NEW MEXICO STATE
HAZARD MITIGATION PLAN

September 2018

Cover graphics

Top Row (left to right)

1. Nambe Pueblo Debris Flow Barrier Project, shows one of a series of three barriers up-stream of Nambe Lake.
2. Flooding in Alamogordo in 2006, Presidential Disastr Declaration FEMA-NM-1659
3. Recommended Defensible Sapce Distance expert of graphic from 'Living with Fire; A Guide for the Homeowner' by the University of Nevada Cooperative Extension with Illustration by Kirah Van Sickle and Animania, LLC

Middle Row (left to right)

1. Watershed Health in New Mexico Newspaper Insert, by New Mexico Department of Agriculture.
2. Landslide and rockfall mitiation fencing, State Road 68 in Taos County
3. Silt fence post-wildfire from All About Watersheds website www.allaboutwatersheds.org

Bottom Row (left to right)

1. Timber and thinning (dated prior to 2017). Photo cpurtesy of New Mexico State Forestry Division
2. Montonyas Arroyo Bank Stabalization, Southern Sandoval County Arroyo Flood Control Authprity Project (SSCAFCA)
3. 'Know Your Arroyos' Activity Book, part of a kindergarden through 12th grade Arroyo Safety outreach campaign (SSCAFCA)

1 PLAN ADOPTION

As Governor's Authorized Representative, I hereby adopt the 2018 edition of the New Mexico Natural Hazard Mitigation Plan.

The New Mexico Natural Hazard Mitigation Plan meets the criteria established in §201.4 for a Standard State Natural Hazard Mitigation Plan. Having a FEMA approved State Mitigation Plan is a condition of receiving non-emergency Stafford Act assistance and FEMA mitigation grants. The State of New Mexico will comply with all applicable federal laws and statutes in compliance with 44 CFR 13. (c), and will amend this plan whenever necessary to reflect changes in state or federal laws and statutes as required in 44 CFR 13.ll(d).

M. Jay Mitchell, Cabinet Secretary

7 Sep 18
Date

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The New Mexico Natural Hazard Mitigation Plan Update (the Plan Update) was developed as a cooperative effort of State agencies under the coordination of the New Mexico Department of Homeland Security and Emergency Management (NM DHSEM). It discusses the process used to identify, profile, and assess natural hazards in New Mexico. The Plan also identifies the actions which should be taken to mitigate those hazards.

The Plan Update facilitates the delivery of mitigation grant funding to agencies, jurisdictions, Tribes, and non-profit organizations through FEMA's Hazard Mitigation Assistance grant programs. The Plan Update also addresses mitigation planning requirements for these grant sources.

The Plan Update will continue to be reviewed and enhanced as new data and mitigation opportunities become available. Comments and suggestions are welcome and should be forwarded to the State Hazard Mitigation Officer.

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2 ACKNOWLEDGEMENTS

The New Mexico Department of Homeland Security and Emergency Management gratefully acknowledges the following offices, departments, and organizations for their contributions, input and participation. Without their participation, completion of the New Mexico Natural Hazard Mitigation Plan would not have been possible.

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3 INTRODUCTION

Across the United States, natural disasters have led to mounting levels of casualties, injury, property damage, and disruption of business and government services. The effects of disasters on families and individuals can be enormous and it is challenging for damaged businesses to contribute to the economy. The time, money, and effort given to response and recovery efforts redirect public resources and attention away from other important programs and problems. The elected and appointed officials of the State of New Mexico know that mitigation actions in the form of projects and programs can become long-term, cost-effective means for reducing the effects of natural hazards.

3.1 Purpose

The contents of this New Mexico Natural Hazard Mitigation Plan Update (Plan Update) are intended to provide the framework for hazard mitigation. This framework includes two components. The first pertains to the recovery and reconstruction process after a given disaster. The second component is a longer-term strategy to identify current and proposed mitigation projects which will reduce the potential for future losses and decrease the costs to the taxpayers. The Plan Update will be used to increase awareness and initiate development of long-range, interagency, multi- objective mitigation activities to be administered by the New Mexico Department of Homeland Security and Emergency Management (NMDHSEM) and the State Hazard Mitigation Planning Team (SHMPT) for the State of New Mexico.

The goal of mitigation is to save lives, reduce injuries, property damage, and recovery times. Mitigation can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical facilities, reduce exposure to liability, and minimize community disruption. Preparedness, response, and recovery measures support the concept of mitigation and may directly support identified mitigation actions. Attempts to comply with widespread mitigation policies, procedures and methods are evident; however, the Plan Update does not necessarily represent the views, policies, and procedures of FEMA.

3.2 Scope

The Plan Update addresses those natural hazards that have resulted in claims for Federal assistance as well as other major natural hazards identified as presenting a substantial risk to human life and private and public property. A joint decision was made by the SHMPT to keep the Plan Update focused on natural hazards. This document is an instrument of mitigation primarily for natural disasters. The Plan Update utilizes a multi-agency planning process to identify hazards that can affect the State and to devise mitigation strategies to reduce or eliminate the effects of those hazards. The State Plan Update provides guidance to local governments in preparing their own mitigation plans by prioritizing mitigation goals and objectives, proposing solutions to certain mitigation problems, and identifying possible funding sources for mitigation projects.

Funding for the 2018 Plan Update came from a FEMA Hazard Mitigation Grant Program award, State General Fund as non-federal match plus Emergency Management Preparedness Grant for staff salaries. This 2018 version of this planning was facilitated by NMDHSEM Mitigation Program. The SHMPT was made up of numerous State agencies, Federal agencies and Subject Matter Experts.

Please note that it is not the intent of this Plan Update to address the prevention or mitigation of the possible impacts of terrorist activity, hazardous materials, transportation accidents or any other human-caused hazard. NMDHSEM addresses these hazards in the Human Caused and Technological Hazard Mitigation Plan.

3.3 Authority

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended by the Disaster Mitigation Act of 2000, provides the legal basis for State, Tribal, and Local governments to undertake risk-based approaches to reducing natural hazard risks through mitigation planning. Specifically, the Stafford Act requires State, Tribal, and Local governments to develop and adopt FEMA-approved hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance. The Stafford Act authorizes the following grant programs; Hazard Mitigation Grant Program, Pre-Disaster Mitigation Grant Program, Public Assistance Grant Program and Fire Management Assistance Grant Program.

The Sandy Recovery Improvement Act (SRIA) of 2013 amended the Stafford Act to provide federally-recognized tribal governments the option to request a Presidential emergency or major disaster declaration independent of a State. Tribal governments may still choose to seek assistance, as they have historically, under a state declaration request.

Title 44, Chapter 1, Part 201 (44 CFR Part 201) of the Code of Federal Regulations (CFR) contains requirements and procedures to implement the hazard mitigation planning provisions of the Stafford Act. The bullets below document the history of changes to the hazard mitigation planning regulations since the State's Mitigation Plan was approved in 2013. The current regulations referenced above incorporate, or supersede, each of these rule changes.

- October 2, 2015 Final Rule (80 FR 59549): Restored sentences requiring amendments to plans
- December 19, 2014 Interim Final Rule (79 FR 76085): Updated references to "2 CFR parts 200 and 3002" and removed sentences requiring amendments to plans
- April 25, 2014 Final Rule (79 FR 22873): Change in submission requirements for State Mitigation Plans

3.4 Assurances

The State of New Mexico will comply with all applicable Federal statutes and regulations during the periods for which it receives grant funding, and will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes.

This Plan Update meets the requirements of FEMA's State Mitigation Plan Review Guide (March 2015). The Guide is the official policy on and interpretation of the natural hazard mitigation planning requirements. The Guide facilitates consistent evaluation for approval of State mitigation plans.

3.5 Description of New Mexico

Location

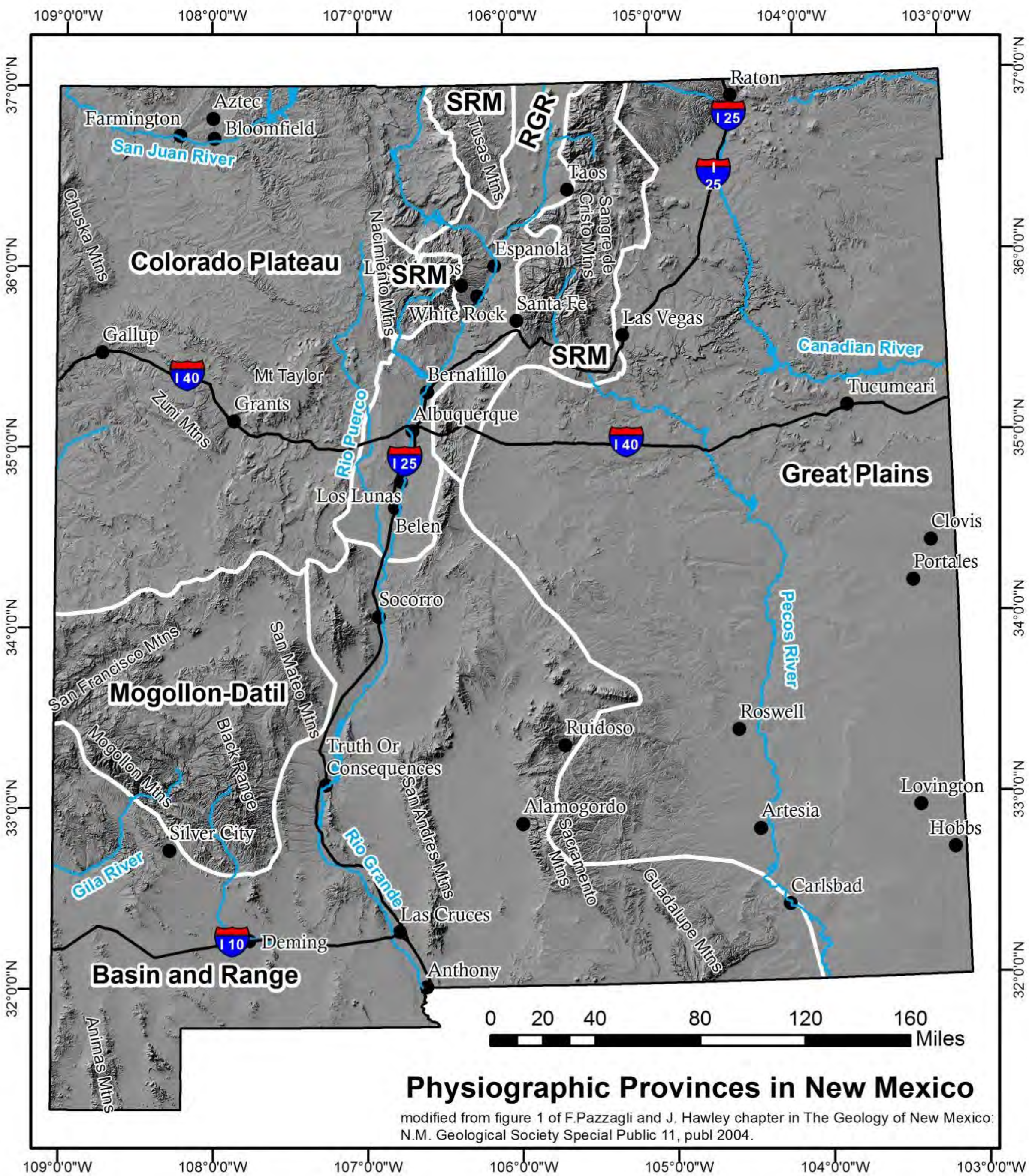
New Mexico is located in the southwestern region of the United States. Contiguous states include Colorado, Arizona, and Utah at its northwestern corner to form the "four corners" region. Bordering New Mexico is Oklahoma to the northeast, Texas to the south and east, Mexico to the south, Arizona to the west, and Colorado to the north (see Figure 3-1). The State's total land area is approximately 121,598 square miles (5th largest in the nation). 121,365 square miles of New Mexico are land areas; water covers only a small part of the State.

