, however, expected impacts from earthquakes are estimated to be **limited**. Overall, the hazard is of a **low** priority to the region, although individual counties may have a higher priority rating based on particular event likelihood.

4.2.8 Flooding

Description

Flooding in Colorado and in the planning region can occur as a result of rainfall, snowmelt, rain on melting snow, or failure of a dam or levee). According to the 2013 Colorado Flood Hazard Mitigation Plan, "A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from: (1) the overflow of stream banks, (2) the unusual and rapid accumulation of runoff of surface waters from any source, or (3) 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."[29] Depending on the cause, flood events have distinct characteristics relative to flow rate, rate of rise, volume, and duration.

When flooding occurs, water overflows into the floodplain, the area that is naturally inundated by floodwaters (not those areas that are flooded as a result of watercourse blockages, such as bridge constrictions or debris-clogged culverts). In its common usage, the floodplain most often refers to that area that is inundated by the 100-year flood, the flood that has a 1% chance in any given year of being equaled or exceeded. The 1% annual chance flood event is the standard national measurement for flood mitigation actions and insurance. This recurrence level is an average and does not mean that a flood of that magnitude will occur exactly every 100 years. Likewise, the 2% chance flood, or 500-year flood event, has a 2% (or 1 in 500) chance of occurring in a given year.

The 100-year flood is the national standard to which communities regulate their floodplains through the National Flood Insurance Program (NFIP). Most of the flood-prone counties and incorporated communities within the planning area participate in the NFIP. Participation in the NFIP requires adoption of a local floodplain management ordinance and its enforcement within a mapped Special Flood Hazard Area. A jurisdiction's eligibility to participate is premised on their adoption and enforcement of state and community floodplain management regulations intended to prevent unsafe development in the floodplain, thereby reducing future flood damages. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. Since floods have an annual probability of occurrence, have a known magnitude, depth and velocity for each event, and in most cases, have a map indicating where they will occur, they are in many ways often the most predictable and manageable hazard.

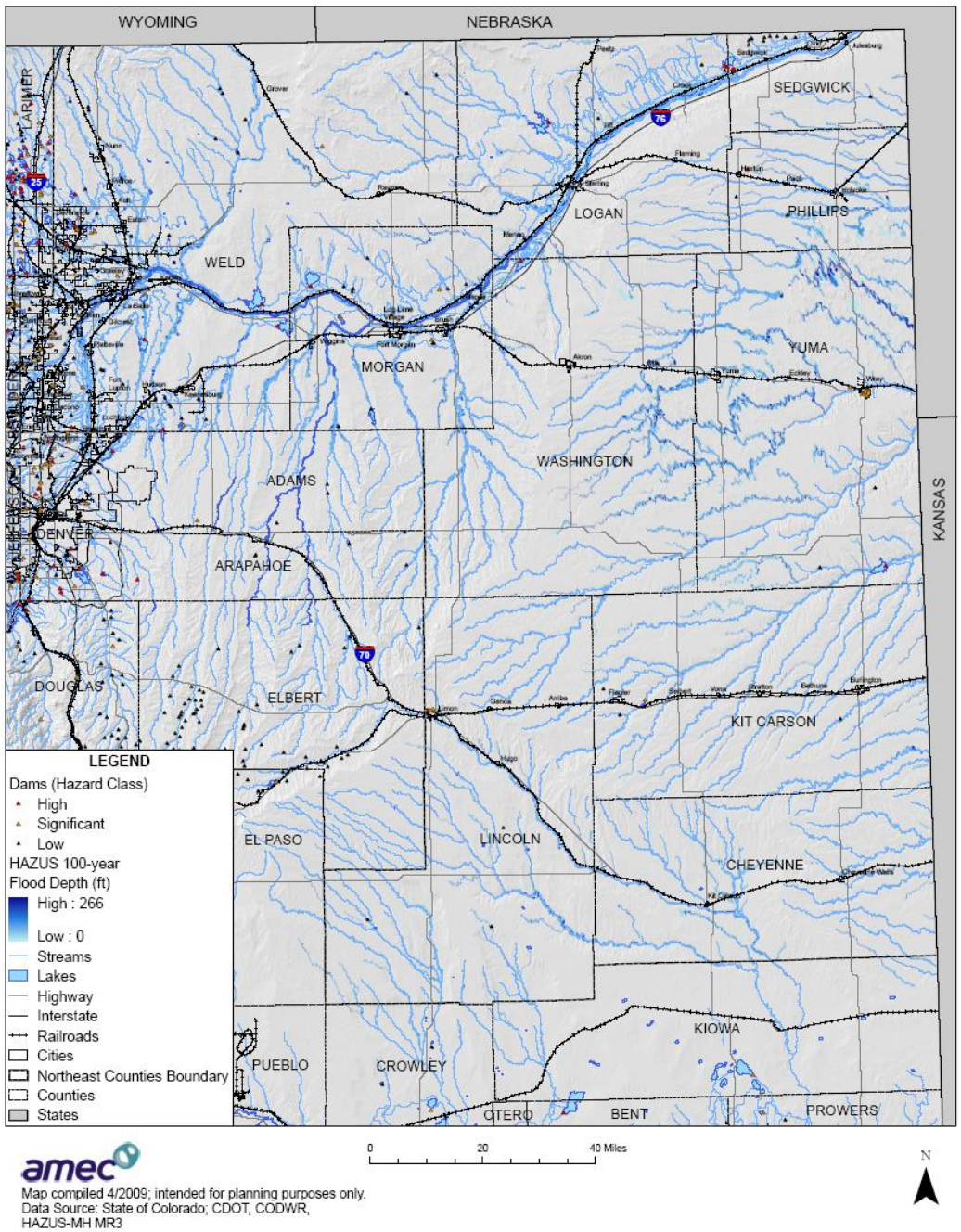
Geographic Extent

All counties within the planning region have the potential for flooding, although the extent of the flooding varies county-to-county and based on the location within each county. Detailed geographic flood assessments are provided in each County Planning Element. Figure 4.6 illustrates the 100-year floodplains in northeastern Colorado. The majority of the flooding in the region occurs along the South Platte River and its tributaries, although flooding along tributaries which contribute to the Arkansas River are also evident in the southern portion of the planning area, and for the Republican River in the easternmost portion of the region. The greatest anticipated source of hazardous flooding in the region stems from the South Platte River and its tributaries. Historically, the South Platte River basin has resulted in 12 of the 24

[29] Colorado Water Conservation Board, *Colorado Flood Hazard Mitigation Plan*, November 2013 (p.16).

notable flood events in Colorado from 1864 to 2006. Major tributaries such as the Big Thompson River and Cache La Poudre River have experienced disastrous floods as well. The City of Sterling in Logan County is the largest population concentration near the South Platte River. Based on this information, and illustrated in the map below, the geographic extent rating on a regional level is **significant**.

Figure 4.7. Northeast Colorado 100-Year Flood Hazard Areas



Previous Occurrences

Flooding has occurred frequently within the planning area. Based on available disaster declaration information and records, the most significant floods in the region were in 1935, 1963, 1965, 1979, 1980, 1997, 1999, and 2013. While the dam failure floods are captured in the dam failure hazard identification section, the other flood events are included here.

In July 1993, the Town of Otis and the unincorporated area of Cope (Washington County) and the City of Yuma (Yuma County) experienced a weekend flood event as a result of three consecutive days of thunderstorms. Several homes suffered damages and roadways were inundated, resulting in significant losses. In Otis, a flood control and storm drainage project protected the northern half of the town. In the spring and early summer of 1995, the lower South Platte River experienced significant flooding, impacting primarily agricultural landowners.

From July 24-28, 1997, the City of Fort Collins and northeastern Colorado received drenching, soaking rains which resulted in disastrous flooding. On July 29, slow-moving thunderstorms deposited large amounts of rain over the Pawnee Creek Basin in Weld and Logan Counties and over the Schaefer Draw Basin in Morgan County north of Weldona. Floodwaters entered the unincorporated Town of Weldona later that night, while similar flooding occurred early on July 30 in the unincorporated Town of Atwood. The flooding flowed east from Atwood into the City of Sterling, ultimately resulting in a Presidential Disaster Declaration.

From April 29-May 1, 1999, heavy rain and saturated soils again caused flooding in northeastern Colorado along the South Platte River and its tributaries.

September 2013 Flood Disaster

During the second week of 2013, a slow-moving cold front stalled over Colorado, colliding with warm humid monsoonal air from the south. The combination resulted in one of the State's most costly and widespread floods, devastating communities along the Front Range and causing downstream impacts in four of the nine counties in the planning region (see Figure 4.8 below). According to the 2013 Colorado Flood Hazard Mitigation Plan, "The moisture over the Rockies was literally being squeezed from both sides by the high to the east and the dry air rotating in from the Great Basin around the upper-level storm. The high over the Midwest acted like a giant roadblock and turned what would have been a several-hour event into a week-long ordeal. The result was a plume of heavy rain that re-fired on an almost daily basis from New Mexico to Colorado and southern Wyoming. Rainfall exceeded 12 inches at a number of locations."[30]

[30] Colorado Water Conservation Board, *Colorado Flood Hazard Mitigation Plan*, November 2013 (pp.32-33).

Figure 4.8. 2013 Flood Damages: Rainbow Bridge (Morgan County) and Washed-Out Bridge (Lincoln County)

Figure 4.9. Logan County Emergency Operations Center, September 2013 Floods

The 2013 flood caused extensive infrastructure and crop damages in northeastern Colorado. Logan, Morgan, Sedgwick and Washington Counties were declared eligible for FEMA Public Assistance and the FEMA Individual Assistance was authorized for residents of Morgan County.

Probability of Future Occurrences

Table 4.11 below indicates the number of flood events that have occurred per county over a 17-year period from 1996 through 2013. The County Planning Elements capture more detail on historic floods and specific impacts.

Table 4.11. Flood Events per County, 1996-2013

County	Flood Events
Cheyenne	3
Kit Carson	2
Lincoln	0
Logan	3
Morgan	6
Phillips	1
Sedgwick	2
Washington	4
Yuma	8
9 County Total	**29**

Source: National Climatic Data Center

Given the information above, the planning area experiences an average of 1.7 floods per year. Based on analysis of the HAZUS-MH level 1 flood loss modeling, Phillips and Morgan Counties have the highest flood risk in the planning region in terms of Percent Building Damage (3.1% and 2.8% respectively) and Per Capita Loss ($6,000 and $4,000 respectively). Both Phillips and Morgan Counties are among the seven counties in the state with the greatest estimated percent of building damages. Phillips County has one of the three highest per capita damage ratings among counties in the state and Morgan County is one of the 18 highest counties.[31] Based on available data and the calculated recurrence rate, the probability for future occurrence of a 100-year flood event in the planning region is **likely**.

Magnitude/Severity

Floods present a risk to life and property, including buildings, their contents, and their use. Floods can affect crops and livestock. Floods can also affect lifeline utilities (e.g., water, sewage and power), transportation, jobs, tourism, the environment, and the local and regional economies.

One method of examining the magnitude and severity of flooding in the region is to examine the damage losses and payments from the National Flood Insurance Program (NFIP). Table 4.12

[31] Colorado Water Conservation Board, *Colorado Flood Hazard Mitigation Plan*, November 2013 (pp. 62-69).

below presents a summary of NFIP policies and claims in northeastern Colorado from the program's inception in 1978 through August 21, 2013. Cheyenne and Kit Carson Counties do not participate in the NFIP.

Table 4.12. FEMA NFIP Policy and Claims Report for Northeastern Colorado 1978-2013

County	Policies	Total Coverage	Claims	Payments
Lincoln	16	$2,200,600	5	$4,362
Logan	355	$45,426,600	54	$199,629
Morgan	175	$17,004,200	28	$58,807
Phillips	11	$2,380,800	2	$7,402
Sedgwick	2	$392,000	0	0
Washington	1	$50,000	0	0
Yuma	20	$3,699,900	2	$1,848
9 County Total	580	$71,154,100	91	$272,048

Source: 2013 Colorado Flood Hazard Mitigation Plan (Colorado Water Conservation Board).
Note: Cheyenne and Kit Carson Counties do not participate in the NFIP.

Based on the historic record of events, generally the flooding in the region is fairly limited. Losses recounted above indicate that some areas may have a more significant impact from flooding than others. Individual county profiles provide more accurate insights into the flooding risk by jurisdiction, which helps account for the variability of the hazard across the planning region. To estimate the magnitude of flood impacts by jurisdiction flood losses were modeled using FEMA's HAZUS-MH loss estimation software. The results of this modeling are captured in map and tabular form in each County Planning Element. The methodology is discussed in Section 4.3 Vulnerability Assessment. Based on the HAZUS results, the likelihood of recurring flooding in counties along the South Platte River, and the vulnerability of these counties to major flood events involving the network of tributaries upstream of the region, the magnitude severity rating for this hazard is **critical**.

Overall Hazard Significance

Flooding was considered a high priority in the original planning process, including the achievement of NFIP eligibility for flood-prone jurisdictions within the region. During the planning process, the planning teams provided feedback that this remains a priority for the region. With a geographic extent rating of **significant**, a **likely** probability, and a regional magnitude severity rating of **critical**, the flood hazard remains of **high** significance in the region.

4.2.9 Fog

Description

Fog is a cloud made up of water droplets suspended in the air at the earth's surface. Fog forms when air is cooled to its dew point, which is the temperature at which air is saturated with moisture. When air reaches its dew point it condenses into very small particles, forming the tiny water droplets that create clouds. When this occurs very close to the ground, the event is called fog. The intensity and duration of fog varies with the location and type of fog. Severity ranges from early morning ground fog that burns off easily to prolonged valley fog that can last for days. Generally, strong winds prevent fog formation. The following list summarizes several possibilities for the formation, intensity, and duration of fog, as compiled in the "Hazardous Weather Resource Guide" by FEMA:

- Ground Fog is associated with clear nights, stable air (winds less than 5 mph), and a small-temperature dew point range. It forms when heat radiates away from the ground, cooling the ground and surface air. When air cools to its dew point, fog forms, usually a layer of less than 100-200 feet. It is common in many areas of the United States and generally burns off from the morning sun.
- Advection Fog is associated with horizontal wind, warm humid air, and winter temperatures. It forms when wind pushes warm humid air over the cold ground or water, where it cools to the dew point and forms fog. Advection fog can cover wide areas of the central U.S. in winter. During the winter this is common when snow covers much of the Midwest. The snow cools the bottom portion of the moist air mass often resulting in condensation. This type of fog can be widespread, covering very large areas.
- Evaporation Fog is associated with bodies of water. It forms as cold air blows over warmer water, causing the water to evaporate into the cold air, increasing the humidity to the dew point. Vapor condenses, forming a layer of fog 1 to 2 feet thick over the water. It can form over ponds and streams on fall days.
- Precipitation Fog is associated with warmer rain and cooler air. It forms when rain evaporates, and the added vapor increases the air to its dew point. The vapor then condenses into fog. Precipitation fog forms on cool, rainy days.

Fog may occur anywhere in the planning region, at any point during the day. Fog is more common during the early morning hours. Fog is typically a semi-regional phenomenon, which means it may affect large portions of a county or within the planning region simultaneously. It may also form in patches, following water sources or cooler ground tracts.

Geographic Extent

The geographic extent of fog is generally regional, though it may not cover the entire planning region. Occasionally various weather conditions may result in 'patchy' fog, which impacts only selected portions of a county within the region. The variability of the hazard, then, merits only a **significant** geographic extent rating.

Previous Occurrences

The National Weather Service (NWS) and the National Climatic Data Center (NCDC) have been tracking fog and dense fog occurrences in the state since 1995. Only two events are listed for counties within the planning area. One event, dated March 4, 1997, impacted Morgan County. The second event, dated August 24, 2008, impacted Yuma County. Statewide, only 133 incidents have been documented via the NCDC database and the majority of these recorded incidents indicate that fog impacted airport flights or caused traffic accidents of significant size. The NCEM Planning Team indicated that fog is a localized problem on I-70 east of Genoa (Lincoln County) near Cedar Point, where it was the likely cause of one traffic fatality.

Probability of Future Occurrences

The hazard is not profiled in the 2013 Colorado State Hazard Mitigation Plan. Limited available data regarding fog incidents makes developing a rate of occurrence difficult. Fog is known to occur multiple times during a calendar year, but the extent, timing and severity of the event are what mark the occurrence of hazardous fog. However, there is no method for tracking incidents, and very few severe instances are reported. It is unlikely, then, that a 100% occurrence rating can be supported. As such, the occurrence rating that best reflects fog events in the region is **likely**.

Magnitude/Severity

The magnitude and severity, which is calculated based on the previous occurrences and specific aspects of risks, provides a qualitative assessment of the potential for deaths or injuries and the extent of anticipated damage to property and infrastructure. For fog, since records of such incidents are not officially tracked, this rating may be more qualitative than others. Generally, fog does not directly cause damages to people or property. It may cause secondary damages which vary in severity on a case-by-case basis. Based on the known incidents of fog, but without much verifiable data, the magnitude and severity rating for fog events in Colorado is best represented by a **negligible** rating. In the future, fog events may merit further study and verification for inclusion in the planning process.

Overall Hazard Significance

Fog is fairly common hazard that impacts a **significant** geographic area within the region during any given occurrence. Fog is a yearly event, though there is no data to differentiate between regular fog events and severe instances which may merit additional precautionary measures or result in higher damages, and so the probability rating is **likely**. The severity of fog is difficult to quantify, as the hazard itself causes no damage, but instead increases the likelihood of other hazards (which are often technologically or human driven), the severity and magnitude rating is **negligible**. Overall, then, fog is considered a **low** priority hazard for the planning area.

4.2.10 Hailstorms

Description

Hail is associated with thunderstorms that can also bring high winds and tornadoes. It forms when updrafts carry raindrops into extremely cold areas of the atmosphere where they freeze into ice. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is pulled by gravity towards the earth. Hailstorms occur throughout the spring, summer, and fall in the region, but are more frequent in late spring and early summer. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 mph. Hail causes nearly $1 billion in damage to crops and property each year in the United States. Hail is also one of the criteria that the National Weather Service uses to classify thunderstorms as “severe.” If hail of 1” or more is produced by a thunderstorm, then the storm is classified by NWS as severe.

The National Weather Service classifies hail by diameter size in comparison to everyday objects to help relay scope and severity to the population. The table below indicates the hailstone measurements utilized by the National Weather Service.

Table 4.13. Hailstone Measurements

Severity	Description	Hail Diameter Size (Inches)
Non-Severe Hail Does not typically cause damage and does not warrant severe thunderstorm warning from NWS.	Pea	0.25
	M&M Plain	0.50
	Penny	0.75
	Nickel	0.875
Severe Hail Research has shown that damage occurs after hail reaches about 1" in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from NWS.	Quarter	1.00
	Half Dollar	1.25
	Ping Pong Ball/Walnut	1.50
	Golf Ball	1,75
	Hen Egg/Lime	2.00
	Tennis Ball	2.50
	Baseball	2.75
	Teacup/Large Apple	3.00
	Grapefruit	4.00
	Softball	4.50
	Computer CD-DVD	4.75-5.0

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Geographic Extent

Colorado's Front Range and Eastern Plains are located in the heart of "Hail Alley" and are among the states receiving the highest frequency of large hail in the United States. The frequency of hailstorm events ranges from 1 to 10 hail days per year in the planning region. The highest frequency of damaging hail appears to occur near the border of Wyoming, Nebraska, and Colorado. The Colorado hail season is April 15 to September 15. Colorado hailstorms occur most frequently in June and are most likely to be destructive in mid-June.[32]

The geographic extent of hail is tied to the area affected by the thunderstorm event which houses the hail. Within the extent of the storm, the extent of the hail also varies widely. It is nearly impossible to pre-determine where hail may fall more than a few hours ahead of the storm. It is unlikely that, on a regional level, hail will damage more than 25% of the area, which indicates a **limited** geographic extent rating. This may change within an individual county or planning jurisdiction, however.