Figure 3-1 Map of New Mexico

Geographic Features

Known for its varied topography, New Mexico includes desert terrain, mesas, grassy plains, wooded forests, and mountain peaks. The Rio Grande runs through the middle of the State from north to south. The highest point in New Mexico is Wheeler Peak, rising to 13,161 feet above sea level in the Sangre de Cristo Mountain range in north-central New Mexico. The mean elevation of the State of New Mexico is 5,700 feet above sea level. The State can be divided into six geographic provinces (Figure 3-2), which are described below (clockwise, starting in the northwest, SRM = southern Rocky Mountains; RGR = Rio Grande rift).

Figure 3-2 New Mexico's Six Geographic Provinces



The *Colorado Plateau* occupies the northwestern part of the State. It features mesas, generally a few hundred feet to a thousand feet in height, separated by broad valleys. Three mountain ranges, the Chuska Mountains, Zuni Mountains and Mount Taylor, rise up to 8,000-11,000 ft in elevation and support forests containing juniper, pinon, ponderosa and spruce pines. Otherwise, the vegetation of most of this sparsely populated region is characterized by desert scrub with saltbush, shadscale, and drought tolerant grasses.[1] In the northern part of the Colorado Plateau, the San Juan River flows westward through a valley supporting agriculture and the city of Farmington.

In the central part of New Mexico, the *southern Rocky Mountains* extend southward into north-central New Mexico from Colorado. The Rio Grande rift separates two arms of the *Rocky Mountains*. On the west lies forested mountains attaining elevations of 9,000-11,000 feet; these western mountains include the Tusas, Jemez, and Nacimiento Mountains. To the east of the Rio Grande rift, the Sangre de Cristo (Blood of Christ) Range are somewhat higher than the western mountains (having maximum elevations of 12,000-13,000 ft). The Sandia Mountains, located immediately east of Albuquerque, may be considered as part of this eastern arm of the southern Rocky Mountains. Vegetation in the Rocky Mountains is characterized by pinon and juniper at lower elevations, but at higher elevations grows ponderosa, fir, spruce, and aspen.

The *Rio Grande rift* extends southward down the middle of the State, merging with the Basin and Range Region near Socorro, New Mexico. Within the Rio Grande rift lies the Rio Grande, the State's most important river, that heads in south-central Colorado and flows south and then southeast to the Gulf of Mexico. Three of the State's four largest cities lie near the Rio Grande: Albuquerque (~560,000 pop.), Rio Rancho (~88,000 pop.), and Santa Fe (~70,000 pop). Sagebrush, pinon-juniper, and juniper savanna is the characteristic vegetation of the rift north of Santa Fe, but to the south the rift is desert grassland.[2]

Covering the eastern third of New Mexico is the *Great Plains*. Generally, a shortgrass prairie, the *Great Plains* extend from high plateaus in the north to lower plains in the south between Hobbs and Carlsbad. Rivers in the high plateau have locally cut deep canyons into the landscape, such as the Canadian River Canyon. Besides the Canadian River, an important drainage is the Pecos River, which heads in the eastern arm of the Sangre de Cristo Mountains and flows southward into Texas. In its valley lie the cities of Roswell, Artesia, and Carlsbad. The *High Plains* or *Staked Plains (Llano Estacado)* are near the eastern edge of New Mexico south of the Canadian River.

The Basin and Range Region covers about one-third of the State. This area is marked by rugged mountain ranges separated by wide desert basins. The mountains generally support desert shrubs and pinon-juniper forests and include the Guadalupe, Sacramento, San Andres, Caballo, and Animas Mountains. In the intervening basins, vegetation is mainly characterized by creosote-mesquite shrublands, with some grasslands. The Rio Grande flows north to south through the Basin and Range Region; in its fertile valley include the towns of Socorro, Truth or Consequences, Hatch, and Las Cruces. The Rio Grande exits New Mexico in the vicinity of El Paso, Texas.

The Mogollon-Datil plateau is a relatively high-topography area that includes the Gila wilderness. The Gila and San Francisco Rivers, which flow westward into Arizona, both head in this wilderness area.

[1] Griffith, G.E., Omernik, J.M., McGraw, M.M., Jacobi, G.Z., Canavan, C.M., Shrader, T.S., Mercer, D., Hill, R., and Moran, B.C., 2006, Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Vriginia, U.S. Geological Survey (map scale 1:1,400,000).

[2] Griffith, G.E., Omernik, J.M., McGraw, M.M., Jacobi, G.Z., Canavan, C.M., Shrader, T.S., Mercer, D., Hill, R., and Moran, B.C., 2006, Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Vriginia, U.S. Geological Survey (map scale 1:1,400,000).

The Mogollon-Datil plateau features mountains supporting pinon-juniper, ponderosa, and fir-spruce forests. The mountain fronts can be relatively steep, such as in the Silver City and Glenwood areas, but topography is somewhat gentler to the north. On its north edge, this physiographic province includes the grasslands of the San Agustin Plains.

Climate

Temperature – Mean annual temperatures range from 64° F in the extreme southeast to 40°F or lower in high mountains and valleys of the north. During the summer months, individual daytime temperatures quite often exceed 100°F at elevations below 5,000 feet; but the average monthly maximum temperatures during July, the warmest month, range from the low 90's at lower elevations to the upper 70's at high elevations. In January, the coldest month, average daytime temperatures range from the middle 50's in the southern and central valleys to the low 20's in the higher elevations of the north. Minimum temperatures below freezing are common in all sections of the State during the winter, but subzero Fahrenheit temperatures are rare except in the mountains. The highest temperature recorded in New Mexico is 122°F on June 27, 1994, at the Waste Isolation Pilot Plant (WIPP) site. The lowest temperature recorded was -50 °F, on February 1, 1951, at Gavilan.

Precipitation – Average annual precipitation ranges from less than ten inches over much of the southern desert and the Rio Grande and San Juan Valleys to more than 40 inches at higher elevations in the State. Summer rains fall almost entirely during brief, but frequently intense thunderstorms. July and August are the rainiest months over most of the State, with from 30 to 40% of the year's total moisture falling at that time. During the warmest six months of the year, May through October, total precipitation averages from 60% of the annual total in the Northwestern Plateau to 80% of the annual total in the eastern plains. Much of the winter precipitation falls as snow in the mountain areas, but it may occur as either rain or snow in the valleys. Average annual snowfall ranges from about three inches at the Southern Desert and Southeastern Plains stations to well over 100 inches at Northern Mountain stations. It may exceed 300 inches in the highest mountains of the north.

Sunshine –The average number of hours of annual sunshine ranges from near 3,700 in the southwest to 2,800 in the north-central portions.

Humidity –Relative humidity ranges from an average of near 65% about sunrise to near 30% in mid-afternoon; however, afternoon humidity in warmer months are often less than 20% and occasionally may go as low as 4%. The low relative humidity during periods of extreme temperatures alleviates the discomforts of summer and winter temperatures. These low humidity levels contribute to decreased winter temperatures since the atmosphere is unable to retain heat in the evenings.[3]

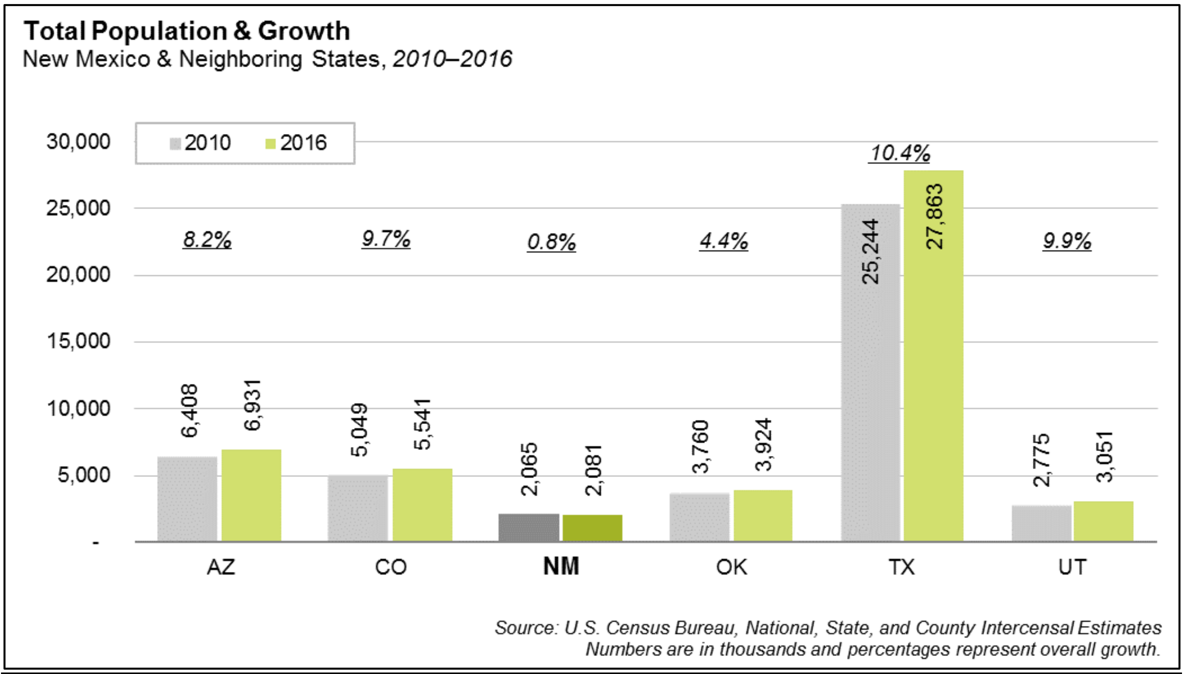
Economy

New Mexico's population reached 2,081,015 in 2016, according to the U.S. Census Bureau, ranking the State 36th in the nation for population. Population in New Mexico grew by 14.3% between 2000 and 2016. This growth, which was only slightly lower than the national growth of 14.5%, ranked the State 24th in the nation. Between 2010 and 2016, New Mexico's population grew by 0.8%. This growth, which was 3.7% points lower than the nation's growth of 4.5%, ranked the State 41st in the nation for

[3]Source: http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm

population growth. Figure 3-3 shows New Mexico's and neighboring States' population and population growth from 2010 to 2016.

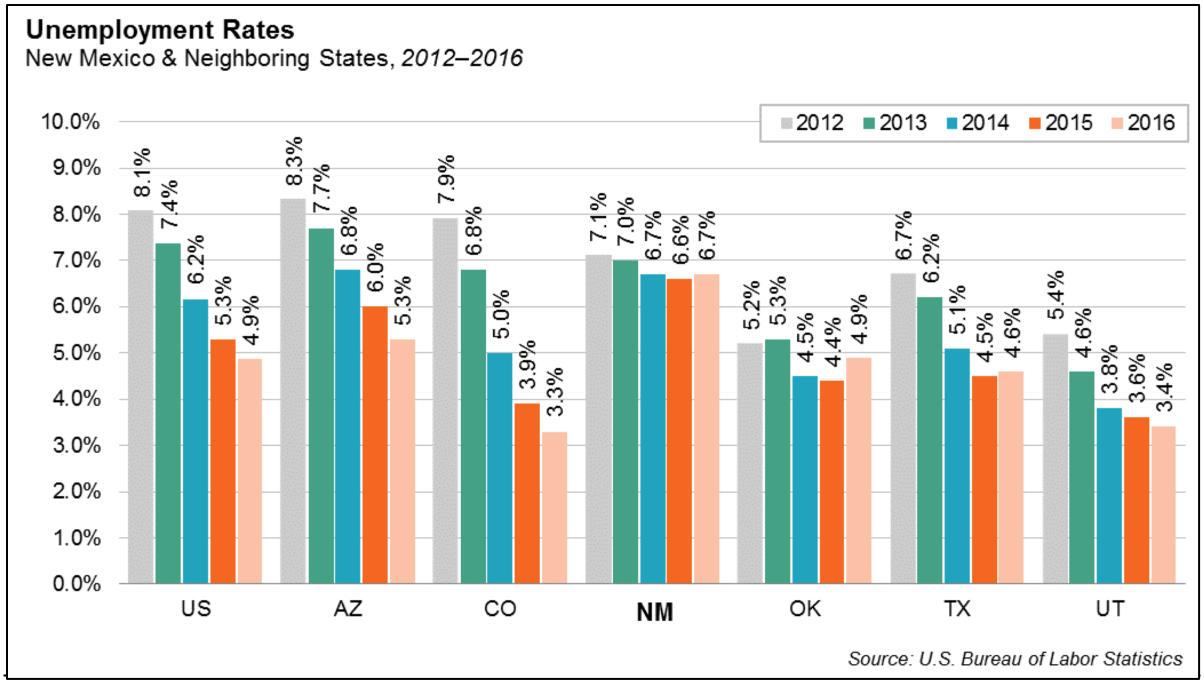
Figure 3-3 New Mexico Population Change, 2010 to 2016



New Mexico's population growth between 2010 and 2016 was solely driven by a natural increase in population from births. During the period, the natural increase of the population equaled 59,585 people (or 0.5% of the population), while net migration reached -37,780 people (an average annual rate of -0.3% of the population). This ranked the State 21st in the nation for rate of natural increase but 49th in the nation for rate of net migration.

As of 2016, New Mexico's not seasonally adjusted unemployment rate was 6.7%, 1.8 percentage points higher than the U.S. unemployment rate of 4.9%, and 0.1 percentage point higher than New Mexico's rate in 2015. The State's unemployment rate has declined more slowly than the rates of most other States in recent years, and it stagnated in 2016, leaving New Mexico with the highest unemployment rate in the country. Figure 3-4 shows New Mexico's and surrounding States' unemployment rates from 2012 to 2016.

Figure 3-4 New Mexico Unemployment Rates, 2012 to 2016

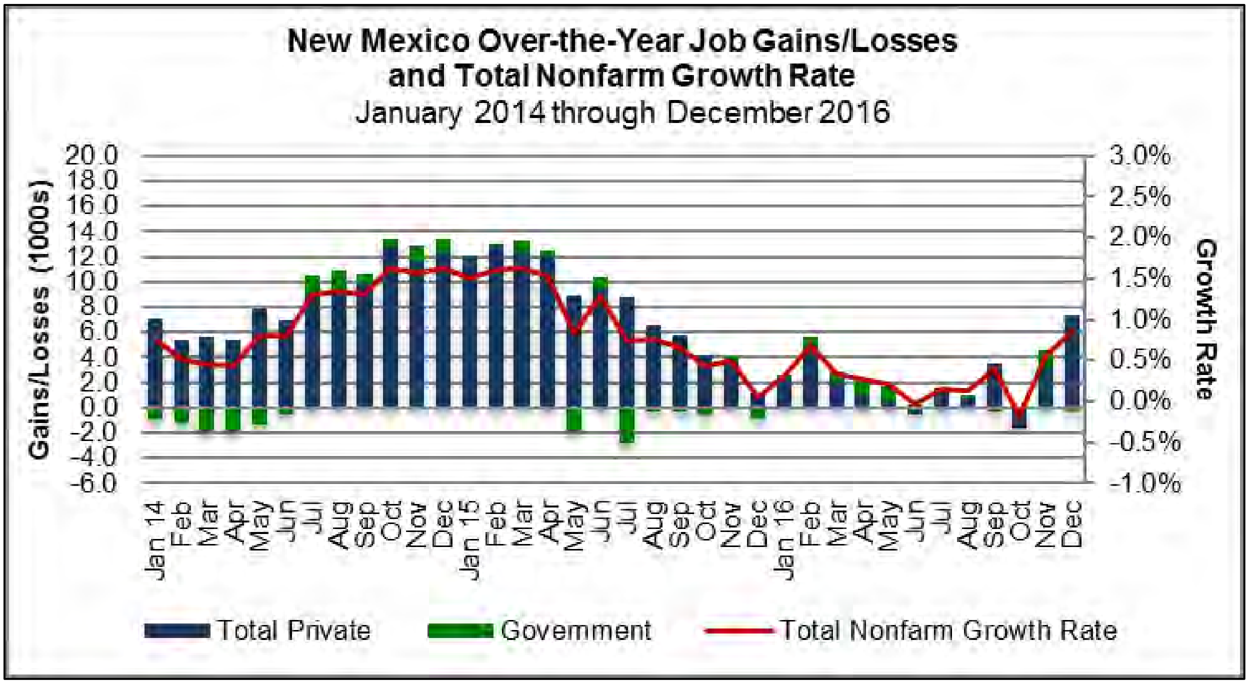


The nation's labor force participation rate has generally been declining in recent years, with the rate dropping from 64.7% to 62.8% between 2010 and 2016. New Mexico's labor force participation rate was 57.6% as of 2016, 5.2 percentage points lower than the national rate. The State was ranked 47th in the nation for this measure. The State's rate declined from 60.0% to 57.6%, or 2.4 percentage points, between 2010 and 2016, ranking the State 32nd for change in rate.

New Mexico's employment-to-population ratio was 53.7% in 2016, 6.0 percentage points below the U.S. ratio of 59.7%. The State's ratio dropped just 1.4 percentage points between 2010 and 2016, a decline that was greater than those of only three other States.

Total nonfarm employment in New Mexico as of 2016 was approximately 830,600, with 639,200 jobs in the private sector (77.0% of total nonfarm employment) and 191,400 jobs in the public sector (23.0% of total nonfarm employment). Between 2015 and 2016, total nonfarm employment increased by 0.3%, ranking New Mexico 44th in the nation for employment growth. Employment grew at an equal rate (0.3%) in the public and private sectors. Figure 3-5 shows the over-the-year jobs gains and losses from January 2014 to December 2016.