[32] Colorado Office of Emergency Management, Colorado Natural Hazards Mitigation Plan, December 2013 (p. 3-62).

Previous Occurrences

Hailstorms are profiled as an individual hazard because hail is a major cause of agricultural losses within the planning area, as reported by the National Crop Insurance Services. The following table reflects the number of reported hail occurrences for each county in the planning area and the consequences in terms of property and crop damages. No deaths and only two reported injuries (Morgan County) have been associated with hailstorms in the planning region over the period of record.

Table 4.14. Hail Events and Damages in Northeastern Colorado by County: 1950-2013

County	Events	Property Damage	Crop Damage	Total Damages
Cheyenne	308	$851,000	$3,000	$854,000
Kit Carson	478	$908,000	$0	$908,000
Lincoln	334	$11,000	$110,000	$121,000
Logan	261	$21,000	$100,000	$121,000
Morgan	287	$2,200,000	$2,500,000	$4,700,000
Phillips	134	$20,000	$9,500,000	$9,520,000
Sedgwick	102	$0	$0	$0
Washington	381	$30,000	$1,200,00	$1,230,000
Yuma	580	$1,889,600	$8,055,000	$9,944,600
9 County Total	**2,865**	**$5,930,600**	**$20,269,200**	**$27,398,600**

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Probability of Future Occurrences

Hailstorms are a frequent event in every county in the planning region, resulting in annual property damages and crop losses ($9,563 per event on average based on the figures above). Northeastern Colorado is one of the most hail-prone regions in the country. Yuma County is one of three Colorado counties that experienced more than 500 hail events between 1950 and 2010. Based on the information in Table 4.14 above, the planning area has experienced an average of 4.5 significant hailstorms per year, which equates to a 100% probability of future occurrence. This corresponds to an occurrence rating of **highly likely**. Atmospheric convection activity producing conditions favorable to hail events is expected to occur in the future as in the past.

Magnitude/Severity

Although large hail events may result in high aggregate insured losses, property damages are generally limited, serious injuries are rare, and there is typically little or no impact to critical facilities, which are generally able to operate without much disruption of services. However, the combined total of property and crop damages represents a significant impact in the region

($27,398,600 over the period of record). Due to the high costs of hail damage (insured and uninsured losses), particularly in an agriculturally based region, the most appropriate magnitude severity rating for hail in the region is **critical**.

Overall Hazard Significance

Crops are at significant risk to hail events, as is property such as automobiles, homes, and businesses. Insurance losses due to hail top the hazards event lists in the state of Colorado. People may be injured or killed by severe hail if shelter is unavailable, and damages often have long-term effects, both physically and financially. Hail has an **extensive** geographic range, and is **highly likely** to occur every year. The magnitude and severity of severe hail events are **critical**. Overall, hail is considered one of the most significant hazards to the planning region, or a **high** significance rating.

4.2.11 Landslides

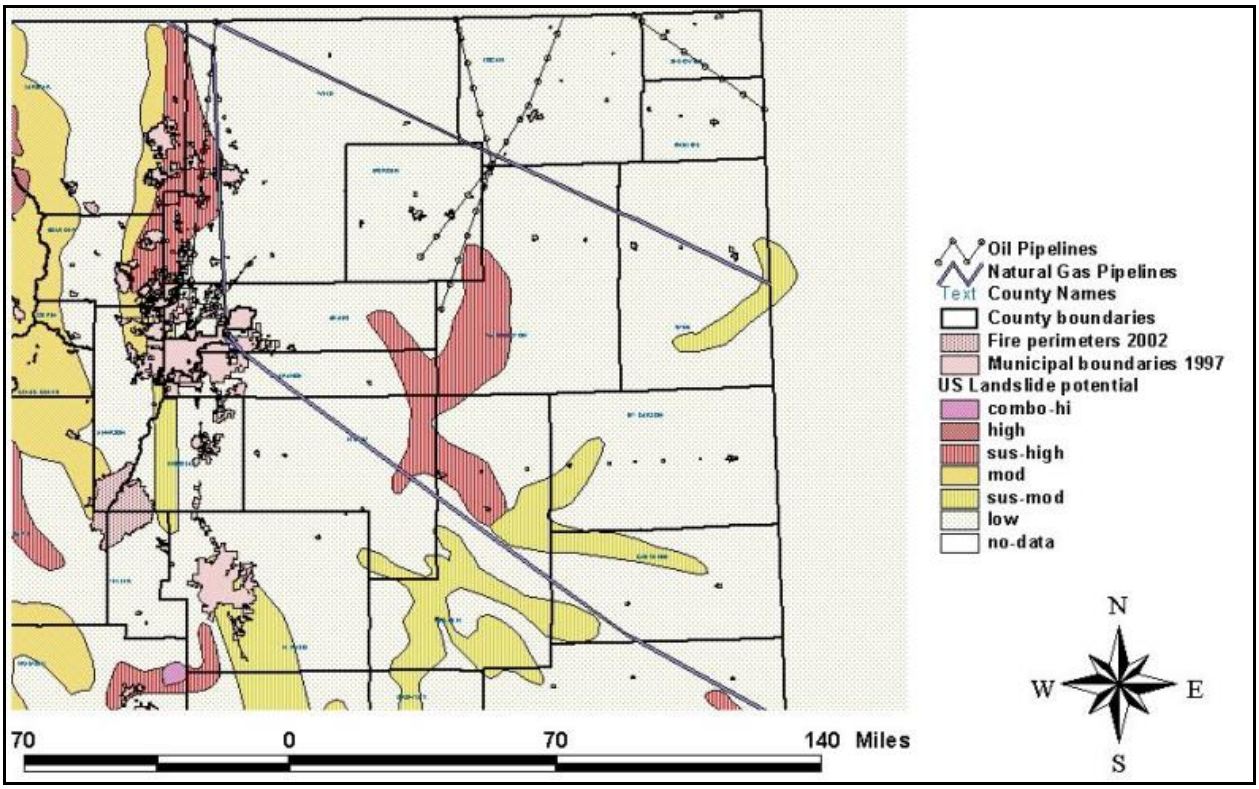
Description

The 2013 Colorado Natural Hazards Mitigation Plan defines landslides as the "downward and outward movement of slopes composed of natural rock, soils, artificial fills, or combinations thereof." Landslides may damage infrastructure by either moving materials into the buildings or across roads, or sliding out from under them. Both events may render structures and roadways unstable and/or unusable, and the damage may or may not be repairable. Damage to waterways, oil and natural gas pipelines, and electrical conduits may hinder the delivery of vital services, both to the affected area and those further down the pipelines from affected areas. Landslides are most common in areas with steep slopes and grading, but may occur anywhere that natural or artificial materials may shift or slide.

Geographic Extent

Although landslides are far more likely along the Front Range and western slope areas of the state, small portions of northeastern Colorado have landslide potential. The map below depicts areas of suspected high and suspected moderate landslide risk within the planning area, with the majority of the areas shown in Washington and Lincoln Counties. Given that most of the planning area is relatively flat, and that potential landslide incidents are isolated, the extent rating is considered **limited**.

Figure 4.10. Landslide Potential for Northeastern Colorado



Source: Unknown.

Previous Occurrences

There are no reported or known incidents of landslides in the planning area, but the potential consequences of landslides are enormous. As noted in the 2013 Colorado Natural Hazards Mitigation Plan, "Landslides occur commonly throughout Colorado, and the annual damage is estimated to exceed $3 million dollars to buildings alone."[33] Because the potential for high and moderate risk landslides exist in the planning region, this hazard must be profiled in the mitigation plan.

Probability of Future Occurrences

Without previous occurrences, it is not possible to gauge a probability of a future occurrence using the methodology described in this plan. Figure 4.10 above indicates the probability of potential occurrence; however, and so from that several estimates may be formed. For the majority of the planning region, a landslide event is considered **unlikely**. For most of Lincoln County and portions of Yuma County, the risk may rise to **occasional**. The other vulnerable

portions of Lincoln County, along with sections of Washington and Morgan Counties, experience a suspected **likely** occurrence, should the events actually occur. The aggregate rating for the region is **occasional**.

Magnitude/Severity

Though largely linked to where an event occurs, landslide events for the region are generally categorized as **limited** to **negligible**. Significant damage to property is not expected, nor would such damage be widespread. The availability of services would be impacted, but probably not for extended periods of time. Only a small portion of a natural gas pipeline falls in a suspected risk area, and no known gas lines are in this area. Without actual occurrences, this rating remains an estimate and the hazard should be re-evaluated as more data becomes available.

Overall Hazard Significance

Even in the areas where a significant risk is possible, there are no documented events or other data on which to base qualitative analysis. The distribution of risk is heavily skewed for Washington and Lincoln counties, as well. Therefore, it may be more appropriate for potentially impacted counties to prioritize landslide at a higher level than the rest of the planning area. Without further data, the significance of the hazard on a regional level is **low**.

4.2.12 Lightning

Description

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. The length and duration of each lightning stroke vary, but typically average about 30 microseconds.

Lightning is one of the more dangerous 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, and deaths and injuries to livestock and other animals. According to the National Lightning Safety Institute (NLSI), estimates of property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects exceed $8-10 billion per year. In 2010, lightning caused 7,164 wildland fires, destroying more than two million acres.[34] Impacts can be direct or indirect. People or objects

[33] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-185).
[34] National Lightning Safety Institute web page. Available at www.lightningsafety.com/nlsi_lls/ListofLosses14.pdf (last accessed July 26, 2014).

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, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage. According to the 2013 Colorado Natural Hazards Mitigation Plan, Colorado averages 529,000 cloud-to-ground lightning strikes per year. Deaths and injuries due to lightning occur on a regular basis.[35]

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, the United States monitors an average of 25 million strokes of lightning from the cloud-to-ground every year.

Geographic Extent

Lightning can occur anywhere. Though a single point of lightning affects only a **limited** area, and an electrical storm at most affects only a **significant** area, the sheer possibility of an event makes the geographic hazard rating **extensive**.

[35] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-74).

Previous Occurrences

Table 4.15 below depicts the average number of cloud-to-ground lightning strikes, per year, for each county in the planning area. Data concerning lightning events resulting in injuries or deaths provides a look at risks to people and are also included in the table. Every county in the state experiences lightning flashes, but the Front Range counties of Arapahoe, Boulder, Denver, El Paso, Jefferson and Larimer report the highest number of casualties, each with more than 20 lightning deaths and/or injuries per year on average since 1950.

Table 4.15. Lightning Flashes, Deaths, Injuries, and Damages in Northeastern Colorado by County, 1950-2013

County	Annual Flashes	Deaths	Injuries	Total Damages
Cheyenne	7,800	0	0	$48,765
Kit Carson	9,500	0	2	$1,050,521
Lincoln	18,100	0	1	$50,521
Logan	8,500	0	1	$70,733
Morgan	7,300	1	4	$70,882
Phillips	2,700	0	0	$61,516
Sedgwick	2,100	0	0	$42,683
Washington	13,100	0	0	$69,483
Yuma	10,400	0	0	$62,849
9 County Total	79,500	1	8	$1,527,953

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Probability of Future Occurrences

Lightning can occur anywhere there is a thunderstorm. The average number of lightning flashes for any given day for each month is shown in Table 4.16. In any given day in July or August, over 4,000 lightning flashes are expected to occur in Colorado.

Table 4.16. Average Lightning Flashes in Colorado per Day by Month

Month	Number of Flashes Per Day
January	1
February	4
March	39
April	225
May	1,203
June	2,621
July	4,035
August	4,215
September	1,457

October	261
November	11
December	1

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Lightning has emerged as one of the greatest weather hazards in Colorado. In a typical year, there are several fatalities or injuries. Unlike tornadoes that are most common in selected areas of the state, lightning can and does occur everywhere. The probability of any lightning strike in the region is 100% and **highly likely** as, in fact, thousands of strikes occur per year in the region.

Magnitude/Severity

Lightning strikes have many different potential impacts. Lightning impacts the safety of individuals directly, as people outdoors during electrical storms are vulnerable to being struck. In addition, lightning may strike and injure or kill livestock or other animals on pastures and fields, if they are unable to find shelter. This, in turn, negatively impacts the financial well-being of the livestock owner. While a single event may not be catastrophic, multiple injuries and deaths over repeated occurrences add up and increase the overall impact. In addition, lightning may ignite wildfires when striking dry fields or prairie lands. Wildfires are profiled in greater detail below, but are a potentially catastrophic hazard in the region. Lightning strikes to buildings may cause fires, impact and disrupt power supplies, damage electrical equipment in the building, and perhaps even injure occupants. Depending on the nature of the building damaged, lightning strikes may indirectly disrupt critical services. Service personnel, who may be forced to operate in exposed locations during a storm, are also at a heightened risk to lightning.

Lightning severity and magnitude depends on both what the lightning strikes and secondary impacts caused by the strike. For example, lightning strikes in a dry field have a **critical** or perhaps **catastrophic** severity potential if a significant wildfire is sparked. Lightning that leaps from cloud to cloud presents a **negligible** risk in the region except for aircraft. Lightning which strikes people may cause severe injury and death (which merits a **critical** rating) but does not necessarily damage extensive amounts of property (which rates as **limited**). In general, then, a **limited** rating best reflects the majority of lightning-related events.

Overall Hazard Significance

Lightning strikes are an extremely common occurrence in Colorado. With a geographic rating of **extensive** for possibility of events, any location is considered vulnerable. Strikes that cause injuries or fatalities are also considered **highly likely**, though extensive property damages are not documented. This directly correlates to the **limited** magnitude and severity rating. Mitigation priority for lightning is mostly related to public education and should remain a consistent focus in the planning process, with a **medium** significance rating.

4.2.13 Noxious Weeds

Description

Noxious weeds are a hazard across the entire State of Colorado, and particularly in the agricultural region that makes up the planning area. The Colorado Noxious Weed Act defines noxious weeds as "plant species that are not indigenous (native) to the state of Colorado and meet at least one of several criteria regarding their negative impacts upon crops, native plant communities, livestock, and the management of natural or agricultural systems. This definition applies to species listed by both state and local governing bodies." Native plants are also defined in the Act as "species that are indigenous to Colorado, may not be designated as noxious weeds by either state or local governments. Furthermore, the law does not permit distinctions to be made regarding the historical range or habitats of native species. Therefore, even a native species that expands its range within Colorado due to human influences and otherwise meets the descriptive criteria as a noxious weed may not be listed as such."[36]

All noxious weeds are aggressive and very competitive, stealing moisture, nutrients and sunlight from native, desirable plants. Established noxious weeds compete with the production of agricultural crops, as well as natural grasses, plants and groundcover. Often, noxious weeds can out-compete native plants entirely, which impacts the entire ecology of the area.

Noxious weeds are divided into three categories. Weeds listed in the "AW" category are considered A-list weeds, and are those species which are designated for eradication by the Commissioner. List B species (those listed in the "BW" category) are those for which the Commissioner develops and implements state noxious weed management plans designed to stop the continued spread of the species. This category is assigned based on consultation with the state noxious weed advisory committee, local governments, and other interested parties. List C weeds (those categorized as "CW") are those species for which the Commissioner will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species.[37] Some of the more common are profiled below.

Saltcedar or Tamarisk (scientific name: *Tamarix ramosissima*) grows along I-76 in Morgan and Logan Counties. There is also a significant concentration along the southeast border of Yuma

[36] Colorado Noxious Weed Act, Title 35-Article 5.5, Colorado Revised Statutes (35-5.5 CRS).
[37] Colorado Department of Agriculture, *Noxious Weeds List.* Available online at http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438 (last accessed July 28, 2014).

and Kit Carson Counties. Saltcedar is a small evergreen shrub or tree that grows between 5 and 20 feet in height. Mature plants can produce up to 600,000 seeds per year. The plant was introduced from central Asia, northern Africa, and southern Europe for ornamentation and stream bank stabilization. Saltcedar can aggravate drought conditions by sucking up large volumes of water from riverbeds, increasing the salinity of surface soil (which renders the soil inhospitable to native plants). Saltcedar can also contribute to flooding by becoming a barrier within the watercourse channels.[38]

Other noxious weeds such as Spotted Knapweed (*Centaurea maculosa)*[39], Diffuse Knapweed (*Centaurea diffusa)*[40], and Russian Knapweed (*Centaurea repens)*[41] readily establish on any disturbed soil. The plants produce as many as 40,000 seeds per plant. The plants thrive in both wet and dry conditions, and out-compete livestock and wildlife forage plant species. Their early spring growth makes them competitive for soil moisture and nutrients and there is some evidence that they release chemical substances that inhibit surrounding vegetation.

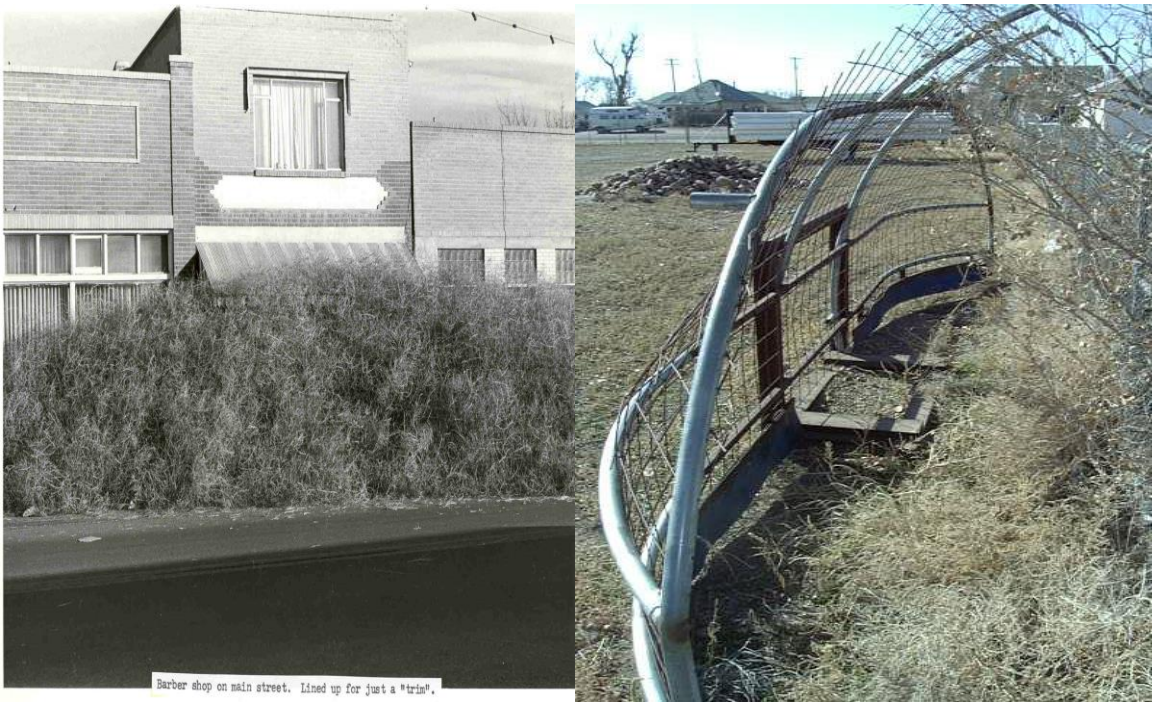
Field Bindweed (*Convolvulus arvensis)* is severely concentrated in Logan County, with long, narrow distributions along county roads in all other counties in the planning area. The weed is difficult to eradicate because of a root system that can penetrate the soil to a depth of 20 feet and which gives rise to numerous lateral roots. The plant seeds may remain viable in the ground for up to 40 years. It can adapt to different environmental conditions and can be found at altitudes as high as 10,000 feet. The plant is extremely competitive, and continual stress on the plant is necessary to ensure eradication.[42]

The tumbleweed is also a hazard in the planning region, and one that may exacerbate other hazardous conditions, particularly when combined with lightning, high winds, and dry climates. 'Tumbleweed' is a common name for the occurrence of Russian Thistle, which is not technically included on the Colorado Noxious Weeds list. These plants are small, spiny bushes which reproduce by drying out and breaking off at the base of the stem during high winds, and then tumbling across flat, open spaces, scattering as many as 250,000 seeds per plant. The plant is native to the steppes of the Ural Mountains in Russia, but is now a common feature of North American prairies and deserts. The plant does not tolerate saturated soils for long durations of time, but is otherwise very hearty.[43]

[38] Colorado Department of Agriculture, *Saltcedar Fact Sheet*. Available online at http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438 (last accessed on July 28, 2014).
[39] Ibid. *Spotted Knapweed Fact Sheet.*
[40] Ibid. *Diffuse Knapweed Fact Sheet.*
[41] Ibid. *Russian Knapweed Fact Sheet.*
[42] Ibid. *Field Bindweed Fact Sheet.*
[43] Tumbleweeds: http://www.desertusa.com/flowers/tumbleweed.html (last accessed July 28, 2014).