Figure 3-5 New Mexico Job Gains/Losses



As of 2015, farm employment in New Mexico reached approximately 28,770, representing about 1.1% of all employment in the State and ranking New Mexico 34th in the nation for concentration of farm employment. The State's farm employment grew by 3,142, or 12.3%, between 2010 and 2015, a rate faster than the rate of 44 other States.

New Mexico's employment has been projected to grow by 7.7%, or about 65,829 jobs, between 2014 and 2024. The industry subsector projected to grow the most numerically is ambulatory health care services; employment has been projected to increase by about 15,233 jobs, or 32.3%, over the period. Industries with the largest projected percentage growth include beverage and tobacco product manufacturing (40.1%); social assistance (34.8%); ambulatory health care services (32.3%); warehousing and storage (31.2%); and wholesale electronic markets and agents and brokers (24.6%).

Tourism

New Mexico's diverse and scenic beauty is a major draw for visitors. The Rocky Mountains, the Chihuahua Desert, portions of the Great Plains, spectacular canyons and the Rio Grande all combine to make the State a popular tourist destination.

Of the many features that set New Mexico apart, one is the presence of numerous Native American and Spanish colonial ruins. The Aztec Ruins and Chaco Canyon in the northwest region and the Bandelier National Monument in the north-central region are considered key national monuments. El Morro National Monument contains inscription rock that bears autographs, drawings, and messages from Spanish explorers and westbound pioneers. Fort Selden Monument consists of remains of the 19th-century adobe fort. Other attractions include the Gila Cliff Dwellings National Monument, Pecos National Historic Park (which contains ruins of a pueblo and Spanish colonial mission abandoned by 1838), Poshouinge Ruins, Salmon Ruins and Heritage Park, and the Three Rivers Petroglyph National

Recreation Site, Carlsbad Caverns National Park and White Sands National Monument. The Organ Mountains-Desert Peaks National Monument was declared a national monument on May 21, 2014.

The State is home to a myriad of museums. The Museum of New Mexico includes the New Mexico History Museum/Palace of the Governors in Santa Fe. The Palace of the Governor's is the oldest continually occupied public building in the country. The Museum of New Mexico also includes the New Mexico Museum of Art, the Museum of Indian Arts and Culture and the Museum of International Folk Art. The Indian Pueblo Cultural Center, located in Albuquerque, is owned and operated by the 19 Indian Pueblos of New Mexico and dedicated to the preservation and perpetuation of Pueblo Indian culture, history and art. The New Mexico Bureau of Geology and Mineral Resources in Socorro houses the Mineral Museum, known as one of the finest mineral collections in the world. In addition, there are numerous of private art museums throughout the State such as the Georgia O'Keefe Museum (Santa Fe), The International Rattlesnake Museum (Albuquerque) and the International UFO Museum (Roswell).

There are several National Park locations in New Mexico including; Aztec Ruins National Monument (Aztec), Bandelier National Monument (Los Alamos), Capulin Volcano National Monument (Capulin), Carlsbad Caverns National Park (Carlsbad), Chaco Culture National Historic Park (Nageezi), El Camino Real de Tierra Adentro (New Mexico and Texas), El Malpais National Monument (Grants), El Moro National Monument (Ramah), Gila Cliff Dwellings (Silver City), Organ Mountains Desert Peak National Monument (Dona Ana County), Pecos National Monument (Pecos), Petroglyph National Monument (Albuquerque), Valles Caldera National Preserve (Jemez Springs), White Sands National Monument (Alamogordo).

New Mexico also contains a large number of State monuments, including the Jemez State Monument in Jemez Springs, the Coronado State Monument in Bernalillo County, the Fort Sumner State Monument, the Lincoln State Monument, and the Fort Selden State Monument in Radium Springs.

Major Industry Sectors

The largest private-sector industry in New Mexico as of 2016 was the education and health services industry. Employment in the industry, at approximately 138,700, comprised 16.7% of total nonfarm employment in the State. Education and health services includes two subsectors for which data are available: educational services, with employment of 21,100 as of 2016, representing 2.5% of total nonfarm employment, and health care and social assistance, with employment of 117,700, representing 14.2% of total employment. Employment in the professional and business services industry comprised 12.2% of total nonfarm employment, while employment in the leisure and hospitality and retail trade industries comprised 11.5 and 11.2% of total nonfarm employment, respectively.

The education and health services industry was not only the largest private-sector industry in the State as of 2016, but it also reported the largest numeric and percentage growth between 2015 and 2016 (5,400 jobs, or 4.1%. Leisure and hospitality was the only other private-sector industry to register percentage growth of 2.0% or more (employment grew by 2.7%). Six private-sector industries lost jobs between 2015 and 2016, including mining and logging (down 5,900 jobs, or 23.0%), manufacturing (down 900 jobs, or 3.2%), retail trade (down 400 jobs, or 0.4%), wholesale trade and transportation, warehousing, and utilities (each down 200 jobs, or 0.9% and 0.8%, respectively), and construction (down 100 jobs, or 0.2%). Losses in manufacturing occurred entirely within durable goods manufacturing (down 1,300 jobs, or 7.7%); non-durable goods manufacturing employment increased by 300 jobs, or 2.8%.

Just over half of all public-sector jobs (54.1%, or 103,200 jobs) were in local government as of 2016. Employment in State government represented about 30% of all public-sector jobs, while the remaining 15% of public-sector employment was in Federal government. Both Federal and State government employment grew between 2015 and 2016 (by 300 jobs, or 1.0%, and 400 jobs, or 0.7%, respectively). Growth in State government came entirely from an increase in jobs in State government education. Employment in local government fell slightly (by 100 jobs, or 0.1%), with all losses occurring in local government education.

Major industry sectors in which the share of employment in New Mexico is notably greater than the share in the nation include: mining and logging; government; and construction. Major industry sectors that have comparatively smaller shares of employment include: both durable and non-durable goods manufacturing; wholesale trade; and financial activities.

Mining activities are primarily concentrated in the southeastern (oil and natural gas extraction in the Permian Basin along with potash mining) and northwestern parts of the State (mostly natural gas extraction in the San Juan Basin). The mining and logging industry experienced significant declines in employment between the end of 2014 and early 2016 that were the result of the precipitous fall in oil prices. Employment losses have slowed since peaking in February 2016, almost reaching neutral losses in the fall of 2017.

Government is a major sector throughout New Mexico. Employment growth in Local and State government has been trending down over the last few years, generally, with Federal government employment growth trending up.

Construction is another significant industry for the State. After taking a significant hit during the Great Recession, the industry was slow to recover. Employment growth remained fairly stagnant between 2013 and 2015. A slowing in employment growth in 2016 has been sharply countered by quick increases in growth in 2017. Figure 3-6 shows total nonfarm employment by industry from 2015 to 2016.

Figure 3-6 New Mexico Total Nonfarm Employment by Industry, 2015 to 2016

Total Nonfarm Employment by Industry
New Mexico, 2015–16

Industry	New Mexico 2015	2016	2016 Share	Chg 15–16 Num	Pct
Total Nonfarm Employment	**828.0**	**830.6**	**100.0%**	**2.6**	**0.3%**
Total Private	**637.1**	**639.2**	**77.0%**	**2.1**	**0.3%**
Total Public	**190.9**	**191.4**	**23.0%**	**0.5**	**0.3%**
Goods-Producing	**96.9**	**89.9**	**10.8%**	**-7.0**	**-7.2%**
Mining, Logging & Construction	69.1	63.1	7.6%	-6.0	-8.7%
Mining & Logging	25.6	19.7	2.4%	-5.9	-23.0%
Construction	43.5	43.4	5.2%	-0.1	-0.2%
Manufacturing	27.8	26.9	3.2%	-0.9	-3.2%
Durable Goods	16.9	15.6	1.9%	-1.3	-7.7%
Non-Durable Goods	10.9	11.2	1.3%	0.3	2.8%
Service-Providing	**731.1**	**740.6**	**89.2%**	**9.5**	**1.3%**
Private Service-Providing	**540.2**	**549.2**	**66.1%**	**9.0**	**1.7%**
Trade, Transp. & Utilities	139.6	138.9	16.7%	-0.7	-0.5%
Wholesale Trade	21.6	21.4	2.6%	-0.2	-0.9%
Retail Trade	93.5	93.1	11.2%	-0.4	-0.4%
Transp., Wareh. & Utilities	24.6	24.4	2.9%	-0.2	-0.8%
Information	12.7	12.8	1.5%	0.1	0.8%
Financial Activities	33.3	33.5	4.0%	0.2	0.6%
Professional & Business Svcs	99.7	101.2	12.2%	1.5	1.5%
Education & Health Services	133.3	138.7	16.7%	5.4	4.1%
Educational Services	20.1	21.0	2.5%	0.9	4.5%
Health Care & Social Asst.	113.2	117.7	14.2%	4.5	4.0%
Leisure & Hospitality	93.1	95.6	11.5%	2.5	2.7%
Other Services	28.5	28.6	3.4%	0.1	0.4%
Government	**190.9**	**191.4**	**23.0%**	**0.5**	**0.3%**
Federal Government	29.1	29.4	3.5%	0.3	1.0%
State Government	58.4	58.8	7.1%	0.4	0.7%
State Government Education	*27.0*	*27.5*	*3.3%*	*0.5*	*1.9%*
Local Government	103.3	103.2	12.4%	-0.1	-0.1%
Local Government Education	*54.2*	*53.7*	*6.5%*	*-0.5*	*-0.9%*

3.6 Demographic Features

Population

As of 2016, 51.5% of New Mexico's population was not Hispanic/Latino, while 48.5% were Hispanic/Latino. New Mexico had the largest concentration of Hispanic/Latino residents than any other U.S. State and the District of Columbia (Figure 3-7). The minority racial group with the largest share of New Mexico's population as of 2016 was American Indian/Alaska Native. As of 2016, 8.6% of non-Hispanics/Latinos and 10.6% of all persons (Hispanic/Latino or not) were American Indians/Alaska Natives.

New Mexico's racial and ethnic composition has changed over time. Between 2000 and 2016, persons identifying as two or more races experienced the largest percentage increase in population (102.8% across both ethnicities). The population of this racial group who also identified as Hispanic/Latino increased by 209.3%, while those who also identified themselves as not Hispanic/Latino increased by 63.8%.

Figure 3-7 New Mexico Population by Hispanic Origin and Race, 2000 to 2016

Population by Hispanic Origin and Race

New Mexico, 2000–16

Sex, Race, and Hispanic Origin	July 1, 2000	July 1, 2010	July 1, 2016	Change 00–16		Change 10–16	
				Num	Pct	Num	Pct
TOTAL	**1,821,204**	**2,064,741**	**2,081,015**	**259,811**	**14.3%**	**16,274**	**0.8%**
White	1,555,012	1,724,967	1,718,307	163,295	10.5%	-6,660	-0.4%
Black	38,255	49,335	52,133	13,878	36.3%	2,798	5.7%
AIAN	178,825	209,433	219,953	41,128	23.0%	10,520	5.0%
Asian	21,329	31,501	35,287	13,958	65.4%	3,786	12.0%
NHPI	2,124	3,161	3,293	1,169	55.0%	132	4.2%
Two+ Races	25,659	46,344	52,042	26,383	102.8%	5,698	12.3%
NOT HISPANIC	**1,051,216**	**1,106,911**	**1,071,142**	**19,926**	**1.9%**	**-35,769**	**-3.2%**
White	819,189	838,442	792,167	-27,022	-3.3%	-46,275	-5.5%
Black	30,986	36,165	37,585	6,599	21.3%	1,420	3.9%
AIAN	162,280	176,109	179,014	16,734	10.3%	2,905	1.6%
Asian	18,937	26,920	30,295	11,358	60.0%	3,375	12.5%
NHPI	1,047	1,275	1,323	276	26.4%	48	3.8%
Two+ Races	18,777	28,000	30,758	11,981	63.8%	2,758	9.9%
HISPANIC	**769,988**	**957,830**	**1,009,873**	**239,885**	**31.2%**	**52,043**	**5.4%**
White	735,823	886,525	926,140	190,317	25.9%	39,615	4.5%
Black	7,269	13,170	14,548	7,279	100.1%	1,378	10.5%
AIAN	16,545	33,324	40,939	24,394	147.4%	7,615	22.9%
Asian	2,392	4,581	4,992	2,600	108.7%	411	9.0%
NHPI	1,077	1,886	1,970	893	82.9%	84	4.5%
Two+ Races	6,882	18,344	21,284	14,402	209.3%	2,940	16.0%

New Mexico's population growth between 2010 and 2016 was solely driven by a natural increase in population from births. During the period, the natural increase of the population equaled 59,585 people (or 0.5% of the population), while net migration reached -37,780 people (an average annual rate of -0.3% of the population). This ranked the State 21st in the nation for rate of natural increase but 49th in the nation for rate of net migration. Alaska and Illinois reported larger rates of net outmigration than New Mexico. Figure 3-8 describes the components of New Mexico's population change, by county.

Twenty-three of the State's counties reported a net natural increase in population, while four reported a net immigration of population. Curry County saw the largest average annual rate of natural increase (1.1% of the total population), while Sierra County experienced the largest negative average annual rate of natural increase (-1.2%). Sandoval County experienced the largest average annual rate of net migration (0.8% of the total population), while San Juan County experienced the largest negative average annual rate of net migration (-2.8%).

Figure 3-8 New Mexico Components of Population Change, by County 2010 to 2016

Components of Population Change
New Mexico and Counties, 2010–16

Area	Est. Base 2010	July 1, 2016	Change Num	Change Pct	Component: Nat. Increase Num	Nat. Increase Rate	Net Migration Num	Net Migration Rate
					(rates are per 1,000 population)			
New Mexico	**2,059,198**	**2,081,015**	**21,817**	**1.1%**	**59,585**	**4.5**	**-37,780**	**-3.2**
Bernalillo	662,547	676,953	14,406	2.2%	18,143	4.3	-3,222	-0.9
Catron	3,729	3,508	-221	-5.9%	-81	-3.6	-90	-4.7
Chaves	65,651	65,282	-369	-0.6%	1,791	4.4	-2,003	-5.2
Cibola	27,215	27,487	272	1.0%	821	4.6	-558	-3.5
Colfax	13,750	12,253	-1,497	-10.9%	-91	-1.3	-1,392	-17.6
Curry	48,376	50,280	1,904	3.9%	3,347	10.6	-1,446	-6.1
De Baca	2,022	1,793	-229	-11.3%	-66	-6.4	-159	-13.2
Doña Ana	209,235	214,207	4,972	2.4%	9,659	7.3	-4,971	-4.3
Eddy	53,829	57,621	3,792	7.0%	1,809	5.1	2,068	6.2
Grant	29,514	28,280	-1,234	-4.2%	-189	-1.0	-1,039	-5.4
Guadalupe	4,687	4,376	-311	-6.6%	2	0.2	-335	-12.6
Harding	695	665	-30	-4.3%	-16	-3.3	-15	-2.6
Hidalgo	4,895	4,302	-593	-12.1%	61	1.8	-658	-22.1
Lea	64,727	69,749	5,022	7.8%	3,834	9.3	1,275	3.7
Lincoln	20,497	19,429	-1,068	-5.2%	-50	-0.2	-944	-7.8
Los Alamos	17,950	18,147	197	1.1%	325	3.1	-151	-2.0
Luna	25,095	24,450	-645	-2.6%	607	4.1	-1,197	-8.2
McKinley	71,488	74,923	3,435	4.8%	3,893	8.5	-477	-1.3
Mora	4,881	4,504	-377	-7.7%	-4	-0.4	-366	-12.9
Otero	63,799	65,410	1,611	2.5%	2,005	4.8	-269	-1.8
Quay	9,041	8,365	-676	-7.5%	-102	-1.7	-600	-12.1
Rio Arriba	40,244	40,040	-204	-0.5%	1,018	3.9	-1,084	-4.5
Roosevelt	19,840	19,082	-758	-3.8%	889	7.2	-1,682	-15.3
Sandoval	131,578	142,025	10,447	7.9%	3,154	3.6	6,797	7.6
San Juan	130,045	115,079	-14,966	-11.5%	5,650	7.2	-20,770	-27.9
San Miguel	29,393	27,760	-1,633	-5.6%	272	1.2	-1,884	-10.7
Santa Fe	144,172	148,651	4,479	3.1%	1,616	1.7	2,540	2.7
Sierra	11,994	11,191	-803	-6.7%	-817	-11.5	7	-0.7
Socorro	17,860	17,027	-833	-4.7%	313	3.2	-1,129	-10.4
Taos	32,940	33,065	125	0.4%	169	0.9	-47	-0.1
Torrance	16,381	15,302	-1,079	-6.6%	51	0.2	-1,141	-11.7
Union	4,554	4,183	-371	-8.1%	-41	-1.6	-324	-12.1
Valencia	76,574	75,626	-948	-1.2%	1,613	3.2	-2,514	-5.7

Notes: Natural change equals births minus deaths. Total net migration includes international and domestic. add to total change due to a residual. Average rate represents the average of 2011 through 2016.

In 2017, the University of New Mexico's Geospatial Population Studies released a set of population growth projections for the time period 2010 to 2040. Figure 3-9 shows New Mexico total population growth projections by county.

Figure 3-9 New Mexico Projected Population Growth (2010 - 2040) [4]

County	2000 Count	2010 Count	2015 Estimate	2020 Projection	2025 Projection	2030 Projection	2035 Projection	2040 Projection
Bernalillo	556,678	662,564	679,810	715,115	740,500	763,571	783,612	799,465
Catron	3,543	3,725	3,602	3,333	3,109	2,875	2,641	2,418
Chaves	61,382	65,645	66,168	68,856	70,083	71,403	72,607	73,393
Cibola	25,595	27,213	27,590	28,647	28,875	29,030	29,103	29,058
Colfax	14,189	13,750	12,917	12,323	12,114	11,893	11,651	11,397
Curry	45,044	48,376	50,560	53,402	54,849	56,339	57,951	59,581
De Baca	2,240	2,022	1,902	1,877	1,776	1,687	1,605	1,520
Doña Ana	174,682	209,233	216,577	232,946	244,455	255,070	264,537	273,074
Eddy	51,658	53,829	57,372	57,913	58,220	58,547	58,609	58,233
Grant	31,002	29,514	29,288	28,505	27,449	26,407	25,371	24,365
Guadalupe	4,680	4,687	4,471	4,642	4,555	4,468	4,374	4,251
Harding	810	695	692	634	587	545	504	462
Hidalgo	5,932	4,894	4,582	4,612	4,333	4,072	3,809	3,535
Lea	55,511	64,727	70,881	75,784	77,308	78,992	80,612	81,635
Lincoln	19,411	20,497	19,954	19,800	19,145	18,455	17,699	16,915
Los Alamos	18,343	17,950	17,905	17,675	17,326	17,092	16,846	16,426
Luna	25,016	25,095	24,806	25,283	25,021	24,795	24,589	24,348
McKinley	74,798	71,492	75,397	76,435	76,604	76,623	76,256	75,365
Mora	5,180	4,881	4,714	4,645	4,424	4,210	3,997	3,774
Otero	62,298	63,797	64,656	65,884	65,606	65,304	64,977	64,402
Quay	10,155	9,041	8,581	8,213	7,997	7,797	7,580	7,323
Rio Arriba	41,190	40,246	39,752	41,212	40,649	40,041	39,332	38,496
Roosevelt	18,018	19,846	19,639	21,325	21,896	22,328	22,586	22,719
San Juan	113,801	130,044	123,979	128,162	131,278	134,446	137,173	138,762
San Miguel	30,126	29,393	28,264	28,754	27,843	26,753	25,495	24,123
Sandoval	89,908	131,561	138,928	148,708	163,767	180,269	197,371	213,929
Santa Fe	129,292	144,170	148,238	151,767	157,104	162,782	169,142	175,242
Sierra	13,270	11,988	11,466	10,602	9,964	9,357	8,821	8,368
Socorro	18,078	17,866	17,465	18,164	17,922	17,616	17,252	16,812
Taos	29,979	32,937	33,287	33,299	33,309	33,172	32,855	32,336
Torrance	16,911	16,383	15,731	15,482	15,424	15,324	15,089	14,684
Union	4,174	4,549	4,370	4,512	4,501	4,491	4,467	4,413
Valencia	66,152	76,569	76,312	78,669	79,574	82,721	81,576	80,655
State Total	**1,819,046**	**2,059,179**	**2,099,856**	**2,187,183**	**2,247,564**	**2,308,475**	**2,360,091**	**2,401,480**

New Mexico ranks sixth in number of distinct tribal areas, behind Alaska, California, Nevada, Oklahoma, and Washington. Of the State's 23 distinct tribal areas, three are located within more than one state.