The State Noxious Weed Act also requires that local governing bodies of counties and municipalities uphold a number of duties, responsibilities, and powers regarding the management of noxious weeds. A 2007 legislative update requires all local governing bodies to have a noxious weed management plan. The state also has a management plan, which outlines regional and general control concepts. Funding for addressing noxious weeds is available through the Colorado Noxious Weed Management Program, including assistance for implementation of preventative strategies and public education.[44]

Figure 4.11. Tumbleweeds in Cheyenne Wells and the "Weed-Catcher" tractor attachment they built to remove them.



Tumbleweeds cause hazards by inundating communities, contributing to or spreading grassland fires (particularly when fueled by winds), and clogging drainage ways, which exacerbates flooding. Tumbleweeds can result in miles of closed roads and cover homes, businesses, barns, machinery, streams and fence lines. Tumbleweeds pose a significant fire danger when piled against structures. Fence line tumbleweeds can contribute to wildland fire growth.[45] Tumbleweeds are actually considered refuse, and property owners may be required to dispose of weeds that on their property.

[44] Colorado Department of Agriculture, Noxious Weeds Program. Available online at http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618780047 (last accessed on July 28, 2014).

[45] Rocky Mountain PBS News, March 7, 2014. Available online at www.inewsnetwork.org/2014/03/07/southeastern-colorado-battles-onslaught-of-tumbleweeds.

Geographic Extent

Distribution maps of noxious weeds can be found on the Colorado Department of Agriculture website. Many noxious weeds are found in the planning region, as indicated in the description section above. The weeds profiled in this section are all commonly found in the planning area, and so the geographic rating is **extensive**.

Previous Occurrences

Weeds are not tracked as other hazards are and so documentation is difficult to compile; however, weeds are an annual problem that affects all residents to some degree within the planning area. County Weed Supervisors submit annual reports to the Colorado Department of Agriculture which indicate the infested acreage estimates per 9,000 acre QuarterQuad. A QuarterQuad is one quarter of a standard 1:24,000 USGS 7.5min topographic quadrangle. The data is compiled by the Colorado Department of Agriculture and posted as maps on its website. These maps provide the only datasets for weed hazards currently available.

In 2014, after three years of drought, there was little vegetation left to compete with Russian Thistle growth. Untimely rains followed and created conditions that were ideal for proliferation of the weed. As a result, rolling tumbleweeds have become widespread across much of the region and have occasionally presented serious problems for residents, farmers and ranchers. In January 2014, Cheyenne County was impacted by an extraordinary number of tumbleweeds following several days of high winds. Agricultural operations in the western half of the county were disrupted for days and Cheyenne County spent approximately $30,000 clearing and removing tumbleweeds.

Probability of Future Occurrences

Weed infestations exist annually, with some years worse than others, and the hazard is expected to continue, though the state weed mitigation programs may reflect an impact on the hazards in the future. This corresponds to an estimated **highly likely** future occurrence rating, with future data considerations required.

Magnitude/Severity

Prolonged drought, combined with high winds and untimely rains, has resulted in an explosion of tumbleweeds across the Eastern Plains and much of the planning region. Russian Thistle is very drought-resistant and the weed has taken over large areas previously covered by native forage. Public safety issues resulting from tumbleweeds are rare, but can be serious. Highways and roads that are closed or impassable can make it impossible for emergency vehicles to reach certain areas. In addition, dried-up weeds are highly flammable and ignite quickly, posing a fire hazard when tumbleweeds come into contact with heated farm equipment, sparks from

passing trains, and other ignition sources. As a result of these factors, the rating for this hazard is **limited**.

Overall Hazard Significance

The hazard, while perhaps an extremely common event and a consistent nuisance, is not a considerably significant hazard for the planning region, although tumbleweeds can present public safety challenges during high wind events. The geographic extent overall is **extensive**, though actual distribution of noxious weeds varies by location. There is no consistent occurrence data and a probability rating cannot be calculated, but is estimated as **highly likely**. Current available information indicates the severity and magnitude of the events are **limited**. While noxious weeds are undoubtedly a nuisance, pose hazards to the ecology of the region, and occasionally present a public safety hazard, particularly in relation to grassland fires, the hazard is addressed through other elements and efforts at a state and local level. The hazard is of **low** significance to the region, in terms of this plan's scope and purpose.

4.2.14 Straight Line Winds

Description

In addition to tornadoes, the planning area is subject to significant, but non-tornadic (straight-line), winds. High winds, as defined by the NWS glossary, are "sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration." These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events such as thunderstorms. Straight-line winds may also exacerbate existing weather conditions, as in blizzards, by increasing the effect on temperature and decreasing visibility due to the movement of particulate matters through the air, as in dust and snow storms. The winds may also exacerbate fire conditions by drying out the ground cover, propelling fuel, such as tumbleweeds, around the region, and increasing the ferocity of exiting fires.

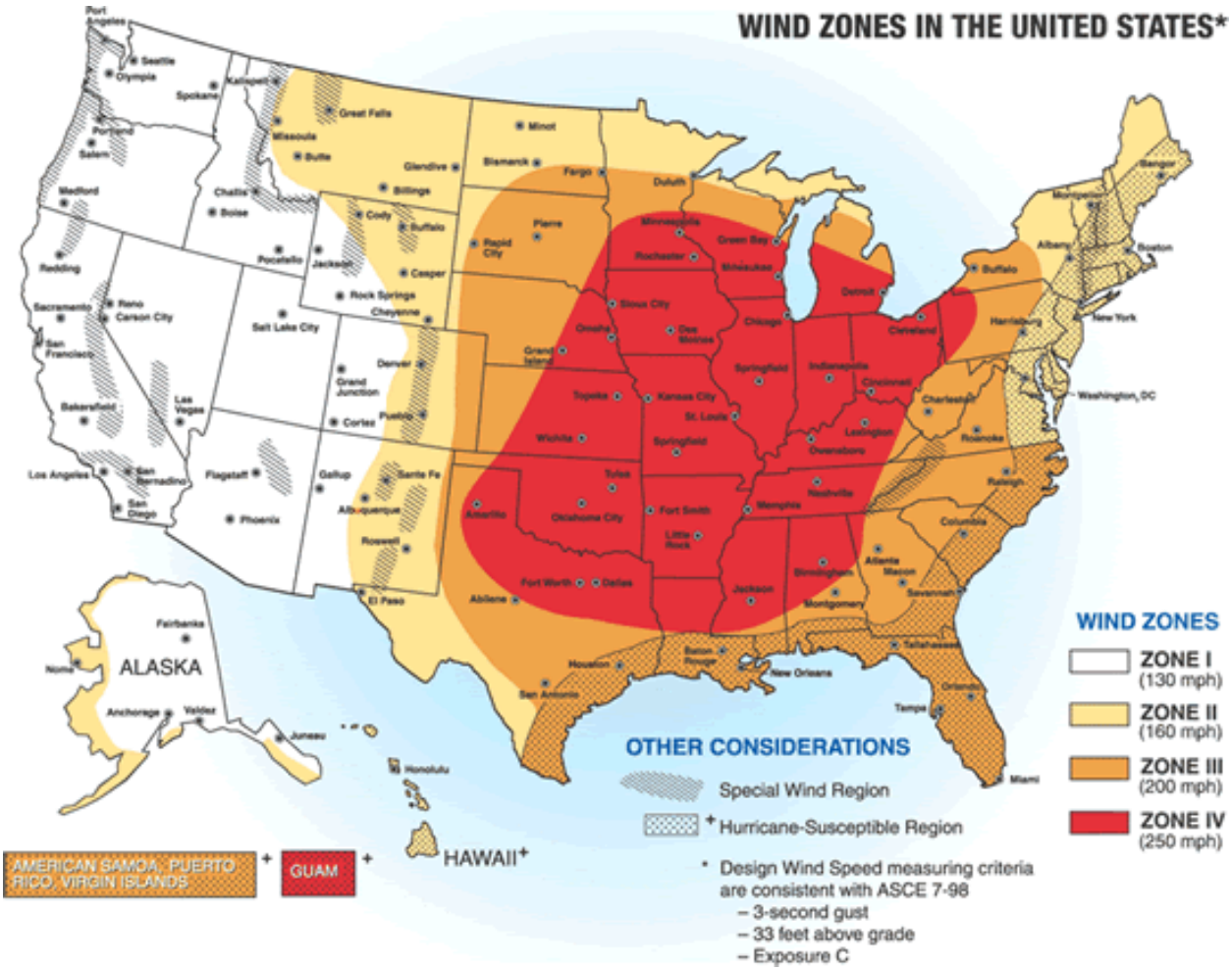
These winds may damage crops, push automobiles off roads, damage roofs and structures, and cause secondary damage due to flying debris. Blowing dust also damages homes, vehicles, property, and livestock, and causes erosion and reduces visibility, which may increase the danger to motorists and travelers. According to the 2013 Colorado Natural Hazards Mitigation Plan, windstorms are one of Colorado's costliest hazards. Over the last 60 years, wind events have caused a reported $367 million in property and crop damage. Deaths and injuries are also a result of wind events in the state with 21 and 406 respectively between 1950 and 2010.

Geographic Extent

The map below depicts wind zones for the United States. The map denotes that the majority of the planning area falls into Zone II, which is characterized by high winds of up to 160 mph. The

far eastern edges of Sedgwick, Phillips, Yuma, Kit Carson, and Cheyenne Counties fall into Zone III, characterized by high winds of up to 200 mph.

Figure 4.12. Wind Zones in the United States



Source: Federal Emergency Management Agency

The entire planning region is subject to straight-line wind events. These events may affect areas as small as a few miles or as large as the entire region. Wind is generally considered a regional phenomenon. The geographic rating for the hazard is considered **significant**. Blowing dust is also considered in this assessment.

Previous Occurrences

The table below depicts the total number of high wind events reported and recorded in the planning region. A total of 1,101 events have been recorded since 1950, for an average occurrence rate of 17.2 events per year.

Table 4.17. Severe Wind Events, Deaths, Injuries, and Damage in Northeastern Colorado by County, 1950-2013

County	Events	Deaths	Injuries	Property Damage	Crop Damage	Total Damages
Cheyenne	139	1	0	$77,000	$0	$77,000
Kit Carson	162	1	2	$1,022,500	$0	$1,022,500
Lincoln	68	0	3	$27,000	$0	$27,000
Logan	124	3	30	$30,130,000	$0	$30,130,000
Morgan	151	1	30	$33,836,000	$50,000	$33,886,000
Phillips	81	0	13	$5,406,000	$0	$5,406,000
Sedgwick	76	1	24	$32,745,000	$0	$32,745,000
Washington	132	1	16	$240,225	$0	$240,225
Yuma	168	0	0	$3,730,500	$18,000,000	$21,730,500
9 County Total	**1,101**	**8**	**118**	**$107,214,225**	**$18,050,000**	**$125,264,225**

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

Significant Straight-Line Wind Events, 2009-2014

On April 14-15, 2011, an intense, slow-moving winter-like storm moved across northeastern Colorado, producing high winds with gusts over 60 mph, in addition to heavy, wet snow. Interstate 70 was closed from Limon to the Kansas state line due to snow and strong winds and US Highway 385 was closed from Burlington to Wray.

In February 2012, a strong upper-level jet stream produced high winds along the Front Range and in adjacent northeastern Colorado. Peak wind gusts of 63 mph were recorded in Sterling.

In October 2012, a wind storm produced near zero visibilities in blowing dust for miles east of Haxtun. Peak gusts of 64 mph were recorded in Crook and in Holyoke, where a significant number of trees were knocked down by the storm. That same month, a second powerful wind storm associated with a fast-moving cold front swept across the northeast plains and caused wind gusts of 64 mph in Sterling, 58 mph in Keenesburg, and 57 mph in Wiggins. Minor damages to homes and vehicles were reported, as well as downed trees and power lines.

In February 2013, strong to severe wind gusts of up to 63 mph in northeastern Colorado resulted in areas of blowing dust. Visibilities of less than a quarter mile were reported across Kit Carson and Cheyenne Counties.

In April 2013, a fast-moving cold front spread across northeastern Colorado and spawned severe thunderstorms, three tornadoes, and hail up to walnut size. Washington County was the hardest hit, where straight-line winds flipped a mobile home, tore off the roof of a barn, and brought down power lines. The town of Akron was left without power after six power poles

between Brush and Last Chance were destroyed. In a separate wind event the same month, sustained winds of 40-50 mph were reported in the towns of Yuma and Wray (Yuma County).[46]

Figure 4.13. Severe Wind Damage in Phillips County (2008) and Yuma County (2009)

Probability of Future Occurrences

Colorado will continue to experience Bora winds that will send winds in excess of 100 mph from the west and northwest and on to the eastern plains. These wind events can potentially cause more damage than a localized severe thunderstorm.

There have been 1,101 reported straight-line events in the last 64 years in the planning region, which equates to a 100% chance of occurrence in the next year. There may be a margin of error in the event reporting, as the hazard may be regional and therefore a single event may impact multiple counties simultaneously and be double counted. This can be addressed by finding the average number of reported occurrences across the region, which equates to 122 events. Even so, the occurrence rate is 100%, so the probability of a future occurrence rating is **highly likely**.

Magnitude/Severity

Straight-line winds cause structural and economic damage during high wind events. Based on these likely events, damages include injuries and fatalities, as well as high dollar damage estimates. Logan, Morgan and Sedgwick Counties have each experienced more than $30 million in damages from straight-line winds over the period of record. These factors contribute to a **critical** magnitude and severity rating. The more common events, which cause less damage and offer minimal documentation of injuries, are more **limited** in severity. Of course, the potential

[46] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (pp. 3-90 to 3-93).

for a greater magnitude event remains, and the likely rating of such an event could be **catastrophic**.

Overall Hazard Significance

Straight-line winds are frequent events in the region, and anticipated yearly during the spring and summer months. The entire planning area is vulnerable, reflecting the **extensive** geographic rating, though individual events are more **limited** in direct impacts. Past occurrences indicate that straight-line winds are **highly likely** to occur in the future, though more severe storms are only **likely**. Corresponding severity and magnitude ratings indicate that damaging storms are often **critical**, while the majority of events are only **limited** in severity. Straight-line wind warnings, mitigation projects for shelters and wind-resistant buildings, and public education are ongoing efforts in the region, and the hazard remains a **high** priority.

4.2.15 Temperature Extremes

Description

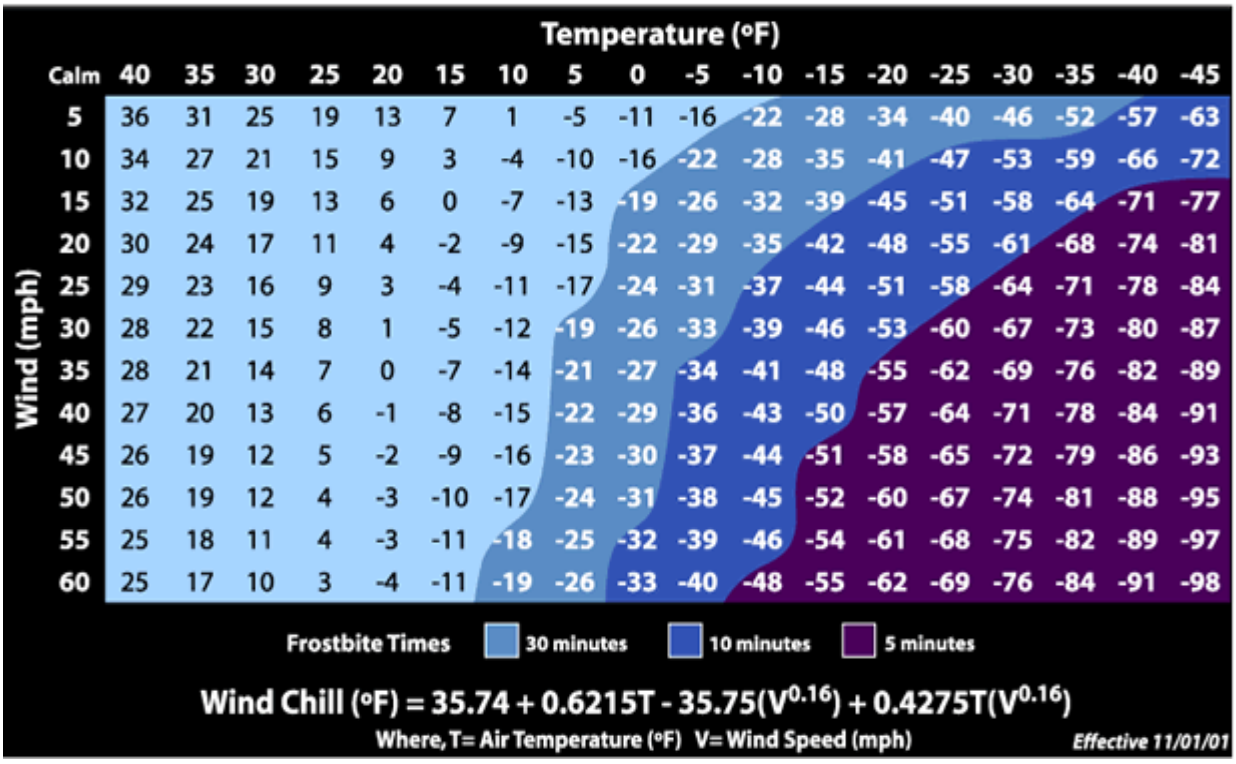
Temperature extremes -- both cold and hot – cause more deaths than any other natural hazard.

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 National Weather Service (NWS) implemented an updated Wind Chill Temperature index, which is reproduced below. This index was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 4.14. Wind Chill Temperature Chart



Source: National Weather Service

The impacts of cold temperature on agriculture generally relate to frost and freeze impacts early or late in growing seasons. Prolonged periods of extreme cold temperatures can have devastating effects on trees, winter crops and exposed livestock as well.

Extreme Heat

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. Heat is one of the top weather-related killer in the United States, resulting in hundreds of fatalities each year. According to the National Weather Service, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined.

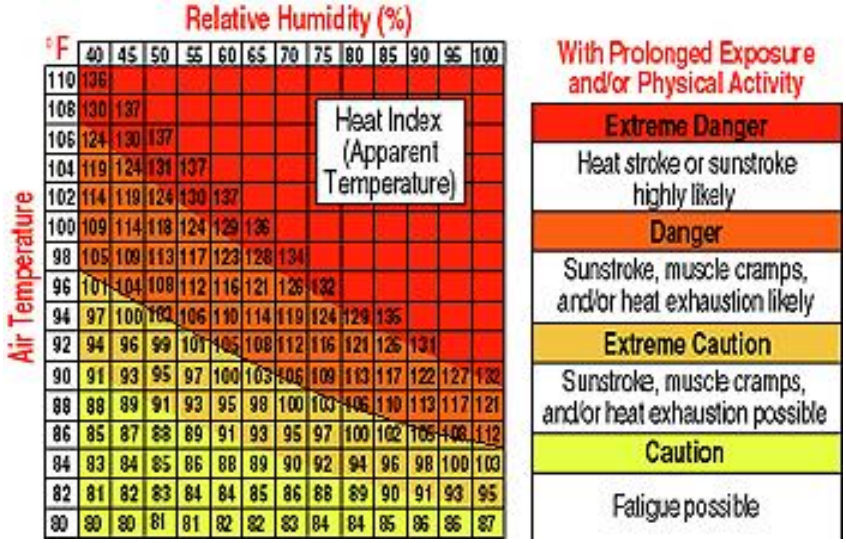
Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop. Specific high-risk groups typically experience a disproportionate number of health impacts from extreme heat conditions.

According to the 2013 Colorado Natural Hazards Mitigation Plan, the populations that have physical, social, and economic factors that make them at high risk to extreme hat events include:

- Older persons (age > 65)
- Infants (age < 1)
- The homeless
- The poor
- People who are socially isolated
- People with mobility restrictions or mental impairments
- People taking certain medications (e.g., for high blood pressure, depression, insomnia)
- People engaged in vigorous outdoor exercise or work or those under the influence of drugs or alcohol.

The chart below illustrates the relationship of temperature and humidity to heat disorders.

Figure 4.15. Heat Index



Source: National Weather Service
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 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.

According to the 2013 Colorado Natural Hazards Mitigation Plan, "Various sectors of the agriculture community are affected by extreme heat. Livestock, such as rabbits, poultry, pigs, and cows are severely impacted by heat waves. Millions of birds have been lost during heat waves and milk production and cattle reproduction also decreases during heat waves. High temperatures at the wrong time inhibits a crop yields and wheat, rice, maize, potato, and soybean crop yields can all be significantly reduced by extreme high temperatures at key development stages."[47]

Geographic Extent

Like fog and many severe winter storms, extreme temperatures are often a regional occurrence and impact entire counties or significant portions of the planning region simultaneously. The nine-county total reflected in the table below shows how events reported in multiple counties are often part of a larger, regional event. This corresponds to an **extensive** geographic rating.

Previous Occurrences

In a region known for extremely cold weather, exacerbated by high winds, temperature extremes and particularly severe cold present a danger to the inhabitants of the planning area. On February 8, 2011, a winter storm hit northeastern Colorado and wind chill temperatures ranged from 30 degrees below zero to 50 degrees below zero Fahrenheit, as winds gusted to 25-40 mph. Following the storm, an Arctic high pressure moved into the area and the combination of cold air temperatures and strong winds resulted in wind chill values between 25 and 30 degrees below zero Fahrenheit. Wind chill values were estimated at -27 degrees Fahrenheit at Burlington.

The NCDC database reflects the total number of extreme cold/wind-chill events and extreme heat events combined in the planning region between 1996 and 2013. This information is captured in the table below.

[47] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (pp. 3-45).

Table 4.18. Extreme Temperature Occurrences per County, 1996-2013

County	Occurrences
Cheyenne	1
Kit Carson	3
Lincoln	0
Logan	0
Morgan	0
Phillips	0
Sedgwick	0
Washington	0
Yuma	4
9 County Total	**8**

Source: National Climatic Data Center

The Colorado Department of Public Health and Environment does not track heat-related injury or mortality statistics by county. The NCDC database does not reflect any extreme heat incidents, outside of those captured as drought, for the region either. The Colorado Climate Center notes that the humidity of the eastern plains is very low, but that the highest temperatures in the state occur in this region. This indicates that while many hot days in the planning area fall in the 'danger' or 'extreme danger' area of the heat index, the low humidity may make the heat feel less uncomfortable to people (possibly not noticing the effects of extreme heat on themselves until serious injury occurs).

The 2013 Colorado Natural Hazards Mitigation Plan includes information that shows the extreme temperatures in Fahrenheit between 1961 and 2013, which is replicated for the planning area below.

Table 4.19. Temperature Extremes by County, 1961-2013

Counties	Extreme Low (ºF)	Extreme High (ºF)
Cheyenne	-30	108
Kit Carson	-29	107
Lincoln	NA	NA
Logan	-35	110
Morgan	-32	107
Phillips	-33	109
Sedgwick	-37	109
Washington	-32	107
Yuma	NA	NA

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management)

Probability of Future Occurrences

According to the 2013 Colorado Natural Hazards Mitigation Plan, "Since the record hot year of 1998, six of the last ten years (2004-2013) have had annual average temperatures that fall in the hottest 10 percent of all years on record for the United States. This example supports a shift towards a warmer climate with an increase in extreme high temperatures and a reduction in extreme low temperatures. These types of changes have been apparent in the western half of North America."[48]

Temperature variations are expected in the planning region. While extremes are usually statistical outliers, they still present a useful picture of potential ranges. Heat wave records or other indications of extremely high temperature variations are not tracked in a manner that allows for analysis or reproduction. The cold events that are documented are clearly incomplete, as demonstrated by comparing the number of severe winter weather incidents to severe cold incidents. Generally; however, the common association of droughts and extreme heat and severe winter storms with extreme cold lends itself to a generalized prediction of correlating future occurrence predictions. These events are expected to occur yearly, in general, and are considered **highly likely**.

Magnitude/Severity

Current data records are not complete, and so only best estimates may be offered in assessing the magnitude and severity of the hazard. In general, extreme temperatures do not directly damage critical infrastructures and buildings permanently, although an overly high demand on electricity (either for heating or cooling capabilities) may strain the infrastructure. First responders and other personnel subjected to exposure to such conditions may also experience a higher vulnerability to the events, which would raise the severity of an occurrence, but the data is not available to support the common-sense supposition. Available health records do indicate that extreme cold corresponds to higher injury and death rates to cold-related activities and/or injuries, and it is reasonable to assume that heat-related injuries have similar correspondence rates, though data is not tracked. Based on this information, on a regional level, this hazard is of **limited** severity.

Overall Hazard Significance

Rates of occurrence are tied to the overarching hazards during which extreme temperatures are expected to occur, such as severe winter weather or droughts. The geographic distributions are regional on a multi-county, and sometimes multi-state level, though the severities often

[48] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (pp. 3-40).

vary between jurisdictions within the same county. Overall, the hazard is more associated with other corresponding hazards, such as drought and severe winter storms, and so as an individual effort, it may remain of **low** significance to the region. Potential mitigation measures include conducting pre-season public information campaigns, identifying location of vulnerable populations, issuing advisories and warnings, and establishing cooling/warming centers.

4.2.16 Tornadoes

Description

Tornadoes

According to the 2013 Colorado Natural Hazards Mitigation Plan, a tornado is a localized, violently destructive windstorm occurring over land, especially in the Midwestern United States and characterized by a long, funnel shaped cloud, composed of condensation and containing debris that extends to the ground and marks the path of greatest destruction. Tornadoes are generated by severe thunderstorms. Tornadoes in Colorado are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the Polar Regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind known as funnel clouds. Colorado lies at the western edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Kansas and Nebraska. In Colorado, the primary threat of tornado is east of the Continental Divide along the Front Range and across the Eastern Plains, although they have occurred statewide. Three counties, Adams, Weld, and Washington, have over 100 reported tornadoes reported between 1950 and 2013.

Tornado intensity is measured on the Enhanced Fujita Scale (Table 4.19). The Enhanced Fujita Scale rates the intensity of a tornado based on damaged caused, not by its size. “It is important to remember that the size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is very difficult to judge the intensity and power of a tornado while it is occurring. Generally, that can only be done after the tornado has passed, using the Enhanced Fujita Scale as the measuring stick.”[49]

[49] Colorado Office of Emergency Management, Colorado Natural Hazards Mitigation Plan, December 2013 (p. 3-105).

Table 4.20. Enhanced Fujita (EF) Scale

EF Scale	Wind Estimate (mph)	Type/Intensity of Damage
EF0	65-85	Light damage: peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	Moderate damage: roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	Considerable damage: roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	Severe damage: entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	Devastating damage: well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	Over 200	Incredible damage: strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration.

Geographic Extent

Tornadoes are an annual occurrence in Colorado, most often occurring during June, July and May in the afternoon or evening hours. Population growth, storm spotter programs, and increased coverage of Doppler radar has resulted in an increase in the number of tornado reports over the past several decades. Increases in the number of reported tornadoes over the last decade can be attributed to advances in technology and reporting. Tornadoes have occurred across the planning area frequently and are possible in all areas of the region. In terms of overall potential, the geographic rating is **extensive**; however, tornadoes do not impact the entire region uniformly, as individual tornadoes vary in location, duration, extent, and size. Therefore, the individual geographic rating for a tornado is **significant**.

Previous Occurrences

The table below indicates that over 605 tornadoes have occurred in the planning area since 1950.

Table 4.21. Tornado Events, Deaths, Injuries and Damage in Northeastern Colorado by County, 1950-2013

County	Events	Deaths	Injuries	Total Damages
Cheyenne	61	0	5	$2,555,000
Kit Carson	77	0	6	$379,000
Lincoln	85	0	15	$2,933,300
Logan	78	0	4	$3,345,000
Morgan	64	0	0	$1,041,000
Phillips	38	0	0	$828,000
Sedgwick	30	0	10	$333,000
Washington	102	2	4	$325,661
Yuma	70	0	14	$3,364,000
9 County Total	**605**	**2**	**58**	**$15,103,300**

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management).

The 1990 Limon tornado is the most devastating tornado event in recent history in the planning region. According to the Denver Museum of Nature and Science, "On the evening of June 6, 1990, an ominous dark funnel cloud descended from a massive thunderstorm near the town of Limon, Colorado. Within minutes, an EF3 tornado roared through the heart of town, packing winds of 150–200 mph. After the tornado passed, many businesses and homes lay in ruins. Miraculously, no lives were lost."[50]

The vast majority of tornadoes affecting the planning area are rated between EF0 and EF2. The table below presents all F3 or greater events in the planning area. According to available data, no events greater than F3 have been documented in the planning area. More detail on past tornadoes and their specific impacts are referenced in the County Planning Elements.

Table 4.22. Tornadoes of EF3 Intensity

Scale	Date	County	Community	Injured	Killed	Damage
EF3	7/5/2000	Logan	Dailey	2	0	$750,000
EF3	6/31/1999	Lincoln	Genoa	0	0	$4,000,000
EF3	5/30/1996	Washington	Elba	0	0	$300,000
EF3	6/6/1990	Lincoln	Limon	14	0	$25,000,000
EF3	5/10/1975	Washington		0	0	$25,000
EF3	8/15/1974	Logan		0	0	$250,000
EF3	6/27/1960	Sedgwick		3	2	$250,000

Source: National Climatic Data Center

[50] Denver Museum of Nature and Science, Forces of Nature webpage. Available at www.dmns.org/main/minisites/coloradoForces/tornadoes.html (last accessed August 1, 2014).

Figure 4.16. Tornado Damages in Yuma County in 1916 and 2011

Probability of Future Occurrences

Tornadoes

Based on the information above, the planning area has experienced an average of 9.6 tornadoes per year, or an occurrence rate of 100%. On average, one out of every 86 tornadoes will be an EF3 tornado. This leads to a probability of future occurrence rating of **highly likely** for some level of tornado event and a rating of **occasional** for a severe event.

Magnitude/Severity

Historically, the planning region has been highly vulnerable to smaller-scale tornado events, but has also experienced the occasional EF3 tornado, the most severe documented events available. Based on the likelihood of these events, expected consequences include injuries and fatalities, as well as significant property damages. These factors contribute to a **critical** magnitude and severity rating. The more common events, which cause less damage and result in minimal injuries, are more **limited** in severity. However, the potential for a greater magnitude event remains, and the likely rating of such an event could be **catastrophic**. Straight-line winds also cause structural and economic damage with similar severity ratings corresponding to appropriate magnitudes of events.

Overall Hazard Significance

Tornadoes are frequent events in the region, and anticipated yearly during the spring and summer months. The entire planning area is vulnerable, reflecting the **extensive** geographic rating, though individual events are more **limited** in terms of the land area impacted. Past occurrences indicate that tornadoes are **highly likely** to occur in the future, though more severe storms are only **likely**. Corresponding severity and magnitude ratings indicate that damaging storms are often **critical**, while the majority of events are only **limited** in severity. Tornado

warning systems, safe rooms, wind-resistant buildings, and public education are all important mitigation measures in the region, and the hazard remains a **high** priority.

4.2.17 Wildfires

Description

According to the 2013 Colorado Natural Hazards Mitigation Plan, a wildfire is "an unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.

Wildfires are divided into four categories:

- Wildland fire – fuel consists mainly of natural vegetation;
- Interface or intermix fire – urban/wildland fires that consist of vegetation and manmade fuel;
- Catastrophic Fire – a very intense event that makes suppression very difficult and negatively impacts human values;
- Prescribed fire – Any fire ignited by management actions to meet specific objectives."[51]

Wildfires occur everywhere in Colorado. In the planning area, the most common kinds of wildfires are grassland fires, which occur along railroad tracks, in fields, and on prairie land. Wildfires occur naturally (often through lightning strikes) and also from human causes, both intentional and accidental. Examples of human-driven causes of wildfire include campfires, sparks from trains, discarded cigarettes, and outdoor cooking grills. Droughts lead to an increase in the number of wildfire incidents by drying out fuel sources.

As noted in the 2013 Colorado Natural Hazards Mitigation Plan, prolonged drought has resulted in extremely dry and volatile fuels and a corresponding upswing in large, erratic wildfires. "The combination of dry fuels compounded by the ample availability of those fuels as the result of years of fire suppression activities has created conditions where wildfires are burning faster and hotter than under more historically natural conditions."[52] The 2012 Last Chance fire in Washington County burned 45,000 acres within a day due to a combination of wind, heat, and drought conditions.

[51] Colorado Office of Emergency Management, Colorado Natural Hazards Mitigation Plan, December 2013 (p. 3-214).
[52] Ibid (p. 3-217).

Geographic Extent

All of the counties in the planning region have a high to moderate wildfire risk, according to the 2013 Colorado Natural Hazards Mitigation Plan. Wildfire growth and behavior is influenced by topography, fuel, and weather. Other hazards can trigger wildfires, such as lightning or power lines brought down by high winds. Drought conditions increase wildfire potential by decreasing fuel moisture. Experience and available data indicates that wildfires are possible at any location within the planning area and that a large area of the region could be impacted by a single event; therefore, the geographic hazard rating is considered **extensive**.

Previous Occurrences

In June 2009, the Karval Fire in Lincoln County burned more than 1,883 acres of prairie and croplands and burned for seven miles. Nine fire departments responded and no structures were lost and there were no reported injuries or fatalities. In 2002, the Cheyenne County complex fire burned 15,000 acres, making it one of the larger wildfires documented in the county. Scattered thunderstorms in 2002 also ignited dozens of grass fires across Logan, Morgan, and Washington Counties. The winds, strong surface pressure gradients, and extreme drought conditions allowed the fires to scorch over 12,000 acres of farmland in a short period of time.

On March 18, 2012, the Heartstrong Fire caused an evacuation of a 224-square-mile area of Yuma County, including the Town of Eckley, as wind gusts of 50-70 mph helped to spread the fire. Two homes were destroyed, three firefighters were injured, and 2,400 acres of grass and croplands were scorched.

Figure 4.17. Heartstrong Fire and Destroyed Farmstead (Yuma County)

On June 25, 2012, the Last Chance Fire burned 45,000 acres of grassland, farmland and 11 structures, including four homes. Firefighters from all over northeastern Colorado battled the fire and contained it in less than 48 hours. The fire was started by sparks from a tire blowout and quickly burned through the town of Last Chance and near the town of Woodrow in

southern Washington County. One fire truck and a county bridge were also destroyed in the fire.

Figure 4.18. Last Chance Fire and Destroyed County Bridge (Washington County)

Probability of Future Occurrences

The location of a fire is almost impossible to predict, as the factors which contribute to a fire are highly variable, including current weather conditions, drought cycles, and human activities. It is reasonable to assume that wildland and grassland fires are a yearly occurrence in the region, even if they are not always documented and reported. The likelihood of a future occurrence is 100%, or **highly likely**.

Magnitude/Severity

Similar to the probability assessment above, the magnitude and severity of wildland/grassland fires depends on many factors, most of which make an accurate prediction difficult. This assessment may yield more useful results when examined on a local level. It is reasonable to assume that the magnitude and severity of a fire increases as the size of the fire, and its proximity to settled populations, increases. Wildland-Urban Interface (WUI) maps demonstrate this correlation. The likelihood that an event will result in permanent injuries and fatalities is difficult to quantify as well, but the possibility is always present. Damages depend, again, on location. A fire in an urban setting or that wipes out significant crop yields results in a higher severity rating. A general assessment for the region may best be reflected in a **limited** rating.

Overall Hazard Significance

The NCEM Planning Team continues to rate wildfire as a significant hazard in the region and in each of the nine counties. The geographic rating for this hazard is **extensive** and the probability of future occurrences is considered **highly likely**. While the magnitude and severity rating is

only a **limited** assessment, it is reasonable to assume that the overall significance of the hazard is **high**, particularly based on input from the county-level planning teams around the region.

4.3 Vulnerability Assessment

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

4.3.1 Methodology

According to the 2013 Colorado Natural Hazards Mitigation Plan, "Coloradans become vulnerable to hazards when they live, work, or visit an area where these events occur. Individuals and communities that prepare for the occurrence of a hazard are less vulnerable to its consequences than those that do not. The vulnerability of Colorado's population is rooted in a relationship between the occurrence of hazard events, the proximity of people and property to these occurrences, and the degree that a community and its members are committed and prepared to cope with these occurrences and mitigate their effects."[53]

The NCEM Planning Team and the County Planning Subcommittees reviewed recent risk data and updated the Vulnerability Assessment to determine the impact that each hazard identified in the preceding section would have upon the planning area. The Vulnerability Assessment quantifies, to the extent feasible, assets at risk to natural hazards and estimates potential losses.

This section is a prelude to more detailed vulnerability and loss information captured in each County Planning Element (CPE). In the CPEs that follow Chapter 6 there is a county-by-county

accounting of historic hazard impacts. Actual impacts and associated losses of past occurrences are included within the "History of Recorded Losses" developed for each county. These "histories" confirm that the hazard poses some risk to that county, and describes, where data is available, how it has impacted the county.

The county-by-county assessments examine vulnerable community assets by describing the populations, the rate of population growth, and a general description of land-uses and development trends. Each county assessment also presents a listing of the total values (actual and/or assessed) of property at risk. Each CPE includes an estimate of losses to flood, and a qualitative analysis of risk to dam and levee failure and wildfire. Agriculture is a critical economic asset of all counties in the region, and often accounts for the highest disaster losses. Each CPE contains an analysis of potential losses from floods using HAZUS and an analysis of vulnerable agricultural assets based on federal crop insurance records.

A County Hazard Summary table is included in each CPE. Like the Regional Hazard Analysis (Table 4.1), each county summary identifies and rates the significance of a variety of possible hazards. Significance was measured in general terms, focusing on key criteria such as the likelihood of the event, past occurrences, spatial extent, and damage and casualty potential. While Table 4.1 reflects a qualitative assessment of hazard significance from a region-wide perspective, individual county assessments in each CPE may reflect higher or lower assessments, based on the particular exposures, geography, and vulnerabilities of the area. Only the more significant hazards (high or medium) have a more detailed hazard profile and are analyzed further in this Vulnerability Assessment and in the CPEs.

The medium or high significance hazards assessed are:

- Biological Hazards
- Blizzards and Severe Winter Storms
- Dam and Levee Failures
- Drought
- Dust Storms
- Flooding
- Hailstorms
- Lightning
- Straight-Line Winds
- Tornadoes
- Wildland & Grassland Fires.

[53] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 3-284).

The low significance hazards include:

- Earthquake
- Fog
- Landslides
- Land Subsidence
- Noxious Weeds
- Temperature Extremes

The remainder of this section includes methodologies for estimating potential losses, and a discussion of regional trends, where possible.