[4] Source: New Mexico County Population Projections July 1, 2010 to July 1, 2040, Geospatial and Population Studies Group, University of New Mexico (February 2017)

The Navajo Nation Reservation and Off-Reservation Trust Land is located within Arizona, New Mexico, and Utah; the Ute Mountain Reservation and Off-Reservation Trust Land is located within Colorado, New Mexico, and Utah; and the Zuni Reservation and Off-Reservation Trust Land is located within Arizona and New Mexico. The other 20 tribal areas are located exclusively within New Mexico.

As of 2015, there were 255,701 people living on tribal lands in New Mexico, representing 12.3% of the New Mexico population. This was a slight increase from a 2010 population of 248,997, or 12.4% of the New Mexico population. More people lived on Navajo Nation Reservation and Off-Reservation lands than any other tribal area. San Felipe Pueblo saw the largest percentage increase in population (37.1%), while Santa Ana Pueblo saw the largest percentage decrease (29.9%) between 2010 and 2015. Figure 3-10 describes the Tribal populations in New Mexico.

Figure 3-10 New Mexico Tribal Populations

Tribal Populations

New Mexico, 2006–10 and 2011–15

	Population		Change 2010–15	
Area	**2010**	**2015**	**Num**	**Pct**
New Mexico	**2,013,122**	**2,084,117**	**70,995**	**3.5%**
Acoma Pueblo	2,987	3,019	32	1.1%
Isleta Pueblo	3,271	3,881	610	18.6%
Jemez Pueblo	1,918	1,983	65	3.4%
Jicarilla Apache Nation Reservation	3,113	2,995	-118	-3.8%
Laguna Pueblo	4,646	3,944	-702	-15.1%
Mescalero Reservation	4,025	3,550	-475	-11.8%
Nambe Pueblo	1,829	1,683	-146	-8.0%
Navajo Nation Reservation	169,052	173,822	4,770	2.8%
Ohkay Owingeh	6,419	7,044	625	9.7%
Picuris Pueblo	1,980	1,832	-148	-7.5%
Pueblo de Cochiti	1,424	1,751	327	23.0%
Pueblo of Pojoaque	3,281	3,694	413	12.6%
San Felipe Pueblo	3,241	4,442	1,201	37.1%
San Ildefonso Pueblo	1,669	1,970	301	18.0%
Sandia Pueblo	5,471	5,034	-437	-8.0%
Santa Ana Pueblo	935	655	-280	-29.9%
Santa Clara Pueblo	11,231	11,531	300	2.7%
Santo Domingo Pueblo	3,169	3,422	253	8.0%
Taos Pueblo	5,258	5,007	-251	-4.8%
Tesuque Pueblo	865	839	-26	-3.0%
Ute Mountain Reservation	1,436	1,314	-122	-8.5%
Zia Pueblo	901	879	-22	-2.4%
Zuni Reservation	10,876	11,410	534	4.9%

*Includes reservation and off-reservation lands.

The State's Economic Department provided updated population information as of July 1, 2016. The table below shows a summary of the population size of each Preparedness Area in New Mexico (Figure 3-11).

Figure 3-11 Populations by Preparedness Area

Preparedness Area	Counties	Total Population (2010)	Total Population (2016)
Preparedness Area 1	Guadalupe, Quay, Curry, Chavez, Roosevelt, De Baca, Lincoln, Eddy, Lea	288,670	295,977
Preparedness Area 2	Colfax, Union, Harding, Mora, San Miguel	53,268	49,365
Preparedness Area 3	Rio Arriba, Taos, Los Alamos, Santa Fe	235,303	239,903
Preparedness Area 4	San Juan, McKinley, Cibola	228,749	217,489
Preparedness Area 5	Sandoval, Bernalillo, Torrance, Valencia, Socorro	904,943	926,933
Preparedness Area 6	Catron, Grant, Sierra, Otero, Doña Ana, Luna, Hidalgo	348,246	351,348

Housing

According to the Census Bureau American Community Survey one-year estimates, the total number of occupied housing units in the State in 2015 totaled 761,797, with a homeownership rate of 67.5%. The State-wide median value of owner-occupied housing units was $164,100 per unit (national median value is $194,500 per unit). The median value is much higher in urban/suburban and resort areas in the State. The median value of a residential structure in Santa Fe County, for example, is approximately $286,200. The State-wide average household size was 2.72 persons per household for 761,797 households. The national average is 2.71 persons per household.

Income

New Mexico's per capital personal income was $38,807 as of 2016, ranking the State 49th in the nation for income. Per capita personal income increased by $8,443, or 27.8%, between 2006 and 2016 and by $4,070, or 11.7%, between 2011 and 2016; the growth rates were the 40th and 43rd highest in the nation, respectively. New Mexico's annual median household income was $45,382 as of 2015, ranking the State 49th in the nation in that measure. Median household income increased by $3,292, or 7.8%, between 2010 and 2015.

3.7 Utilities and Infrastructure

Electricity

New Mexico has several large power generating facilities, upon which significant portions of the State are dependent. The Four Corners Power Plant and San Juan Power Plant northwest of Farmington in San Juan County are the two major power generation plants in the State. Both plants not only generate electricity for New Mexico, but also for Arizona, Utah, and Colorado. The Four Corners Power Plant is operated by the Arizona Public Service Company and provides electrical transmission to the Tucson Power Company, the Pacific Corporation in Utah, and the Western Area Power Administration in Colorado. The San Juan Power Plant is run by the Public Utility Company of New Mexico (PNM) and provides electrical transmission to many rural electric cooperatives, as well as customers in the Albuquerque Metro Area. Other major PNM generating plants are located in Albuquerque, Afton, and Las Vegas.

Gas

There are several natural gas distributors serving the population of New Mexico. PNM is the major distributor, along with the El Paso Natural Gas Company, Transwestern Pipeline Company, and the Natural Gas Pipeline Company of America.

Two major gas pipelines cross the State, running roughly parallel southeast from Gallup toward Roswell and Carlsbad. There are several regional gas pipelines serving the valley areas, but not crossing over any mountain passes. Major gas pipeline compressor stations are located in Otero, Sierra, Lea, Curry, Rio Arriba, San Juan, Sandoval, McKinley, Bernalillo, and Valencia Counties. Within the State are many propane distributors, which are dependent upon truck and rail transportation.

Located west of the Albuquerque International Sunport are several bulk petroleum tank farms. These facilities are located near the Rio Grande and are primarily in agricultural and light industrial areas.

New Mexico has a significant oil production industry. There are two major refineries in the State, one east of Gallup and the largest one in Artesia.

Water Supply

Most jurisdictions have their own water companies, while extensive rural areas are dependent upon private wells or mutual domestic water users associations. Currently, the State's principal surface water supplies are low due to drought conditions that have prevailed for many years. Drought conditions have impacted groundwater supplies as well, and the reduction of well water reserves is a serious concern for the State's water planners. Forest and watershed health in contributing headwater areas affect New Mexico's surface water supplies and ground water recharge.

3.8 Transportation

Roadways

Three major interstate highways serve New Mexico: I-40, I-10, and I-25. I-40, running through Albuquerque, is the major east/west corridor through central New Mexico. I-10 serves the southern portion of the State from El Paso through Las Cruces to the Arizona border. I-25 is the major north-south corridor in the State, originating in Las Cruces, running northward through Albuquerque and continuing into Colorado. I-40 and I-25 converge in Albuquerque to form an intersection popularly known as "the Big I."

New Mexico has many important highway bridges crossing the Rio Grande and other major rivers. In urban areas such as Albuquerque and Las Cruces, there are other routing alternatives if a bridge should be rendered inoperable. In areas that are more rural river crossings are less frequent, and considerable detouring would be necessary if a bridge were to close.

Railroads

Since 1878, when the first transcontinental railway service began across New Mexico, railways have been an important component of the State's transportation and economic network. Two freight carriers (BNSF and Union Pacific) and a passenger train (Amtrak) serve the State. In addition to carrying large tonnages of freight from the West coast, the railways serve as a mechanism for transporting hazardous materials, which are a major concern to populated areas along the rails, specifically the Albuquerque metro area. In addition, the State operates a narrow-gauge tourist railroad called the Cumbres, and Toltec Scenic Railroad. This tourist railroad runs between Chama, New Mexico, and Antonito, Colorado.

The Burlington Northern Santa Fe (BNSF) Railroad hauls 90% of all freight originating in New Mexico and 80% of all cargo terminating in the State. The BNSF has two major routes that provide east-west and north-south service. The east-west route from the Texas border generally parallels U.S. Route 60 thru Vaughn to Belen. From Belen, the route parallels State Road 6 toward the intersection again with I-40.