4.3.2 Assets at Risk

Total Exposure of Population and Structures

Table 4.23 displays the total exposure of building and content value by county (containing the total cost of structures and contents). "To develop this table, building and content value data from the geodatabases supplied with the HAZUS software was used. The source files used were hzExposureOccupB, representing replacement cost values for the general building stock at the census block level, and hzExposureContentB, representing content values for the general building stock at the census block level."[54]

Table 4.23. Regional Population and Building Inventory Summary

County	2012 Population*	Building Count	Total Building Exposure**
Cheyenne	1,888	10	$752,361
Kit Carson	8,070	32	$3,311,476
Lincoln	5,438	80	$147,769,377
Logan	22,133	175	$305,321,305
Morgan	28,206	154	$61,813,074
Phillips	4,401	7	$417,449
Sedgwick	2,355	37	$2,349,911
Washington	4,706	31	$4,257,973
Yuma	10,023	89	$14,072,096
Total	87,220	615	$580,065,911

[54] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 2-18).

* Estimated 2012 U.S. Census Figures
** HAZUS hzExposureOccupB and hzExposureContentB

Critical Facilities, Infrastructure, and Other Important Community Assets

A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. FEMA's HAZUS-MH loss estimation software uses the following three categories of critical assets. Essential facilities are those that if damaged would have devastating impacts on disaster response and/or recovery. High potential loss facilities are those that would have a high loss or impact on the community. Transportation and lifeline facilities are a third category of critical assets. Examples of each are provided below.

Table 4.24. Critical Facilities, Definitions and Examples

Essential Facilities	High Potential Loss Facilities	Transportation and Lifelines
Hospitals and other medical facilities	Power plants	Highways, bridges, and tunnels
Police stations	Dams and levees	Railroads and facilities
Fire stations	Military installations	Airports
Emergency operations centers	Hazardous material sites	Water treatment facilities
	Schools	Natural gas, facilities and pipelines
	Shelters	Communications facilities
	Day care centers	
	Nursing homes	
	Main government buildings	

Source: FEMA HAZUS-MH MR3

A fourth category called Other Assets has been added to capture items that do not fit the above categories. This could include economic assets at risk may include major employers or primary economic sectors, such as, agriculture, where losses or inoperability would have severe impacts on the community and its ability to recover from disaster. After a disaster, economic vitality is the engine that drives recovery. Every community has a specific set of economic drivers, which are important to understand when planning ahead to reduce disaster impacts to the economy. When major employers are unable to return to normal operations, impacts ripple throughout the community.

NCEM Planning Team members identified the assets in their respective jurisdictions that they considered to be critical facilities or of particular importance/value. Assets for each county are identified in their respective CPE.

Table 4.25 identifies the number of critical facilities in each of the nine counties that are vulnerable to drought, wildfire and flood hazards.

Table 4.25. Critical Facilities in Drought, Wildfire and Flood Hazard Areas by County

		CRITICAL FACILITIES IN HAZARD AREA		
County	**Total Structures**	**Drought**	**Wildfire**	**Flood**
Cheyenne	5,237	47	32	10
Kit Carson	NA	NA	155	NA
Lincoln	3,899	66	111	39
Logan	11,912	62	216	9
Morgan	13,601	91	209	11
Phillips	3,966	68	35	68
Sedgwick	2,299	53	63	22
Washington	3,611	39	81	1
Yuma	16,380	100	99	32
Total	60,905	526	1,001	192

Source: 2013 Colorado Natural Hazards Mitigation Plan (Colorado Office of Emergency Management)

Scour Critical Bridges

Included with HAZUS-MH is a database of bridges called the National Bridge Inventory (NBI) developed by the Federal Highway Administration. One of the database items is a "scour index", which is used to quantify the vulnerability of a bridge to scour during a flood. Bridges with scour index between 1 and 3 are considered "scour critical," or a bridge with a foundation element determined to be unstable for the observed or evaluated scour condition. Scour critical bridges are identified in the CPEs.

Historic Sites

Each CPE provides a listing of the sites registered on either the federal or state Register of Historic Places. This is included because it is important for communities to have an awareness of cultural resources that could be impacted by natural hazards, and because if they are, the rules for repairing and rebuilding historic structures differ from others. Not having an inventory of historic resources available when disaster strikes can prolong a community's recovery and aggravate economic recovery.

4.3.3 Growth and Development Trends

Table 2.1 in the Community Profile shows the estimated total population and population growth projections for each county in the planning region. The State Demographics Office (SDO) predicts that overall the region will grow at a relatively slow rate from 2010 through 2040. It is estimated that population growth over the period will be modest in Logan and Morgan Counties, low in Cheyenne, Kit Carson, Lincoln and Yuma Counties, and flat in Phillips,

Sedgwick and Washington Counties. The 2012 estimated population for the entire planning region, according to the U.S. Census, is 87,220.

Recent and relatively recent economic development trends in the region include:

- Alternative energy
  - Wind farms
    - Three wind farms were constructed between 2008 and 2012 along the Palmer Ridge in Lincoln County and a fourth is planned for 2014 (a fifth has been proposed).
    - A wind farm is planned for northern Cheyenne County.
    - Morgan County has permitted two ethanol production plants and one biodiesel plant. A large ethanol facility is also operating in Yuma County.
  - Oil production
    - Oil production in Lincoln County has increased steadily over the past five years. In 2014, there are 75 producing wells in the county, with another 50 permitted and waiting to be drilled.
- Agriculture
  - Hog farms
    - There are currently four companies operating in Yuma County (there were none 15 years ago). The number of sites has increased from 27 to 39 through 2013. This number includes facilities for sows, boars, nurseries, and finishing.
  - Development of the industrial section of Burlington, mainly grain/fertilizer storage.

Concerns about specific hazards and future development are addressed by hazard in the following section.

4.3.4 Estimating Potential Losses by Hazard

Each of the following hazards was discussed in the Hazard Profiles section. Here, the hazards are described in terms of their potential for future impacts in the region to both existing development and potential future development, in quantitative terms where possible. A summary vulnerability overview is provided for those hazards with a low planning significance. These planning significance levels take into account the entire planning area.

Figure 4.18. Field Day in Akron (Washington County) in 1939; Modern Agricultural Operations

Agriculture: Underpinning of the Region's Economy

Agriculture is the primary driver of the region's economy, and often the majority of hazard impacts are to crops and livestock. Federal Crop Insurance Data represents losses from multiple hazards that could include: biological hazards, flooding, drought, hailstorms, noxious weeds, temperature extremes, tornadoes, wildfires and straight-line winds. An overview of these losses is presented in the following table, but further detail on the loss by particular hazard was not available.

Table 4.26. Federal Crop Insurance Coverage and Losses, 1980-2013

County	Liability (amount of coverage)	Total Premium	Federal Premium Subsidy	Farmer Paid Premium	Amount Paid in Claims	Average Annual Amount Paid in Claims
Cheyenne	$526,449,956	$135,492,258	$73,939,665	$51,552,593	$153,650,680	$4,656,080
Kit Carson	$1,514,417,285	$238,032,479	$121,152,067	$103,880,412	$298,218,471	$9,036,923
Lincoln	$362,343,045	$87,115,715	$50,355,723	$36,759,992	$89,188,327	$2,702,677
Logan	$793,784,010	$100,146,963	$54,206,345	$45,940,618	$71,473,011	$2,165,848
Morgan	$684,151,016	$79,148,717	$43,198,390	$35,950,327	$69,281,754	$2,099,447
Phillips	$923,289,681	$109,446,541	$58,736,238	$50,710,103	$89,755,013	$2,719,849
Sedgwick	$492,388,798	$55,467,784	$29,690,259	$25,777,525	$42,238,257	$1,279,947
Washington	$903,734,849	$153,025,170	$86,567,039	$66,458,131	$127,702,796	$3,869,782
Yuma	$2,314,196,452	$239,752,235	$132,504,533	$107,307,702	$152,489,670	$4,620,900
Totals	$8,514,755,092	$1,197,627,862	$650,350,259	$524,337,403	$1,093,997,979	$33,151,453

Source: USDA Risk Management Agency

Biological Hazards

Potential Losses to Existing Development

Planning Significance: Medium. The impact that wildlife, and more notably, insects can have upon the planning area is substantial. The fact that there have been two state disaster declarations to combat the impact of grasshopper infestations is indicative of the potential for future loss. A widespread agricultural infestation could seriously impact the economic base of the planning area.

Buildings, Infrastructure, and critical facilities are not vulnerable to this hazard. It impacts agriculture production and losses are primarily economic in nature, rather than structural impacts. Rough estimates of potential direct losses from agricultural infestation fall in a range of 1 to 50 percent of annual crop receipts for a County and/or 1 to 75 percent of livestock receipts. However, additional data is not available regarding historical uninsured or unclaimed losses or general reductions in crop and livestock yields.

In 2009, the planning area experienced the highest grasshopper infestation since 2002-2003. Timely rains and aggressive spraying ultimately helped mitigate the impacts. In 2010, grasshoppers again reached numbers that required direct action (sprays, dusts and baits were used to control the infestation). During the summers of 2011 and 2012, Colorado again experienced substantial infestations with grasshoppers numbering as many as 17 per square yard in test areas, according to the U.S Department of Agriculture. Timely spraying and other field management methods were employed to help limit the damages to crops and rangeland. A cold, wet spring promoted bacteria that limited grasshoppers in 2013 and it is estimated that there will be low populations of grasshoppers in northeastern Colorado in 2014.

West Nile Virus has and will continue to have impacts on human health in the region. There are several strategies being utilized in combating West Nile virus, including spraying areas where mosquitoes breed, inoculating horses and livestock in areas where the virus has been confirmed, general public education, and wearing clothing that minimizes exposure of the skin. Tracking expenses related to combating West Nile Virus is difficult, primarily because the cost of inoculations is borne by the owner of the livestock, and record keeping of the distribution and use of the vaccine is sketchy.

Future Development

Future development is not expected to be significantly impacted by this hazard.

Blizzards and Severe Winter Storms

Existing Development

Planning Significance: High. 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. The region can experience high winds and drifting snow during winter storms that can occasionally isolate individuals and entire communities and lead to serious damage to livestock populations and crops. Winter storms contribute directly to other hazards examined in this plan: extreme temperatures (cold).

Travelers on highways in the region, particularly along remote stretches of road, can become stranded, requiring search and rescue assistance and shelter provisions. When interstate highways are closed, this action cuts the provision of primary supplies (gasoline and food) to the communities, potentially stranding thousands of motorists and filling up hotel rooms in the closest communities with available lodging.

Figure 4.19. Closed Interstate Highway

Proactive and coordinated road closures enacted by CDOT have been successful in mitigating impacts to travelers, and reducing shelter demands. In Sedgwick County I-80 is closed by the State of Nebraska when I-76 in Colorado closes, and this helps to alleviate large populations needing shelter in Julesburg. In Yuma County shelters have been designated and special needs individuals have been identified that may need assistance during winter storms.

Research presented in Section 4.2 Blizzards and Severe Winter Storms indicates significant impacts from this hazard in the past. Structural losses to buildings are possible and structural damage from winter storms in Colorado has resulted from severe snow loads on rooftops. Older buildings are more at risk, as are buildings with large flat rooftops (often found in public

buildings such as schools). Elderly and disabled citizens are particularly vulnerable to winter storm impacts.

Smaller communities prevalent in the region may become isolated during winter storm events. Residents that choose to live in rural areas are generally self-sufficient, and should be, as government and emergency services may be limited during a severe winter storm.

Another common impact of blizzards and severe winter storms on the planning area is the loss of power. 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 for grocery stores, large facilities that provide feeding services (such as prisons, hospitals and nursing homes), and restaurants.

The county-by county "History of Hazard Losses" identifies specific impacts (the monetary impact and number of downed power poles) where data are available. Severe winter storms are a fact of life in the region and will continue to occur. Expected losses will be related to snow removal, roadway closures, and loss of electrical power.

Future Development

Future residential or commercial buildings built to code should be able to withstand snow loads from severe winter storms.

Dam and Levee Failure

Existing Development

Planning Significance: Medium. Based on the information in the hazard profile in section 4.2, the impacts to existing development from a dam failure in some parts of the region could be severe to catastrophic, similar in some cases to impacts associated with flood major events. The failure of a Class I dam would present a much greater threat of injury and damage to property and infrastructure than an event involving a smaller dam due to the potential speed of onset and greater depth, extent, and velocity of flooding. Dam failure floods are capable of inundating areas outside of mapped floodplains. Determining the vulnerability to flooding from dam failure differs from riverine flooding because the land areas that would be inundated in the event of a dam failure are not typically displayed on FEMA and CWCB flood hazard area maps.

Colorado law requires all owners and operators of Class I dams to prepare Emergency Action Plans (EAPs). Dam failure inundation maps must be prepared as part of the planning process

and included in the EAP. EAPs also contain emergency call-down notification lists to immediately alert downstream property-owners of possible problems. An analysis of the dam failure hazard, including potential downstream impacts, captured in each CPE that includes dam failure risk. The only certified levees in the planning are in Morgan, and Yuma counties. The towns of Wray (Yuma County) and Weldona (Morgan County) may face the greatest risk in the region of flooding caused by the failure or overtopping of a levee.

Future Development

It is important that communities in the region keep the dam failure hazard in mind when permitting new development, particularly downstream of the high and significant hazard dams located within the nine counties or that drain into the planning area.

Drought

Existing Development

Planning Significance: High. Based on prolonged drought conditions in northeastern Colorado and Colorado's drought history, it is evident that the entire region is vulnerable to drought. With most of the land dedicated to agriculture, the planning area has significant exposure to this hazard. In addition to economic and public water supply impacts, drought also leads to soil erosion, dust/dust storms, and an increase in the number and size of wildfires. In addition to crop losses and livestock deaths, the costs of feeding livestock and other animals increases significantly. Most of the region's water resources come from ground water, surface water reservoir storage, and the South Platte River. Vulnerability to low flows on the South Platte River increases with consecutive winters of below-average snowpack.

While widespread, the losses associated with drought are often the most difficult to track or quantify. While FEMA requires potential losses to structures to be analyzed, drought does not normally have a structural impact. Drought can indirectly lead to property losses by creating extreme wildfire conditions. The implications of drought for the regional economy are widespread, from forcing ranchers to sell off their herds, to increasing hydroelectric power rates, to spreading noxious weeds in areas that no longer can support crops.

Future Development

Drought vulnerability will increase with future development as there will be increased demands for limited water resources. Future growth in the region will mean more wells and more demands on groundwater resources. Given that new development is limited in scale, future development is unlikely to exacerbate drought conditions in the short term.

Dust Storms

Existing Development

Planning Significance: Medium. One of the most hazardous effects of a dust storm is the reduction in visibility. Dust storms commonly reduce the visibility to less than a quarter of a mile. Dust storms can rapidly change the appearance of an area with the shifting and re-forming of dunes by the wind. Dust storms in arid regions can be formed when small, light dust particles are blown in to the air, often lifted by the strong winds at the leading edge of a cold front. In some drought prone areas, a 'dustbowl' effect can be caused by prolonged drought over a long period because of persistent failure of the rains, and often exacerbated by overgrazing. Dust storms can have a devastating effect on agriculture, both crops and livestock, commerce, public health and the environment.[55]

Dust storms can impact infrastructure and utilities and disrupt commerce. Dust particles can get into buildings and businesses and work their way inside computers and telecommunications equipment, resulting in damaged or destroyed technology.

Future Development

Future development is not expected to be significantly impacted by this hazard.

Flood

Existing Development

Planning Significance: High. Flooding and floodplain management are significant issues in these nine counties and in some of the incorporated areas. The significance of this hazard, the requirements for Flood Mitigation Assistance plans, and the availability of digital hazard data in GIS drove the development of a detailed vulnerability assessment that is discussed in the following pages.

Methodology

Special Treatment of Flood Hazards: Inventory of Flood Hazard Areas

Flooding is one of the few hazards within the planning area where it can reasonably be predicted where problems will occur. Floodplains in northeastern Colorado vary in size and depth of flooding. A variety of uses, structures and critical facilities occupy these floodplains, as

[55] University of Texas at El Paso, Center for Environmental Research and Management. Available online at www.research.utep.edu/ (last accessed August 4, 2014).

evident in the flood hazard area inventories developed by each county and included in the CPEs, which contain information about:

- The types and numbers of buildings (residential, commercial, and manufactured housing) in the identified floodplain,
- The actual values of these buildings, so that an estimate of the potential dollar losses could be made,
- The types and locations of critical facilities within each identified floodplain, and
- The number of structures uninsured against flood through the NFIP.

These flood hazard inventories help the County Planning Subcommittees to:

- Characterize the extent of each community's exposure to potential flood losses,
- Determine if adequate flood insurance coverage is in place,
- Determine which buildings, occupants and critical facilities are at-risk, and
- Identify appropriate types of mitigation measures.

FEMA/NFIP paper maps, where available, were utilized manually to conduct the floodplain inventories. Generally across the region, the flood hazard area inventories indicate that most of the floodplain areas outside the incorporated communities are undeveloped. Each participating community has an official map designating the Special Flood Hazard Areas. These maps are available through each community's Building or Planning Department or at msc.fema.gov

During the 2009 update the NCEM Planning Team used HAZUS-MH to quantify the potential flood losses to the county and cities in the region. An approximate 100-year floodplain was generated for major rivers and creeks in each county in the region (those with a 10 square mile minimum drainage area). A USGS 30 meter resolution digital elevation model (DEM) was used as the terrain base in the model. HAZUS-MH produces a flood polygon and flood-depth grid that represents the base flood. While not as accurate as official flood maps, such as digital flood insurance rate maps, these floodplain boundaries are suitable for use in GIS-based loss estimation. Potential losses to the county were analyzed with HAZUS-MH, based on Census Block-based buildings and population inventory and the flood hazard data. HAZUS-MH provides reports on the number of buildings impacted, estimates of the building repair costs, and the associated loss of building contents and business inventory. Building damage can cause additional losses to a community as a whole by restricting the building's ability to function properly. Income loss data accounts for business interruption and rental income losses as well as the resources associated with damage repair and job and housing losses. These losses are calculated by HAZUS-MH using a methodology based on the building damage estimates. Building damage is estimated by Census Block based on the average depth of flooding within a given Census Block. Flood damage is directly related to the depth of flooding. HAZUS-MH uses depth-damage functions to model the losses. For example, a two-foot flood generally results in

about 20 percent damage to the structure (which translates to 20 percent of the structure's replacement value). The results of the loss estimation are summarized in the following table. Each CPE includes more detail on the loss, including maps and tables that detail how the losses vary by jurisdiction.

When comparing the county-by-county HAZUS runs on a regional level there is a potential for $94.5 million in losses. Morgan and Logan Counties have the highest potential for flood losses.

Table 4.27. HAZUS-MH Flood Loss Estimation by County

County	Cost Building Damage ($)	Cost Contents Damage ($)	Inventory Loss ($)	Relocation Loss ($)	Capital Related Loss ($)	Rental Income Loss ($)	Wage Loss ($)	Total Loss ($)
Morgan	39,230,000	55,272,000	2,206,000	106,000	195,000	37,000	431,000	97,477,000
Logan	22,057,000	29,127,000	942,000	122,000	98,000	36,000	584,000	52,966,000
Yuma	11,055,000	17,111,000	1,121,000	30,000	65,000	9,000	152,000	29,543,000
Phillips	9,613,000	16,702,000	936,000	38,000	85,000	17,000	392,000	27,783,000
Lincoln	2,936,000	5,177,000	107,000	10,000	6,000	3,000	681,000	8,920,000
Washington	3,247,000	3,348,000	179,000	-	5,000	-	19,000	6,798,000
Cheyenne	2,435,000	3,573,000	63,000	6,000	9,000	-	65,000	6,151,000
Sedgwick	2,483,000	2,444,000	81,000	9,000	11,000	-	51,000	5,079,000
Kit Carson	1,449,000	1,483,000	125,000	-	-	-	3,000	3,060,000
Total	94,505,000	134,237,000	5,760,000	321,000	474,000	102,000	2,378,000	237,777,000

Source: HAZUS-MH –MR3

Limitations

Default HAZUS-MH data was used to develop the loss estimates. Thus, the potential losses derived from HAZUS-MH, the best available data, may contain some inaccuracies. The building valuations used in HAZUS-MH MR3 are updated to R.S. Means 2006 and commercial data is updated to Dunn & Bradstreet 2006. There could be errors and inadequacies associated with the hydrologic and hydraulic modeling of the HAZUS-MH model. The damaged building counts generated by HAZUS-MH are susceptible to rounding errors and are likely the weakest output of the model due to the use of census blocks for analysis.