Rail Runner Express

The New Mexico Department of Transportation and the Mid-Region Council of Governments are responsible for developing the Rail Runner. While the NMDOT is the ultimate authority responsible for the Rail Runner, the Mid-Region Council of Governments is the lead agency for implementation of the new passenger rail service. The Rail Runner Express is a commuter rail system serving the metropolitan area of Albuquerque, New Mexico. The Rail Runner Express is administered by the New Mexico Department of Transportation (NMDOT) and a regional government planning association known as the Mid-Region Council of Governments (MRCOG).

In addition to the NMDOT and the MRCOG, local governments (including counties, towns, and the Native American Tribes and Pueblos in the corridor) all play key roles in the planning and execution of the Rail Runner. This local involvement is an essential ingredient in the development of the project. Specifically, local jurisdictions have participated in the planning stages as well as the facilitation of public involvement and outreach. These communities will play important roles in the day-to-day operations of the Rail Runner.

The Rail Runner officially went into service on July 14, 2006. Using the existing Santa Fe Southern Railway track from Lamy to Santa Fe, which is filled with sharp curves, would have required the train to slow to 15 miles per hour (24 km/h) in some places, so new tracks were laid to the west (near Interstate 25) to produce travel times comparable to the automobile. The route uses a previously existing track from Bernalillo to the base of La Bajada, a hill south of Santa Fe. It then runs on a newly built track, with a new associated right-of-way to Santa Fe. In Santa Fe, the Rail Runner uses improved Santa Fe Southern Railway track from I-25 to the terminal at the Santa Fe Railyard (Figure 3-12). The Rail Runner currently serves the following communities:

- Cities, Villages, and Towns: City of Belen, Village of Los Lunas, City of Albuquerque, Town of Bernalillo and the City of Santa Fe
- Counties: Valencia County, Bernalillo County, Sandoval County and Santa Fe County

Figure 3-12 Rail Runner System Map

Airports

New Mexico is home to 65 FAA-recognized airports. Of these, the Albuquerque International Sunport, the Las Cruces International Airport, and the Santa Fe Airport are the only ones with out-of-state commercial service. Nine of the State's airports have unpaved runways suitable only for light aircraft. Two of the State's airports, Holloman AFB and Cannon AFB, are not open for public use.

The Albuquerque International Sunport is the main arrival and departure point for New Mexico, with commuter flights available to Clovis, Hobbs, Farmington, Gallup, Roswell, Ruidoso, and Silver City.

Kirtland AFB provides aircraft rescue and firefighting services for the Albuquerque Sunport and shares their runways. FAA facilities in Albuquerque include the Airport District Office, Air Traffic Control Tower, Automated Flight Service Station, Civil Aviation Security Office, Flight Standards District Office, and Rio Grande SMO (Airways Facilities). The Transportation Security Administration (TSA) occupies office space at the historic Old Terminal Building. The National Weather Service and U.S. Postal Service Express Mail Facility are also located at the airport. Adjacent to the airport is a major Southwest Airlines Reservations Center.

Corporate jet manufacturer Eclipse Aviation has expanded its operations to Double Eagle II Airport. This airport located on Albuquerque's west side is used primarily for training, military, air ambulance service, charter and corporate flights.

3.9 State of New Mexico WIPP Program

The Waste Isolation Pilot Plant (WIPP) is the nation's only deep geologic long-lived radioactive waste repository. Located 26 miles southeast of Carlsbad, WIPP permanently isolates defense-generated transuranic (TRU) waste 2,150 feet underground in an ancient salt formation. WIPP's disposal rooms are nearly a half mile below the surface. By comparison, the Empire State Building is only 1,454 feet high.

TRU waste began accumulating in the 1940s with the beginning of the nation's nuclear defense program. As early as the 1950s, the National Academy of Sciences recommended deep disposal of long-lived TRU radioactive wastes in geologically stable formations, such as deep salt beds. Sound environmental practices and strict regulations require such wastes to be isolated to protect human health and the environment.

Bedded salt is free of fresh flowing water, easily mined, impermeable and geologically stable — an ideal medium for permanently isolating long-lived radioactive wastes from the environment. However, its most important quality in this application is the way salt rock seals all fractures and naturally closes all openings.

Throughout the 1960s, government scientists searched for an appropriate site for radioactive waste disposal, eventually testing a remote desert area of southeastern New Mexico where, 250 million years earlier, evaporation cycles of the ancient Permian Sea had left a 2,000-foot-thick salt bed.

In 1979, Congress authorized WIPP, and the facility was constructed during the 1980s. Congress limited WIPP to the disposal of defense-generated TRU wastes in the 1992 Land Withdrawal Act. In 1998, the U.S. Environmental Protection Agency certified WIPP for safe, long-term disposal of TRU wastes. On March 26, 1999, the first waste shipment arrived at WIPP from Los Alamos National Laboratory in New Mexico.

In September 2017, the Department of Energy issued a modification to the contract with Nuclear Waste Partnership (NWP) for the management and operations of WIPP. The contract modification enhances the focus on safety, provides cost incentives that will increase the value to the taxpayers, and rewards the workforce for safe and efficient operations. The contract modification also provides greater support for the community of Carlsbad. The Department has extended NWP's period of performance to September 30, 2020, which exercises a newly-negotiated option to extend three of the available five years remaining on the contract.

"This negotiated option will give Nuclear Waste Partnership the necessary time to continue the progress they have achieved through the Waste Isolation Pilot Plant recovery and resumption of shipments," said

DOE Carlsbad Field Office Manager Todd Shrader. "The enhancements to the contract are expected to ensure WIPP is operated safely and efficiently in both waste emplacement and mining operations."

As of January 2018, mining operations resumed at WIPP for the first time in four years when a continuous mining machine made its first cut into the salt where Panel 8 had been started years before. Mining restarted in Panel 8, which will be used for the emplacement of transuranic waste once waste handling crews fill Panel 7. Panel 8 mining began in late 2013, but was halted following separate fire and radiological events that suspended emplacement operations. Completion of Panel 8 is scheduled for 2020.

"Resuming mining operations will allow us to continue fully restoring WIPP and fulfilling our important mission of providing a transuranic waste solution for the DOE complex," Carlsbad Field Office Manager Todd Shrader said. "As with the restart of waste emplacement operations last year, WIPP will take a slow, deliberate approach to mining, keeping safety as a Core Value."

More than 112,000 tons of salt will be removed from the underground to complete the panel, which will contain seven disposal rooms for waste emplacement. Each disposal room is 300 feet long, 33 feet wide and 13 feet high. Mining at WIPP is timed so that a panel is only ready when it is needed for waste emplacement. This is because the natural movement of salt causes mined openings to close. In fact, panels are mined slightly larger than the desired size to account for this closure. This is the salt rock behavior that will eventually permanently encapsulate the waste.

http://www.wipp.energy.gov/wipp-site.asp

3.10 Agriculture

Agriculture is dispersed across the State and is vulnerable to most natural hazards but particularly fire and flood. Agriculture production in the State of New Mexico is the State's third largest economy and is important regionally, nationally and internationally. Each year, agriculture production in New Mexico hovers around $2.86 billion. When considering the impact that agriculture production has on other related industries, the total value of the agriculture production is valued at over $3.22 billion. The dairy industry is the number one agriculture production entity with nearly $1.19 billion in milk sales. New Mexico remains among the nation's leaders in chile production and pecan production producing 29 percent of the country's chile and 27% of the country's pecans. Pecans were the highest crop commodity in the State in total cash receipts of $213 million. In addition, pecans rank number one in New Mexico agricultural exports to foreign markets with over $191 million in sales. Dairy products came in second with $162 million in export sales. The livestock industry typically represents $895 million in sales and includes milk cows, beef cattle, sheep, goats, and others.

In New Mexico, all counties have some form of food and fiber production. In addition to the top economic crops grown in the State other crops include hay, alfalfa, corn, cotton, sorghum, wheat onions, peanuts and pistachios. Many small vineyards and fruit orchards are scattered around the State. The world's largest cheese production plant is in New Mexico and survives because of the State's dairy industry.

3.11 Plan Development Process

2018 Hazard Mitigation Plan Update

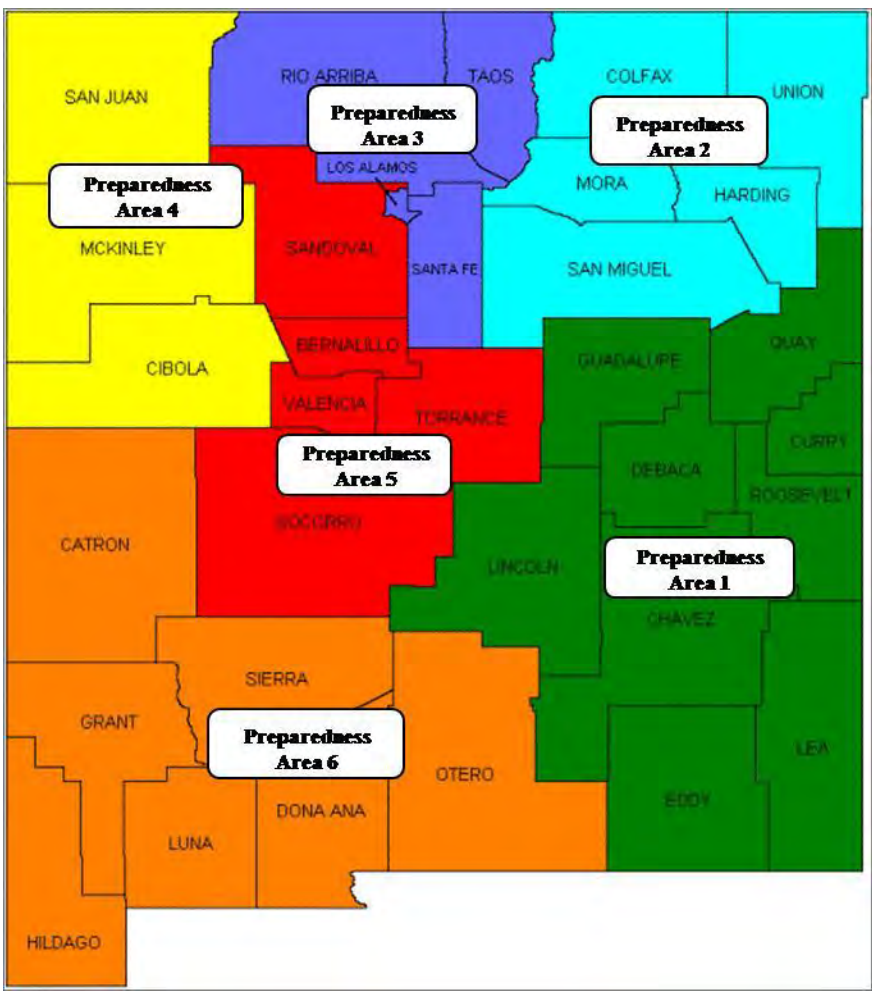
The 2018 New Mexico Natural Hazard Mitigation Plan Update is a collaborative effort resulting from the work of approximately 70 SHMPT Members and Subject Matter Experts over a period of 18 months. Representatives on the SHMPT included State agencies, Federal agencies, educational institutions and State-wide organizations involved in natural hazard mitigation. A list of the agencies/organizations represented and the representative is included in the Acknowledgements Section of this Plan. A more detailed list with agency/organization, contact individual, their associated role and subject matter expertise is included in Appendix D.