Agricultural Losses

Agricultural losses were included in the HAZUS-MH analysis. The HAZUS-MH model assumes a short duration and slow rise flood when estimating losses and does not account for high velocity flash floods. Loss estimates are based on United States Army Corp of Engineers (USACE) damage modifiers. The HAZUS-MH impact analysis predicts a loss estimate value by crop for flow time intervals. The first is a loss estimate for the day of the fixed event; the remaining three are for 3, 7 and 14 days following the event. The results of these analyses are presented in each CPE.

Critical Facilities

To estimate the potential impact of floods on critical facilities a GIS overlay was performed of the flood hazard layer on existing critical facilities point locations. The results are shown in each CPE in map and tabular form. A summary of facilities potentially located in floodplains is provided in Table 4.27 (note that the majority of the facilities are bridges, but the analysis does not determine if these bridges will be overtopped by flooding).

Future Development

Due to varying trends in the nine-county planning area, future development is discussed in more detail in each County Planning Element. The risk of flooding to future development in the region can be minimized by the continued enforcement of the floodplain management programs currently in place. Encouraging additional participation with the NFIP and promoting flood insurance can also encourage sound floodplain practices.

Hailstorms

Existing Development

Planning Significance: High. Hail events resulting in significant losses are reported within the "History of Hazard Losses" section of each CPE. Hail is associated with thunderstorms, and thunderstorms are a common occurrence throughout the planning area between early spring and late fall. Due to the frequency and widespread distribution of hail-producing thunderstorms, the NCEM Planning Team considers the risk of hail and severe summer storms to be the same across the entire planning area. The risk does not vary from county to county.

Hail, in northeastern Colorado, primarily causes crop damage. However, hailstorms in populated areas can cause significant damage to roofs, automobiles, utility lines, trees and windows. Future losses to crops and property from hailstorms in the region will be in the millions.

Future Development

Future development is discussed in more detail in each County Planning Element. New critical facilities such as communications towers and tornado sirens should be built to withstand hail damage. With limited development occurring in the region, future hail losses to new development should be minimal.

Lightning

Existing Development

Planning Significance: Medium. It is difficult to quantify where specific losses will occur due to the random nature of this hazard. Given the lightning statistics for Colorado and the region, the entire region remains at risk and is vulnerable to the effects of lightning. Persons recreating or working outdoors during the months of April through September will be most at risk to lightning strikes. It is difficult to quantify future deaths and injuries due to lightning.

Critical facilities and infrastructure will have the greatest consequences if damaged by a lightning strike. The greatest losses from lightning could result from secondary hazards, such as wildfire.

Future Development

Future development is discussed in more detail in each County Planning Element. New critical facilities such as communications towers should be built with lightning protection measures. Lightning detectors have been installed near public swimming pools and baseball fields in Kit Carson County as a mitigation measure, and are recommended tool for new or existing parks and golf courses.

Straight Line Winds

Existing Development

Planning Significance: High. In addition to tornadoes, the planning area is subject to potentially destructive straight-line winds. High winds are common throughout the planning area, throughout the entire year. Straight line winds are primarily a public safety and economic concern. Wind storms can cause damage to structures and power lines which in turn can create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered.

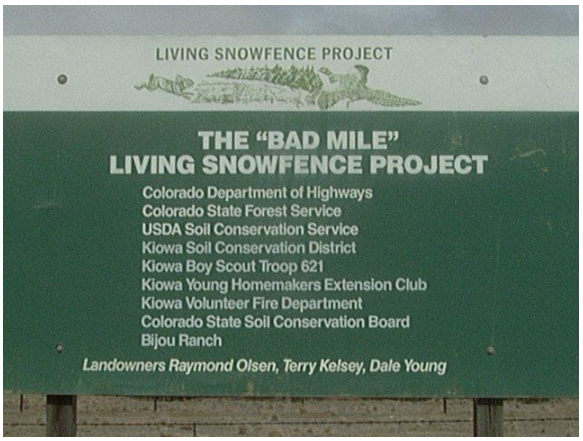
Future losses from straight line winds include:

- Erosion (soil loss)
- Dry land farming seed loss,
- Wind-blown weeds, such as tumbleweed
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs.

While there has been some scattered record keeping describing the impacts of dust storms, and the removal of concentrated piles of tumbleweeds, there is little information to indicate that

straight-line winds are little more than a nuisance. In some areas, mitigation measures such as "Living Snow Fences" (and traditional snow fences) have been established to protect roadways and/or farmsteads from wind-blown snow. On the other hand, the frequent windmills that dot the landscape use the prevailing winds to capture the power of the wind to pump groundwater for livestock.

Figure 4.20. Living Snowfence



Campers, mobile homes, barns, and sheds and their occupants are particularly vulnerable as windstorm events in the region can be sufficient in magnitude to overturn these lighter structures. Overhead power lines are vulnerable and account for the majority of historical damages. Interstate corridors can be vulnerable to high winds and dust storms, where high profile vehicles may be overturned by winds and lowered visibility can lead to multi-car accidents.

Future Development

Future development is discussed in more detail in each County Planning Element. Future development projects should consider windstorm hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Limited development trends in the region are not expected to significantly increase vulnerability to this hazard.

Tornadoes

Existing Development

Planning Significance: High. Tornadoes are the most violent hazard affecting the planning area. Tornadoes can have an atmospheric pressure differential of 2 inches from the outer edge of the funnel to its center, creating winds in excess of 300 mph across an area as small as 300 yards. For the sake of comparison, a hurricane can have the same pressure differential across an area of 300 miles!

When the randomness of tornado location and the vast open space within the planning area are considered, the NCEM Planning Team does not consider any one area at a greater risk to tornadoes than another. When tornadoes do strike populated areas, the impact can be devastating, as residents of the city of Limon (Lincoln County) experienced in 1990. Tornadoes can impact communities by destroying buildings and infrastructure within seconds. They can annihilate power distribution systems, commercial businesses, residential neighborhoods, automobiles and crops. They can create tremendous debris removal problems, overwhelm building departments, and psychologically scar residents.

Little can be done to reduce the damages caused by tornadoes – though recently, significant strides have been made to improve life safety during these events – most notably through improved warning systems and the installation of "safe rooms."

Figure 4.21. Safe Room Projects in Fort Morgan, Colorado

The "Safe Room Team" of Ft. Morgan Middle School

Students build safe rooms and team spirit in Ft. Morgan, CO

Future Development

Limited development trends in the region will not increase exposure or vulnerability to tornadoes.

Wildland/Grassland Fires

Existing Development

Planning Significance: High. According to the NCEM Planning Team, the areas that are most vulnerable to wildfire are agricultural areas where CRP land is burned, rural areas where trash

and debris are burned, and the wildland-urban interface areas. Homes built in rural areas are more vulnerable since they are in closer proximity to CRP land that is burned and homeowners are more likely to burn trash and debris in rural locations. The vulnerability of structures in rural areas is exacerbated due to the lack of hydrants in these areas for firefighting and the distance required for firefighting vehicles and personnel to travel to respond. In addition, structures along the wildland urban interface where wild fuel loads are in close proximity to structures are at increased risk.

During drought conditions, wildfires occur frequently throughout the planning area, even though they cause little damage and generally do not qualify for disaster assistance. There is an apparent increase in fires in areas where the CRP has prohibited grazing on lands enrolled in the program. In this instance, there is little else to stunt the growth of weeds, which in turn, provide fuel for fires.

Future Development

Limited development trends in the region will not increase exposure or vulnerability to wildfires. The planting of "living" wind breaks around existing or new homes and buildings should be set back far enough to limit wildfire vulnerability.

Low Significance Hazard Vulnerability Discussions

Earthquake

Planning Significance: Low. As discussed under the profile for this hazard in Section 4.2, there is only a 10 percent probability of an earthquake exceeding a peak acceleration of 3 percent gravity in the next 50 years in the planning area, according to the USGS. Typically, significant earthquake damage occurs when accelerations are greater than 30 percent of gravity. With this in mind, the NCEM Planning Team has determined that the planning area is not vulnerable to significant earthquake damage. The potential loss estimates developed by the Colorado Geological Survey presented in Section 4.2 indicate that the potential for damaging earthquakes does exist for Lincoln and Kit Carson Counties, but the probability of these earthquakes is low.

Fog

Planning Significance: Low. Fog does not cause impacts to buildings or infrastructure but poses a significant danger to people traveling, particularly on the highways of the region. The extensive highway transportation system across the expansive region includes two interstate highways, major federal and state highways, and County and local roads. While people are not directly vulnerable to fog, the hazard greatly increases the danger of driving on the roads. The

population is indirectly vulnerable to accidents and dangerous traveling conditions caused by fog.

Fog appears to be a localized problem east of Genoa (Lincoln County) near Cedar Point, where it was attributed to one traffic fatality. Fog mitigation techniques can include "low-tech" solutions such as maintaining or improving road striping in susceptible areas (usually along river bottoms), to "high-tech" solutions that utilize variable speed limit signs that change with varying weather conditions.

Noxious Weeds

Planning Significance: Low. Noxious weeds include Bindweed, Canada Thistle, Tamarisk and Russian Thistle (Tumbleweeds). Noxious weeds are a nuisance in northeastern Colorado, and they can aggravate other hazard threats. As cited in the Hazard Identification section of this plan, Tamarisk (Saltcedar) has an impact on drought by limiting water supply and on floods by blocking conveyance channels. Tumbleweeds not only catch on fire, and easily spread fire, but they can clog drainage ways increasing drainage and flood problems, and they can be a debris problem by their sheer number and volume.

There is little economic data available on the financial impact these weeds have upon local governments and area farmers and ranchers. From a hazard perspective, the CRP mandates that the registered land be put in pasture – and when the weeds grow on that, it aggravates the fire danger. There is strong local sentiment that the CRP should allow grazing upon those registered lands, lessening the drought impact on feed costs, lessening the volume of noxious weeds, and lessening the increased fire threat.

Temperature Extremes

Planning Significance: Low. Limited data on temperature extreme impacts per county was available during the development of this hazard's profile (added in 2009). Extreme heat normally does not impact structures as there may be a limited number of days where the temperatures stay high which gives the structure periodic relief between hot and cool temperature cycles. Areas prone to excessively high temperatures are identified normally on a nationwide assessment scale, which doesn't allow detailed results on specific structures. Secondary impacts of extreme heat can affect the supporting mechanisms or systems of a community's infrastructure. For example, when there is high demand 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 medical emergencies, spoiled foods, and other health and safety issues.

The elderly population in the planning area is most vulnerable to temperature extremes. Table 2.2 in Chapter 2 shows that the percentage of elderly people (age 65 or over) in the planning

area is well above the national average, which is 6%. However, most residents of northeastern Colorado are self-sufficient and accustomed to rural living and the climate extremes that are part of the territory. The residents of nursing homes and senior care facilities are especially vulnerable to extreme temperature events. Most facilities have emergency plans or backup power to address power failure during times of extreme heat or cold.

4.4 Capability Assessment

Capabilities refer to the programs and policies currently in place to reduce hazard impacts through the identification and implementation of cost-effective hazard mitigation measures. Capabilities can take the form of regulatory requirements (e.g., building codes or hazard-specific zoning ordinances), plans (e.g., hazard mitigation plans or stormwater master plans), certification programs (e.g., Storm Ready or the Community Rating System), personnel (e.g., floodplain administrators and community planners), insurance (e.g., National Flood Insurance Program), and structural projects that protect critical facilities and other property.

The County Planning Elements (CPEs) document each jurisdiction's existing authorities, policies, programs, and resources related to hazard mitigation, including:

- Building Codes
- Community Rating System
- Community Wildfire Protection Plans
- Comprehensive/Land Use Plans
- Emergency Operations Plans
- Hazard Mitigation Plans
- National Flood Insurance Program
- Sirens and Public Warning/Notification Systems
- Storm Ready Certification
- Stormwater Master Plans
- Structural and Capital Improvement Projects
- Zoning Ordinances.

Each CPE also provides information related to participation by jurisdictions within the county in the National Flood Insurance Program (NFIP), including policies in force, total dollar amount for premiums, and claims information. Table 4.12 in Chapter 4, Risk Assessment (page 43) of this document provides a summary of NFIP policies and claims in the planning region from 1978-2013.

According to the 2013 Colorado Natural Hazards Mitigation Plan, a significant variation in capabilities exists from one part of the state to the other, due to different levels of hazard exposure, varying local tax bases, available staff, and political support. Local land use regulations and building codes, typically implemented at the local government level, are historically effective hazard mitigation tools. Where hazard zone regulations exist, the strength of regulation enforcement can significantly influence the level of capability. Codes are another tool that communities use to enhance public safety through hazard mitigation. "In many cases, codes are intended for structural integrity and fire prevention, but provide benefits in relation to natural hazard avoidance. Even without a statewide mandate, most counties and many municipalities have enacted regulations and codes. Capabilities related to local multi-hazard mitigation plans and Community Wildfire Protection Plans (CWPP), community development related comprehensive plans, along with Emergency Operation Plans, appears to be the strongest capability at the local level."[56]

More detailed information on the capabilities of the nine counties in the planning region can be found in the Capability Assessment sections of the County Planning Elements.

[56] Colorado Office of Emergency Management, *Colorado Natural Hazards Mitigation Plan*, December 2013 (p. 4-58).

CHAPTER 5 MITIGATION STRATEGY

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the mitigation strategy process and mitigation action plan for the 2014 update of the Northeast Colorado Natural Hazards Mitigation Plan. The process for development of information included in this chapter conforms to the third phase of FEMA's 4-phase guidance -- *Develop the Mitigation Plan* -- and corresponds to Step 6 (Set Goals), Step 7 (Review Possible Actions) and Step 8 (Draft an Action Plan) of the 10-step planning process.

5.1 Plan Goals

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

The development of goals and objectives for the 2014 updates and previous versions of this plan were based on: (1) an updated analysis of significant hazards in the planning region, (2) an updated vulnerability assessment that estimates the potential impacts of the hazards identified, (3) an updated capability assessment that identifies resources and safeguards currently in place to reduce potential hazard impacts, and (4) a mitigation strategy and action plan intended to reduce risks to communities in the region in the future.

At a working session of the NCEM Planning Team on July 8, 2014 in Yuma, the goals and objectives from the 2009 plan were reviewed and the Team revalidated the four core goals from the 2009 plan:

1. Reduce loss of life, property damages, and economic impacts caused by natural hazard events;
2. Improve county-level capabilities to reduce disaster losses;
3. Increase public awareness of potential hazard losses;
4. Maintain FEMA eligibility and qualify communities for federal mitigation funding.

No new goals were added. The Team then reviewed the objectives for each goal to determine whether the objectives should be continued, revised or removed from the 2014 plan updates, based on progress made toward achieving goals in the intervening five years. The objectives were also reevaluated and modified to ensure that concepts and terminology were consistent with the 2013 Colorado Natural Hazards Mitigation Plan. The result of this collaborative process is a set of updated goals and objectives for the planning region, as exhibited below.

5.1.1 2014 Regional Goals and Objectives

Goal 1. Reduce Loss of Life, Property Damages, and Economic Impacts Caused by Natural Hazard Events

1.1. Reduce Losses from Drought

1.1.1. Improve Water Supply

1.1.2. Continue to Seek Grazing on CRP Land

1.1.3. Increase Use of Low-Water Crops

1.2. Reduce Losses from Flooding

1.2.1. Promote Flood Insurance

1.2.2. Sponsor Site-Specific, Cost-Effective Mitigation Projects

1.3. Reduce Losses from Tornadoes and Severe Wind Storms

1.3.1. Improve Public Warning

1.3.2. Promote Safe Rooms and other Shelters

1.3.3. Promote Erosion Mitigation Techniques

1.4. Reduce Losses from Wildfires

1.4.1. Improve CWPP-Related Planning

1.4.2 Promote *Firewise* Communities Program

1.4.3. Develop and Adopt Annual Operating Plans (AOPs)

1.5. Reduce Losses from Winter Storms

1.5.1. Identify and Equip Shelters

1.6. Reduce Losses from Other Hazards Identified in This Plan

1.6.1. Develop Projects Focused on Preventing Loss of Life, Injuries and Property Damages from Natural Hazards

Goal 2. Improve County-Level Capabilities to Reduce Disaster Losses

2.1. Continue to Seek NWS Storm Ready Certification in Each County

2.1.1. Coordinate with National Weather Service (NWS)

2.1.2. Acquire NOAA Weather Radio Repeaters

2.1.3. Identify Other Program Requirements

2.1.3.1. Obtain Communications Equipment

2.2. Improve Local Flood Protection Programs

2.2.1. Promote National Flood Insurance Program (NFIP) Participation

2.2.2. Increase Public Awareness of Flood Hazard Areas and Potential Losses

2.2.3. Promote Flood Insurance for Residents/Businesses in Flood Hazard Areas

2.2.4. Seek Improved Floodplain Mapping

2.3. Strengthen Connections between Hazard Mitigation Activities and Preparedness, Response and Recovery Activities

2.3.1. Disaster Plans

2.3.1.1. Local Emergency Operations Plans

2.3.1.2. Homeland Security Plans

2.3.1.2.1. Bioterrorism/Health Department Plans

2.3.1.2.2. WMD/Terrorism-Related Plans

2.3.2. Hazardous Materials and LEPC Plans

2.3.2.1. Materials Transported through the County

2.3.2.2. Materials Stored in the County

2.3.2.3. Materials Manufactured in the County

2.3.3. County Comprehensive Plans

2.4. Reduce Damage to and Maintain Functionality of Critical Facilities & Infrastructure

2.4.1. Strengthen Continuity of Operations Planning (COOP) and Capability to Deliver Essential Services

2.4.2. Strengthen Local Recovery Planning

2.4.3. Develop Projects that Protect Critical Assets in Natural Hazard Risk Areas

2.4.4. Seek FMA, PDM and MAP Program Funds for Needed Plans and Projects

Goal 3. Increase Public Awareness of Potential Hazard Impacts

3.1. Continue to Develop and Expand Public Awareness and Information Programs

3.1.1. Sponsor Annual Public Education Project or Awareness Week

3.1.1.1. Provide Hazard Maps, Data on Historic Events, Preparedness Information and Information on Insurance Availability

3.1.1.2. Utilize Range of Risk Communication Tools: Websites, Social Media, Newspapers, Newsletters, Utility Bills, Radio, 4-H Clubs and Distribution at County Fairs

3.1.1.3 Support Established Programs (Firewise, "I'm Not Scared, I'm Prepared," Code Red) and Provide Preparedness Resources (Tornado, Winter Storm, Lightning, Hail)

3.1.1.4. Identify and Target Specific Areas at Risk to Natural Hazards (e.g., Floodplains)

Goal 4. Maintain FEMA Eligibility and Qualify Participating Communities for Federal Mitigation Funding

4.1. Develop and Adopt this Regional Hazard Mitigation Plan in Conformance with Disaster Mitigation Act (DMA) Requirements

4.1.1. Attend the County Planning Subcommittee Meetings

4.1.2. Provide Data Regarding Hazards, Losses and Existing Capabilities

4.1.3. Review and Provide Comments on Draft Plan Updates

4.1.4. Stimulate and Participate in the Public Input Process

4.1.5. Schedule Plan Adoption and Advise Appropriate Authority

Changes to Goals and Objectives in the Updated 2014 Plan

Although the goals for this plan are not listed in priority order, they have been reordered in this update to ensure that maintaining grant eligibility is not perceived as the primary goal of the plan. The new order is: (1) Reduce Losses, (2) Improve Capability, (3) Increase Awareness, and (4) Maintain Eligibility. A number of new objectives have been added in this update and several other objectives from the previous version have been modified. A summary of the changes is as follows:

(1) Reduce Losses

- 1.4 Reduce Agricultural Losses and 1.4.1 Promote Crop Insurance have been deleted because the objective is achieved. The NCEM Planning Team reports that virtually all agricultural interests in the region are aware of coverage and 95% or more are insured.
- Three recommended actions have been added in support of the Reduce Losses from Wildfires objective (1.4):
  1. Improve CWPP-Related Planning (1.4.1)
  2. Promote *Firewise* Communities Program (1.4.2)

3. Develop and Adopt Annual Operating Plans (1.4.3)

- One recommended action has been added to the Reduce Losses from Winter Storms objective:

1. Identify and Equip Shelters (1.5.1)

- One recommended action has been added to the Reduce Losses from Other Hazards objective:

1. Develop Projects Focused on Preventing Loss of Life and Injuries from Natural Hazards (1.6.1)

(2) Improve Capability

- Objective 2.3, Coordinate Planning Requirements and Community Plans has been changed to "Strengthen Connections between Hazard Mitigation Activities and Preparedness, Response and Recovery Activities"
- Three recommended actions have been added to the Reduce Damage to and Maintain Functionality of Critical Facilities and Infrastructure (2.4):

1. Strengthen Continuity of Operations Planning (COOP) and Capability to Deliver Essential Services (2.4.1)
2. Strengthen Local Recovery Planning (2.42)
3. Develop Projects that Protect Critical Assets in Natural Hazard Risk Areas (2.4.3)
4. Seek FMA, PDM and MAP Program Funds for Needed Plans and Projects (2.4.4)

(3) Increase Awareness

- The two previous objectives have been modified and two new objectives have been added:

1. Provide Hazard Maps, Data on Historic Events, Preparedness Information and Information on Insurance Availability (3.1.1)
2. Utilize Range of Risk Communication Tools: Websites, Social Media, Newspapers, Newsletters, Utility Bills, Radio, 4-H Clubs and Distribution at County Fairs
3. Support Established Programs (Firewise, "I'm Not Scared, I'm Prepared," Code Red) and Provide Preparedness Resources (Tornado, Winter Storm, Lightning, Hail)
4. Identify and Target Specific Areas at Risk to Natural Hazards (e.g., Floodplains)

(4) Maintain Eligibility

- No changes

5.2 Identification and Analysis of Mitigation Actions

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

In order to identify and select mitigation measures to support the mitigation goals, each hazard identified in Section 4.1 Identifying Hazards was evaluated. Only those hazards that pose a significant threat to communities in the planning region were considered further in the development of hazard specific mitigation measures. Each County Planning Subcommittee (CPS) analyzed a set of viable mitigation alternatives for each hazard that would support identified goals and objectives. This process took place in 2004, during the update in 2009, and again in 2014 so that new action items could be identified for each county, where appropriate.

The CPS members were provided with several resources that describe alternative multi-hazard mitigation actions, including FEMA R-5, *Mitigation Ideas: Possible Mitigation Measures by Hazard Type* (September 2002). At the CPS-level, each county reviewed 2009 Action Items and then determined: (a) the status for each, (b) which incomplete actions should be continued, and (c) whether any new action items should be added.

5.3 Mitigation Action Plan

Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This section summarizes and describes the 2014 Mitigation Action Plan, consisting of the specific projects or actions designed to support the goals of the plan. Specific action items for each county are described in the County Planning Elements. This section also identifies the methodology used by County Planning Subcommittees to prioritize action items and the criteria considered when evaluating a proposed action's need and potential effectiveness.

5.3.1 Prioritization Process

As it was in the 2009 update of this plan, the STAPLEE evaluation tool was used as the primary method for evaluating the effectiveness of each action item. STAPLEE considers social, technical, administrative, political, legal, economic, and environmental constraints and benefits of a proposed activity:

- Social: Does the measure treat people fairly?
- Technical: Will it work? (Does it solve the problem? Is it feasible?)
- Administrative: Is there capacity to implement and manage the project?
- Political: Who are the stakeholders? Did they get to participate? Is there public support? Is political leadership willing to support the project?
- Legal: Does your organization have the authority to implement? Is it legal? Are there liability implications?
- Economic: 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?
- Environmental: Does it comply with environmental regulations or have adverse environmental impacts?

In accordance with the DMA requirements, the estimated benefits and costs were a key factor in determining project priority (the 'economic' factor of STAPLEE). In some cases, costs identified with an action are preliminary, or generalized, to give an indication of whether the action can be accomplished with in-house resources, such as staff time, or will need outside funding sources and partners to implement. For projects that pass initial evaluations of feasibility, the detailed engineering studies, implementation costs, and benefit-cost analysis of specific projects may come at future points in the process.

Other criteria considered by the County Planning Subcommittees to recommend which actions might be more important, more effective, or more likely to be implemented than others included:

- Does the action protect lives?
- Does the action address hazards or areas with the highest risk?
- Does the action protect critical facilities, infrastructure or community assets?
- Does the action accomplish multiple objectives?

The priorities differ from county to county. Overall, for the entire planning area, achieving NWS "Storm Ready" certification continues to be a top priority because it is achievable, relatively inexpensive, and a source of pride for communities that meet the standards required by NWS for certification. From county to county, additional priorities were developed based on past damages, existing exposure to risk, other community goals, and weaknesses identified by the individual county capability assessments. The action items endorsed by the County Planning Subcommittees are captured in each CPE and include a description of the activity, the entity responsible for implementation, any other alternatives considered, a cost estimate, and a schedule for implementation.

Wildfires have been a persistent hazard in the five years since the last update of this plan, a consequence of prolonged drought in the region. The NCEM Planning Team and County

Planning Subcommittees reaffirmed their commitment to strengthening planning for wildfire events. The Colorado State Forest Service (CSFS) is the lead state agency for wildfire mitigation. The CSFS has multiple programs to help reduce the wildfire threat and provides technical planning assistance to counties and communities. The CSFS can help with preparation of Community Wildfire Protection Plans and assist communities in gaining national *Firewise Community* designation.

5.3.2 Progress on Implementation

This section describes demonstrated progress on meeting hazard mitigation goals and objectives in the intervening five years since the last update of this plan. Action Items identified in the 2009 plan were reviewed to determine which actions were completed, ongoing, in need of revision, or that should be deleted from the plan. Since 2009, counties in the planning region have made substantial progress in accomplishing action items and achieving objectives. In some cases, worthwhile action items have not been completed due to lack of resources (staff, funding), lower priority (or shift in priorities), or the long-range nature of the proposed activity. In many cases, the projects identified will be implemented as funding becomes available.

A status report of projects identified in the previous 2009 version of this plan is provided in the table below.

Table 5.1. Status of 2009 Action Items by County

County	2009 Action Item	Priority	Goal Supported	Status	New in 2009
Cheyenne	Obtain Storm Ready certification	High	2.1	Complete	
	Combined EOC/Communication Center/Shelter	High	2.4.3	Complete	
	Underground storm shelters	High	1.3.2	Incomplete	
	NFIP Participation – Town of Kit Carson	Medium	2.2.1	Complete	
	Countywide public education program	Medium	3.1	Ongoing	
Kit Carson	Obtain Storm Ready certification	High	2.1	Complete	
	Promote safe rooms and shelters	High	1.3.2	Ongoing	
	Drainage improvements – County Fairgrounds	High	1.2.2	In Process	
	Communications program update	Medium	1.3	In Process	
	Countywide public education program	Medium	3.1	Ongoing	

	De-register historic Spring Creek Bridge	Low	1.2.2	In Process	
	Backup power at Seibert WWTP	High	2.4.3	Complete	
	FEMA Flood Hazard Mapping	Medium	2.2.4	In Process	√
	Drainage improvements – Town of Stratton	Medium	1.2.2	Incomplete	√
Lincoln	Obtain Storm Ready Certification	High	2.1	In Process	
	NFIP Participation – Limon and Hugo	Medium	2.2.1	Complete	
	Sirens/generators – Limon and Karval	High	1.3.1	Complete	
	Generators for schools/events buildings	Low	1.5.1	Complete	
	Identify public shelters countywide	High	1.5.1	In Process	
	Increase Red Flag distribution	Low	1.6.1	In Process	√
	Generators - hospital/Comm. Center, shelters	Low	2.4.3	Complete	√
	Finalize CWPP	Medium	1.4.1	In Process	√
	Continue awareness/education activities	Medium	3.1	Incomplete	√
	Improve regional communications/notification	High	2.4.3	Complete	√
Logan	Obtain Storm Ready certification	High	2.1	Complete	
	Improve speed of weather alerts	High	1.3.1	Complete	
	Establish LEPC/complete LEOP	High	2.3.1.1	Complete	
	Combined EOC/Communications Center	High	2.4.3	Complete	
	Pawnee Creek Flood Mitigation Project	High	1.2.2	Incomplete	
	Sand Creek Flood Mitigation Project	High	1.2.2	Incomplete	
	Pawnee Pass flood control dam	Medium	1.2.2	Incomplete	
	Pawnee Creek retention ponds	Low	1.2.2	Incomplete	
	Promote safe rooms and shelters	Medium	1.3.2	Incomplete	
	NFIP Education – Sterling and Crook	High	2.2.1	Incomplete	
	NFIP Refresher Training	High	2.2.1	Incomplete	
	Flood recovery/mitigation exercise	Medium	2.3.1.1	Incomplete	
	Promote crop insurance	Medium	N/A	Complete	

	Tornado safety/water conservation campaign	Medium	3.1.2	Complete	
	Create and train a CERT	High	1.6.1	Complete	
Morgan	Brush NFIP education campaign	High	2.2.1	Ongoing	
	NFIP refresher training	High	2.2.1	Ongoing	
	Critical facilities flood protection projects	High	2.4.3	In Process	
	Full-scale exercise – Wiggins floodgate	High	2.3.1.1	In Process	
	Brush floodgate exercise	Medium	2.3.1.1	Ongoing	√
	Ft. Morgan floodgate exercise	Medium	2.3.1.1	Ongoing	√
	Promote crop insurance	Medium	N/A	Complete	
	Weldona levee maintenance	Medium	1.2.2	Ongoing	√
	Brush Flood Mitigation Project	High	1.2.2	Complete	√
	Wiggins levee maintenance	High	1.2.2	Ongoing	√
	Source Water Protection Plan	Medium	1.2.2	Ongoing	√
	Ft. Morgan Flood Mitigation Project	High	1.2.2	Complete	√
	Hillrose flood hazard mapping	Medium	2.2.1	In Process	√
Phillips	Obtain Storm Ready certification	High	2.1	In Process	
	NFIP education – Haxtun and Holyoke	High	2.2.1	Ongoing	
	Replace railroad bridge – Paoli	High	1.2.2	Incomplete	
	Drainage improvements – Holyoke	High	1.2.2	Incomplete	
	Comprehensive Plan – integrate mitigation	High	2.3.4	Incomplete	
	Wildfire public education	High	3.1.2	Incomplete	
	Stormwater project/inverted streets - Haxtun	Medium	1.2.2	In Process	
	Holyoke overflow channel	Medium	1.2.2	Incomplete	
	Promote crop insurance	Medium	N/A	Complete	
Sedgwick	Obtain Storm Ready Certification	High	2.1	In Process	
	NFIP Participation – Town of Ovid	Medium	2.2.1	Complete	
	Drainage improvements – Julesburg	Medium	1.2.2	Complete	

Sedgwick	EAPs – Julesburg/Sterling Reservoirs	High	2.3.3.1	In Process	
	Defensible spacing – living snow fences	Medium	1.6.1	In Process	
	Promote crop insurance	Medium	N/A	Ongoing	
	Sedgwick County Reverse 911	High	1.3.1	In Process	√
	Upgrade Sirens – Julesburg/Ovid/Sedgwick	High	1.3.1	In Process	√
	NFIP Compliance – Julesburg/Ovid/Sedgwick	Medium	2.2.1	Ongoing	
Washington	Obtain Storm Ready certification	High	2.1	Complete	
	NFIP refresher training – Akron and Otis	High	2.2.1	In Process	
	Otis Flood Mitigation Project	Medium	1.2.2	Ongoing	
	Washington County flood hazard mapping	High	1.2.1	In Process	√
	NOAA repeater	High	1.3.1	Incomplete	√
	Storm shelter – County Fairgrounds	High	1.3.2	Incomplete	
Yuma	Siren conversion to radio activation	High	1.3.1	Complete	
	Promote tornado shelters - mobile home parks	High	1.3.2	In Process	
	Public education – W. Nile Virus/meth labs	High	1.6.1	Complete	
	NFIP Refresher Training-Wray/Yuma/Yuma Cy	High	2.2.1	Complete	
	Wray flood recovery/mitigation exercise	Medium	2.3.1.1	Incomplete	
	Promote crop insurance	Medium	N/A	Complete	
	Public education – Reverse 911/cell phones	High	1.3.1	Ongoing	√
	Prohibit controlled burns on Red Flag days	High	1.6.1	In Process	√
	Wray flood mitigation/drainage improvements	High	1.2.2	Incomplete	√
	Drainage improvements - Idalia	High	1.2.2	Incomplete	√

5.3.3 2014 Action Items Summary

Table 5.2 below summarizes the Action Items in the planning region that have been included in the 2014 update of this plan. More detailed information about these action items can be found in the County Planning Elements.

Table 5.2. 2014 Action Items by County

County	2014 Action Item	Priority	Goal Supported	New in 2014
Cheyenne	Underground storm shelters	High	1.3.2	
	Update County COOP/COG Plan	High	2.3.1.1	√
	Develop Mass Care Annex (ESF 6) for County EOP	High	2.3.1.1	√
	Regional communications improvements	High	2.4.3	√
	Countywide public education program	Medium	3.1	
	Town of Cheyenne Wells Evacuation Plan	Medium	2.3	√
	Town of Kit Carson Evacuation Plan	Medium	2.3	√
Kit Carson	Promote safe rooms and shelters	High	1.3.2	
	Drainage improvements – County Fairgrounds	High	1.2.2	
	Communications program update	Medium	1.3	
	Countywide public education program	Medium	3.1	
	De-register historic Spring Creek Bridge	Low	1.2.2	
	FEMA Flood Hazard Mapping	Medium	2.2.4	
	Drainage improvements – Town of Stratton	Medium	1.2.2	
	Town of Bethune Emergency Operations Plan	Medium	2.3	√
	Town of Vona Emergency Operations Plan	Medium	2.3	√
Lincoln	Obtain Storm Ready Certification	High	2.1	
	Identify public shelters countywide	High	1.5.1	
	Increase Red Flag distribution	Low	1.6.1	
	Finalize CWPP	Medium	1.4.1	
	Continue awareness/education activities	Medium	3.1	
	NE Lincoln FPD/Town of Arriba Fire Protection	Medium	1.4	√
	Flood recovery/mitigation exercise	Medium	2.3.1.1	
	Pawnee Creek Flood Mitigation Project	High	1.2.2	

Logan	Sand Creek Flood Mitigation Project	High	1.2.2	
	Pawnee Pass flood control dam	Medium	1.2.2	
	Pawnee Creek retention ponds	Low	1.2.2	
	Promote safe rooms and shelters	Medium	1.3.2	
	NFIP Education – Sterling and Crook	High	2.2.1	
	Warning siren - Franklin Park (Sterling)	High	1.3.1	√
	Floodwall/gate – Sterling WWTP	High	1.2.2	√
	Generator – Sterling Service Center	High	2.4.3	√
	Recharge wells – Scalva Farms	High	1.2.2	√
	Tornado Shelters (2) - Sterling	High	1.3.2	√
	Pet Shelters @ designated shelters	High	1.5.1	√
	Critical facilities flood hazard mapping	High	2.4.3	√
	Adopt FEMA revised floodplain maps	High	2.2.4	√
	Backup battery power at siren locations	High	1.3.2	√
	Backup power infrastructure-Sterling Middle School	High	1.3.2	√
	Stormwater drainage improvements (Sterling)	High	1.2.2	√
	Dedicated tornado shelters in small communities	High	1.3.2	√
	NFIP Refresher Training	High	2.2.1	
Morgan	Brush NFIP education campaign	High	2.2.1	
	NFIP refresher training	High	2.2.1	
	Critical facilities flood protection projects	High	2.4.3	
	Full-scale exercise – Wiggins floodgate	High	2.3.1.1	
	Brush floodgate exercise	Medium	2.3.1.1	
	Ft. Morgan floodgate exercise	Medium	2.3.1.1	
	Weldona levee maintenance	Medium	1.2.2	
	Wiggins levee maintenance	High	1.2.2	
	Source Water Protection Plan	Medium	1.2.2	

	River crossing with new water lines	High	1.2.2	√
	Replace Weldona tornado siren	High	1.3.1	√
	New tornado siren – Brush	High	1.3.1	√
	Establish storm shelters at mobile home parks	High	1.3.2	√
	Update county flood hazard mapping	High	2.2.1	√
Phillips	Obtain Storm Ready certification	High	2.1	
	NFIP education – Haxtun and Holyoke	High	2.2.1	
	Replace railroad bridge – Paoli	High	1.2.2	
	Drainage improvements – Holyoke	High	1.2.2	
	Comprehensive Plan – integrate mitigation	High	2.3.4	
	Wildfire public education	High	3.1.2	
	Stormwater project/inverted streets - Haxtun	Medium	1.2.2	
	Holyoke overflow channel	Medium	1.2.2	
	Backup power/activation upgrade for siren locations	High	1.3.1	√
	Dead tree removal program	High	1.6.1	√
	Public warning/shelter preparedness program	High	1.3.1	√
Sedgwick	Obtain Storm Ready Certification	High	2.1	
	EAPs – Julesburg/Sterling Reservoirs	High	2.3.3.1	
	Defensible spacing – living snow fences	Medium	1.6.1	
	Promote crop insurance	Medium	N/A	
	Sedgwick County Reverse 911	High	1.3.1	
	Upgrade Sirens – Julesburg/Ovid/Sedgwick	High	1.3.1	
	NFIP Compliance – Julesburg/Ovid/Sedgwick	Medium	2.2.1	
	Sedgwick County Communications Center updates	High	2.4.3	√
	Otis Flood Mitigation Project	Medium	1.2.2	
	NFIP refresher training – Akron and Otis	High	2.2.1	
	Washington County flood hazard mapping	High	1.2.1	

Washington	NOAA repeater	High	1.3.1	
	Storm shelter – County Fairgrounds	High	1.3.2	
	SW Washington County FD Emergency Generator	Medium	1.3.1	√
	Firewise Public Education	Medium	3.1.2	√
Yuma	Strengthen development planning policies (Wray)	High	2.3.3	√
	Promote tornado shelters - mobile home parks	High	1.3.2	
	Wray flood recovery/mitigation exercise	Medium	2.3.1.1	
	Public education – Reverse 911/cell phones	High	1.3.1	
	Prohibit controlled burns on Red Flag days	High	1.6.1	
	EMS Multi-Agency Training and Exercise	High	2.3.1	√
	Communications Improvements	High	2.4.3	√
	Emergency Backup Power for Generators	High	1.3.1	√
	NFIP Compliance	High	2.2.1	√

5.3.4 Mitigation Funding Sources

The Colorado Division of Homeland Security and Emergency Management (DHSEM) Mitigation Team is the primary state entity responsible for coordinating and facilitating technical assistance for local hazard mitigation planning. The mission of the Mitigation Team is to promote community resiliency and sustainability for the people of Colorado by fostering partnerships and maximizing the availability of mitigation and recovery resources.

Federal Programs

Federal mitigation programs serve as critical funding sources to reduce the risk of natural hazards to Colorado's people, property, environment, and economy. Colorado and its mitigation partners attempt to maximize the application of federal funding from FEMA, USDA, USACE, HUD, SBA, and other agencies each year. Mitigation money from FEMA supports several mitigation projects each year. The state will continue to apply for mitigation grants through the Hazard Mitigation Assistance (HMA) Program, specifically its Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM) grants as the availability of funds is announced. These grants support the development of local hazard mitigation plans as well as construction activities.

Education projects, outreach programs, repeater sites, early detection and warning/notification systems, generators for backup power, and chippers for slash and mulch projects are very popular in Colorado. Local communities are constantly seeking sources of funding to maintain programs and install or upgrade systems. Unfortunately, funds for these types of projects are limited and the need strongly outweighs the availability. Even if communities get startup funds, continuation of programs creates new financial needs on already very tight budgets with competing demands. In spite of this, Colorado communities have made great strides and progress in prevention and preparedness activities and continue to do more each year by taking advantage of limited opportunities. For example, several communities benefited years ago from a grant program through USDA designed to fund repeater sites in remote locations, thereby serving communities with need but without means to get warnings pertinent to their immediate area. DHSEM staff promoted the grant opportunity and worked with communities on grant applications.

State Programs

The state has loan and grant programs for which mitigation activities are eligible. Funding sources traditionally used have been energy impact funds, gaming funds, general funds, and severance tax. Many state agencies have grant programs, including, but not limited to, DOLA, DHSEM, CSFS, CDNR and the State Conservation Service.

State agencies continually work to identify new strategies for implementing mitigation projects, including new funding sources. The Mitigation Team works with local communities to expand the number of FEMA HMA programs for which communities are eligible to qualify.

6 PLAN ADOPTION, IMPLEMENTATION, AND MAINTENANCE

6.1 Formal Plan Adoption

Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure buy-in from the 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 agreed to adopt this hazard mitigation plan by passing a resolution.

The executed copies from the 2009 and 2013 adoption process are included in electronic format as Appendix E Records of Adoption. (Note: Due to the time involved to get the plan review and adoption on official agendas, produce and provide copies in official meeting packets, facilitate the actual adoption, collect the Adoption Resolutions, scan the resolutions, transfer the scanned documents to compact disc, and then reproduce the CDs as Appendix E, these formal adoption documents will be added at a later date.)

6.2 Implementation

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This is Planning Step 10 of the 10-step planning process, and phase 4 of FEMA's 4 phase process. This section outlines how this plan will be implemented and updated. Implementing Action Items is the fundamental purpose of hazard mitigation plans, but most projects face multiple hurdles in the process, principally lack of funding, but other challenges as well such as sustaining political support for long-term projects.

Pursuing low or no-cost high-priority recommendations have the greatest likelihood for success. Examples include NFIP education and promotion, Storm Ready certification, *Firewise Communities* designation, and preparation of Community Wildfire Protection Plans. These efforts can lead to long-standing changes in vulnerability and can be initiated at very little cost, while promoting public education.

6.2.1 Incorporation into Existing Planning Mechanisms

Another effective but low-cost effort is to connect, where feasible, the underlying principles and specific recommendations of this plan to other community plans and mechanisms, such as Comprehensive Planning, Capital Improvement budgeting, Economic Development goals and incentives, or regional plans and initiatives. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of government and development activities. This integration can only be accomplished through persistent efforts to network and to identify and highlight the multi-objective, mutual benefits to each program, the community and other stakeholders.

It is important to vigilantly monitor funding opportunities that can be leveraged to implement some of the more costly recommended actions (see Mitigation Funding Sources in Chapter 5). Strategies for meeting the non-federal share of grants should be considered in advance so that when funding does become available, NCEM and the appropriate counties and municipalities will be in a better position to capitalize upon the opportunity. Funding opportunities include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

6.2.2 Role of NCEM in Implementation and Maintenance

Upon re-adoption of this plan, the NCEM Planning Team will continue to take a lead role with regard to plan implementation and maintenance. The NCEM Planning Team will also serve as an advisory body for hazard mitigation matters in the region. The primary responsibility of the NCEM Planning Team is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. The NCEM Planning Team agrees to:

- Provide a forum for coordination of 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 vigilant monitoring of multi-objective cost-sharing opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and updates to this plan;
- Report on plan progress and recommended changes to the respective Boards of County Commissioners; and
- Inform and solicit input from the public.

The NCEM Planning Team is also tasked with reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on websites and in local newspapers.

6.3 Maintenance

Plan maintenance implies an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized.

6.3.1 Maintenance/Monitoring Schedule

Maintenance and monitoring will take place through a semi-annual review by each County Planning Subcommittee and an annual review by the NCEM Planning Team. This plan will be updated, approved, and adopted within a five-year cycle as per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000 unless disaster or other circumstances (e.g., changing regulations) lead to a different timeframe. With an anticipated re-approval of this plan in December 2014, the plan will next need to be updated and re-approved by the Colorado Office of Emergency Management (COEM) and FEMA Region VIII no later than December of 2019. Each County will submit a Pre-Disaster Mitigation planning grant application to COEM/FEMA for funds to assist with the update. Updates to this plan will follow the most current FEMA and COEM planning guidance.

When each CPS reconvenes for the review, they will coordinate with each jurisdiction that participated in the planning process to update and revise the plan. Public notice will be given and public participation will be invited, at a minimum, through available web-postings and press releases to local media outlets, primarily newspapers and AM radio stations.

Updates to this plan will:

- Consider changes in vulnerability due to project implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- 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;
- Incorporate documentation of continued public involvement;
- Incorporate documentation to update the planning process that 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 COEM/FEMA; and
- Include re-adoption by all participating entities following COEM/FEMA approval.

6.3.2 Continued Public Involvement

Continued public involvement is also imperative to the overall success of the plan's implementation. Public involvement spans the entire implementation and review process, and provides multiple opportunities for integrating the public into the planning process. The update process provides an opportunity to build public support by publicizing success stories related to implementation of action items. Local media can help solicit additional public comment on projects and plans. Public hearings and meetings to receive public comment on plan maintenance and updating were held during the update period and set the precedence for further discussion at local commissioner meetings or other public venues where mitigation discussions are appropriate.

All stakeholders in the planning process will be invited to participate in the next five-year update of this plan and additional participation will be solicited from the public, partner agencies, new entities and community groups in future. The plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, and press releases to local media. Specific communication resources include the Northeast Colorado Emergency Managers website (www.ReadyNortheast.org), local community websites for each county and jurisdiction, school board meetings, LEPC meetings, and Citizen Corps efforts. Mitigation issues can also be introduced at local weather-spotting training, CPR/First Aid, CERT, and other classes and through social media and local media outlets such as radio and newspapers.

7 INTRODUCTION TO THE COUNTY PLANNING ELEMENTS

7.1 Introduction

This plan contains separate planning elements that presents data specifically related to each county within the planning area. Each County Planning Element (CPE) is structured with the same format. This section describes the CPE template and the data sets that are utilized to develop the content of each CPE.

7.1.1 County Planning Subcommittee and General Description

This section includes a list of the entities that participated in the planning process through the County Planning Subcommittee (CPS). The list identifies the County, the incorporated municipalities, and the other "local governments" as defined in the DMA regulations. Most participating jurisdictions provided multiple representatives as members of the County CPS and numerous private businesses, nonprofit organizations and other stakeholders also contributed to the development of CPEs.

7.1.2 County Profile

The general description paragraph details the number of square miles in the county, the latest census data on population by county, population density by county (per square mile), and the rate of population growth by county. Other pertinent census demographic information such as housing density, median income, educational attainment, disability, and spoken languages is included as well. Due to the rural and agricultural nature of the counties in the planning area, farm census data is also included.

7.1.3 Hazard Identification and Summary

Each CPS identified the hazards that affect the County and summarized their frequency of occurrence, special extent, potential magnitude, and significance specific to the County. This information is presented in Table 1.

7.1.4 County History of Recorded Natural Hazard Losses

This section presents county specific hazard data (the Hazard Identification and Vulnerability Assessment sections, presented earlier in the plan, describe the hazards and the impacts that the entire planning area faces). This section identifies the number of events listed in the National Climatic Data Center (NCDC) database for the time period, 1950-2013. A "History of

Recorded Natural Hazard Disaster Losses" is presented in a table format, and includes the date, type of event, location, damages, other information, and data source for each listing. A hazard summary is presented below the table detailing each hazard's frequency of occurrence during the same 1950-2013 timeframe.

Hazard History

This section presents a listing of other pertinent hazard data that did not appear within the "History of Disaster Losses" table, such as total number of tornadoes, wildland/grassland fire reports, number of Class 1 and Class 2 dams, incidences of West Nile Virus, historical earthquakes, and high and low temperature extremes.

7.1.5 County Vulnerability Assessment

The intent of this section is to assess each county's vulnerability separate from that of the planning area as a whole, which is assessed in Section 4.3, Vulnerability Assessment in the main plan. This vulnerability assessment analyzes the population, property, and other assets at risk to hazards ranked of medium or high significance that may vary from other parts of the planning area.

Assets at Risk

This section identifies a county's assets at risk, including values at risk, critical facilities and infrastructure, historic assets, economic assets, and growth and development trends. Two data sources are used: assessed valuations, as available, and HAZUS-MR3 databases. Some figures were obtained from the County Assessor's Office, a participant of each CPS. Because the CPS cannot determine where a hazard will strike in the county, and which property/infrastructure or what percent of property/infrastructure will be impacted, listing the total value of the property/infrastructure at risk was considered the most reasonable approach for detailing "what is at risk." Flooding is the only hazard addressed in this plan where the CPS can reasonably determine where impacts will occur, what will be impacted, and the estimated of the value of the losses.

Critical Facilities Inventory

The Critical Facilities Inventory was added to the CPE template in 2009 and provides information from data collection tools combined with available statewide GIS datasets.

Historic Sites in the County

This section provides a listing of the sites registered on either the federal or state Register of Historic Places. This is included because it is important for communities to have an awareness of cultural resources that could be impacted by natural hazards, and because if they are, the

rules for repairing and rebuilding historic structures differ from others. Not having an inventory of historic resources available when disaster strikes can prolong a community's recovery and aggravate economic recovery.

Development Trends in the County

Mitigation is more cost-effective when measures are taken to protect people and property before development occurs. Knowing a community's development trends, when overlaid with hazard area maps, can be a valuable information tool that provides direction, incentive and alternatives to placing new development in areas known to be at risk from natural hazards. This section describes the development trends within each county.

Floodplain Vulnerability Assessment

Included in the 2014 update was a flood vulnerability assessment for each County generated with HAZUS-MH MR3, FEMA's software program for estimating potential losses from disasters (see the base plan Vulnerability Assessment for a description of the HAZUS methodology). The 100-year floodplain generated with HAZUS-MH is shown countywide in a map and at municipal scales on other maps. All maps indicate the location of critical facilities located in the county.

In communities with NFIP maps, the CPS counted every residential, commercial, and manufactured building within the identified Special Flood Hazard Area (SFHA). In most cases, a CPS team member, accompanied by a Certified Floodplain Manager (CFM), did this manually. In some instances, CADD or GIS maps showing lots and building footprints were utilized. In other cases, communities could provide a listing of properties within the SFHA. In Sterling/Atwood (Logan County), figures from engineering studies for proposed mitigation projects were utilized.

The address of each building was then taken to the County Assessor's office where the individual property cards were pulled and the values of the improved structures were recorded. In a few counties, the Assessor's office was able to produce a digital listing of the properties and their values. The individual values were then totaled to arrive at a total value of property at risk. Actual values were listed. The actual values were utilized because they provide a more accurate picture of what it would cost to repair or replace the damaged properties. The actual values were calculated by adding back in the percentage deducted in calculating assessed values. Only Real Property and Improvement values were used.

Finally, using NFIP depth-damage curves from FEMA's Riverine Flood Benefit-Cost software program, an average percent of damage was calculated (rarely does a flood event cause 100% damage to the property at risk). The value was then converted to an estimate of average annual damage – a figure that could be used to justify future mitigation projects – as the benefits of mitigation are calculated as future damages avoided.

Floodplain Population

This section presents data from the Colorado Natural Hazards Mitigation Plan and includes the floodplain population, number of floodprone structures, and assigned flood risk designation. The state's flood risk designation is based upon the population and number of structures in the floodplain, plus the number of dams in the vicinity. The displaced population and shelter needs estimated by HAZUS are shown in a table.

Critical Facilities in the Floodplain

Each CPS identified the critical facilities within the identified floodplain. This section includes GIS analysis of statewide critical facilities inventories, overlayed in GIS with HAZUS flood hazard areas.

Scour Critical Bridges

Included with HAZUS-MH is a database of bridges called the National Bridge Inventory developed by the U.S. Department of Transportation. One of the database items is a "scour index" used to quantify the vulnerability of a bridge to scour during a flood. Bridges with a scour index between 1 and 3 are considered "scour critical," or a bridge with a foundation element determined to be unstable for the observed or evaluated scour condition. A table is presented with the name of the bridge, road type, stream, and nearest city to the bridge.

Flood Insurance Policies and Claims Information

Each CPE includes a summary tabulation detailing the number of NFIP policies currently in force, the number of A-Zone and non-A-Zone policies, the number of claims filed, and the settlement cost for those claims. This data provides another description of vulnerability to floods in that the number of uninsured floodprone properties can be calculated. In addition, a high number of non-A-Zone policies might indicate an area susceptible to flood damages from ponding or inadequate drainage, because property owners in such areas are not forced to purchase flood insurance (it is strictly a voluntary purchase). Property owners that are incurring flood losses, and who discover that their losses can be insured, may explain groupings of policies outside the floodplain.

Dam Failure

Each CPE includes a summary tabulation of high and significant hazard dams in the county. The locations of these dams are shown in a table with the dam name, the County the dam is located in (the dam may be located outside the County, but threaten populations within the County should the dam fail), the dam's hazard class, the downstream community, and the dam's distance from and potential impacts to downstream properties.

Wildfire

Each CPE includes a summary tabulation of wildland fire hazards in the county. A GIS overlay was used to identify certain facilities in the moderate to high fire risk areas in each County. A narrative describes each community and potentially at-risk critical facilities. The critical facilities identified within a moderate to high wildfire risk area are summarized in a table showing facility types and counts. A shaded wildland urban interface fire hazard risk map is included in each planning element. The County Wildland Urban Interface map shows the location of each type of critical facility within the County.

Agricultural Vulnerability Assessment

In every county in the planning region, average annual insured crop losses exceed the losses of any other hazard. The losses are likely even higher than those indicated because some agricultural losses are uninsured. Also, in every county, the return on the investment of crop insurance averages 4-to-1 (claims paid versus premiums paid).

Included in this section is a loss estimation of flood impacts on crops that was generated by HAZUS-MH. Also included is a summary tabulation of crop loss data for the county between the years 1980-2013, listing the average annual claims paid, the total amount of coverage purchased over the period, the total premiums paid, and the total claims paid. The National Crop Insurance Services, through the USDA/FSA, provided the data. The losses are for multiple hazards, as the policies cover multiple perils.

7.1.6 County Capability Assessment

The purpose of this section is to determine what policies, programs, regulations, and other mechanisms each County, and the incorporated communities, already have in place that either contribute to, or hinder the ability to mitigate the effects of natural hazards.

The Hazard Identification section identifies those hazards that could adversely affect the jurisdictions and the Vulnerability Assessment then estimates the impacts that those hazards could cause. This section quantifies the protective measures and practices that exist to lessen those impacts --- leaving a net vulnerability upon which the plan's goals and objectives are based. Additionally, the analysis of existing capabilities may also lead to the identification of practices which may actually worsen the impacts of hazards upon the communities.

Capability assessment is an ongoing process that will continue with the implementation and maintenance of this plan. The matrix in this section was updated by participating jurisdictions in 2014 and reflects some of the changes in capabilities, such as the achievement of Storm Ready status by several of the counties.

Explanation of Capability Assessment Matrix

The key to the Capability Assessment matrix is described below.

Comp Plan: Does the community have a Comprehensive Long-Term Development Plan?

Land Use Plan: Is there a plan that designates types of land uses desired/required?

Subdivision Ordinance: Is there a regulation that dictates lot sizes, density, setbacks and types of construction?

Zoning Ordinance: Does an ordinance exist that dictates types of use and occupancy (supports Land Use Plan)?

NFIP/FPM Ord: Is there a Floodplain Management Ordinance that directs development in identified Flood Hazard Areas (required for Participation in NFIP)?

Sub. Damage: Does your Floodplain Management Ordinance contain language on Substantial Damage/Improvements?

Administrator: Do you have a Floodplain Management Administrator (someone with the responsibility of enforcing the ordinance and providing ancillary services like map reading, public education)?

# of FP Bldgs: How many buildings are in the mapped floodplain?

# of Policies: How many buildings are insured against flood through the NFIP?

# of RL's: What is the number of Repetitive Losses (paid more than $1,000, twice in the past 10 years)?

CRS Rating: Does your jurisdiction have a Community Rating System rating from the NFIP, and if so, what is it?

BCEGS Rating: Does your community have a Building Code Effectiveness Grading System Rating?

Stormwater Program: Does your jurisdiction have a program designed to move excess stormwater away from the urban areas of the community?

Building Code/Building Official/Building Inspections: Does your community have a building code that is in place, with an official in charge of enforcement through building inspections?

LEOP: Does you jurisdiction have a Local Emergency Operations Plan?

HM Plan: Does your community have a Hazard Mitigation Plan?

Warning: Do you have a public warning system or program, such as Storm Ready, NOAA Weather Radios, outdoor sirens, cable (TV) override, or an Emergency Warning Notification System?

GIS System: Do you have a Geographic Information System

Structural Protection Projects: Has your community built levees, drainage facilities, detention/retention basins or other projects that provide flood protection?

Property Protection Projects: Has your community participated in buy-outs, elevation of structures, floodproofing, construction of small residential levees or berms/floodwalls or other projects designed to protect property?

Critical Facility Protection: Has your community completed projects that protect power substations, sewage lift stations, water-supply sources, the EOC, police/fire stations or medical facilities that are at risk?

Natural And Cultural Inventory: Do you have an inventory of resources, maps, or special regulations within the community (e.g., wetlands and historic structures/districts)?

Erosion or Sediment Control: Do you have any projects or regulations in place?

Public Information and/or Environmental Education Program: Do you have an ongoing hazard awareness program (even if its primary focus is not hazards)? Examples would be "regular" flyers included in city utility billings, a website, or an environmental education program for kids in conjunction with parks/recreation programs.

In the County Capability Assessment matrix, a “C” means the County provides the service, and an “IP” means In Progress. Blank boxes or N/A means the information was either unknown or unavailable.

NFIP Mapping Information

Listed are the names of all incorporated communities within each county, and the current status of mapping within the NFIP. If the community has been mapped, the Community Map # and the Effective Date is cited.

Additional Capabilities in the County

Additional capabilities developed since the 2009 plan update are noted in this section.

Additional Vulnerabilities in the County

Additional vulnerabilities or trends developed since the 2009 plan update that may augment or exacerbate the hazards the County faces are noted here, as applicable.

7.1.7 County Recommendations

The final section of each CPE identifies the Recommended Actions of the County Planning Subcommittee. Each recommendation is presented in a similar format:

Action Item: A brief statement of what is needed;

Issue Statement: An explanation of why the Recommended Action is important;

Implementation Manager and Strategy: Identifies the person, position, department or agency that has the initial lead responsibility for implementation. This could include a range of activities from identifying and applying for appropriate grants, to gathering the technical data needed for project development, or simply extending an invitation for technical assistance.

Priority: A general statement of relative degree of importance, usually from a range of high, medium and low. The assignment of priorities changes from action to action and could be based upon the potential impact if the action is not taken, pressing regulatory requirements, ease of implementation, potential availability of funding, or any combination of these factors. There is little or no inferred priority based upon the order in which the Recommended Actions are presented in the plan, beyond the goal of having each county become Storm Ready. This is the highest priority for those counties not already certified.

Cost Estimate: Where costs are known, they are presented. Potential sources of funding and/or local matches are also identified when known or considered.

Cost-Effectiveness Explanation: A statement of why the Planning Team believes these Recommended Actions would be cost-effective to pursue. In most cases, this is a generic description, as it is fully expected that any project being seriously considered for implementation will need to detail project costs and benefits, and due to the scope of this plan, and the constant fluctuation in project costs and values that help determine benefits, a detailed analysis is not warranted at this point in the planning process.

2014 Update: For actions identified in 2009, the statement here explains the status of progress made on the action, or an explanation on why little or no progress has been made.