Throughout the process, each section of the 2013 version of the Plan was reviewed and edited. The 2018 Plan Update integrates text from previous updates so that each section reads as one continuous narrative.

Preparedness Areas

The 2018 Plan Update is written to reflect hazard profiles and analysis on a Preparedness Area scale. DHSEM coordinates activities for counties and tribes by Preparedness Area. Figure 3-13 below shows the six Preparedness Areas, whose borders coincide with county boundaries, and includes a chart which explains the tribal entities included in each Preparedness Area for NM DHSEM coordination.

Figure 3-13 DHSEM Preparedness Areas



There are a number of tribal entities located within four of the six DHSEM Preparedness Areas. Preparedness Area 3 includes the following tribes:

- Nambe Pueblo, Pojoaque Pueblo, San Ildefonso Pueblo, Tesuque Pueblo (Santa Fe County)
- Jicarilla Apache, Ohkay Owingeh Pueblo, Santa Clara Pueblo (Rio Arriba County)
- Picuris Pueblo, Taos Pueblo (Taos County)

Preparedness Area 4 includes the following tribes:

- Navajo, Ute Mountain (San Juan County)
- Navajo, Zuni Pueblo (McKinley County)
- Acoma Pueblo, Laguna Pueblo, Ramah Navajo, Tojajiilee Navajo (Cibola County)

Preparedness Area 5 includes the following tribes:

- Cochiti Pueblo, Jemez Pueblo, Sandia Pueblo, San Felipe Pueblo, Santa Ana Pueblo, Santo Domingo Pueblo, Zia Pueblo (Sandoval County)
- Isleta Pueblo (Bernalillo County)
- Alamo Navajo (Socorro County)

Preparedness Area 6 includes the following tribes:

- Mescalero Apache (Otero County)

State Hazard Mitigation Planning Team (SHMPT) and Subject Matter Experts Listing

In the fall of 2016, the Mitigation Program compiled a list of the key agencies, organizations, and entities that may have an interest in the State Natural Hazard Mitigation Plan. At the first SHMPT Meeting, participants were asked to supply a list of agencies, organizations or other contacts that should be included in the process. The Mitigation Program added names to the email distribution list as the process continued. If an individual was invited to participate who had not been involved since the kick-off meeting, the Mitigation Program made individual contact to discuss the background and progress. An initial phone call was made. Follow-up was by email and the Kick-off Meeting PowerPoint presentation was provided. Numerous phone conversations were conducted to bring new participants up to speed with the Plan Update process and progress to date.

DHSEM made every effort to encourage participation in the Plan Up-date from the required sectors (emergency management; economic development; land use and development; housing; health and social services; infrastructure; and natural and cultural resources). Figure 3-14 shows the agency or organization that was included in the outreach activities and the sector that they represented.

Figure 3-14 SHMPT Agency and Sector Matrix

Agency/Organization	Emergency Management	Economic Development	Land Use and Development	Housing	Health and Social Services	Infrastructure	Natural and Cultural Resources

Agency/Organization	Emergency Management	Economic Development	Land Use and Development	Housing	Health and Social Services	Infrastructure	Natural and Cultural Resources
American Red Cross	X				X		
New Mexico Bureau of Geology and Mineral Resources							X
New Mexico Department of Agriculture			X				X
New Mexico Department of Game & Fish			X				X
New Mexico Department of Information Technology			X			X	
New Mexico Department of Transportation	X		X			X	
New Mexico Department of Cultural Affairs-Historic Preservation Division							X
New Mexico Department of Health	X				X	X	
New Mexico Department of Homeland Security & Emergency Management	X		X			X	X
New Mexico Department of Public Safety-State Police	X				X	X	
New Mexico Emergency Management Association	X						
New Mexico Energy, Minerals & Natural Resources Department-State Forestry	X		X				X
New Mexico Environment Department-Operations and Infrastructure Division	X		X			X	X
New Mexico General Services Department-Risk Management Division		X			X	X	
New Mexico Highlands University			X				X
New Mexico Human Services Department				X	X		
New Mexico Indian Affairs Department	X	X	X	X	X	X	X
New Mexico Institute of Mining and Technology							X
New Mexico Interstate Stream Commission	X					X	X
New Mexico Museum of Natural History							X
New Mexico National Guard	X					X	
New Mexico Office of the State Engineer	X		X			X	X
New Mexico Public Education Department			X		X	X	
New Mexico Public Regulation Commission	X				X	X	
New Mexico Regulation & Licensing Department				X		X	
The Nature Conservancy			X				X
U.S. Army Corp of Engineers	X	X	X			X	X
U.S. Forest Service	X		X			X	X
U.S. Natural Resources Conservation Service	X		X				X
U.S. National Weather Service	X					X	X

Agency/Organization	Emergency Management	Economic Development	Land Use and Development	Housing	Health and Social Services	Infrastructure	Natural and Cultural Resources
U.S. Federal Emergency Management Agency-Region VI	X		X	X	X	X	X
U.S. Geological Survey-New Mexico Water Science Center	X		X		X	X	X
U.S. Bureau of Reclamation	X					X	X
U.S. National Park Service	X		X			X	X
U.S. Department of Homeland Security-Office of Infrastructure Protection	X		X			X	X
University of New Mexico-Earth Data Analysis Center	X		X			X	X

SHMPT Members were expected to participate in the Planning Team Meetings. The Subject Matter Experts were to provide edits and feedback on specific hazards or topics and provide reference material/citations. Both the SHMPT Members and the Subject Matter Experts were expected to assist with integrating the State Natural Hazard Mitigation Plan Update into their agency's, jurisdiction's or organization's planning documents. Based on feedback from the participants, there was one email list created that included both SHMPT Members and Subject Matter Experts. This way any updates, progress reports, or requests for feedback would go to all involved.

The SHMPT meetings were held at the DHSEM offices in Santa Fe and by webinar. Some participants attended in person and some called-in to the webinar. DHSEM utilized the HISN portal to share information about the Plan Up-date with the SHMPT. An email was sent to the SHMPT one week prior each Planning Team Meeting. It included the agenda and other reference information that could be sent via email. The HISN link was also included with directions on how to access any additional reference information that would be used in the up-coming meeting. Reference information like the section of the plan that would be reviewed during the up-coming meeting was posted on the HISN web site. During the meeting, remote participants would view the PowerPoint presentation by linking to HISN. They could also access all relevant files by downloading from HISN. One week after each Planning Team Meeting, SHMPT members would receive an email with meeting notes and any follow-up forms or documents. If any documents were too large to email, they were up-loaded the HISN and directions were provided in the email.

Invitations to Local Jurisdictions and Tribes

In January 2015, as part of the FEMA-DR-4197 and FEMA-DR-4199 notification process, communities and tribes were invited to participate in the State Plan Update. All County Emergency Managers were sent the Notification Letter with a copy to the County Manager and Floodplain Manager (if applicable). Incorporated jurisdictions within counties with FEMA approved Mitigations Plan also received Notification Letters. All tribal Governors and Presidents were sent the letter with a copy to the Emergency Manager and Floodplain Manager (if applicable).

Additional invitations to participate were extended at numerous Workshops, Conferences and Task Force Meetings. Below is a list of those events:

- Drought Monitoring Working Group (February 2017, November 2017)
- Forest and Watershed Management Coordinating Group (July 2017)
- New Mexico Homeland Security and Emergency Management Conference (August 2016 and August 2017)
- New Mexico Floodplain Manager's Association Meetings (April 2017, September 2017 and April 2018)
- New Mexico Emergency Management Association Meetings (January 2017, April 2017)
- Partners in Preparedness Conference (March 2017)
- New Mexico Infrastructure Finance Conference (October 2014, September 2016)
- New Mexico Association of Counties Workshop (June 2017)
- Rockin Around New Mexico (July 2017, July 2018)
- Preparedness Area Quarterly Meetings
    - January 2018 – Preparedness Areas 1, 2, 3, 4, 5, & 6

SHMPT Meetings

SHMPT Members and Subject Matter Experts were invited to attend five meetings at the NM DHSEM Office in Santa Fe. All meetings were conducted in person with a webinar option so that participants could follow the presentation visually and hear the discussion. Dates, primary topics, and next steps are listed below.

- February 16, 2016: Primary topic was to introduce the regulatory requirements and the planning process. A description of the role of a SHMPT Member and of a Subject Matter Expert was discussed. All attendees were asked to provide feedback on the planning process, overall approach, and the draft Plan Update. Participant next steps were to provide up-dates on the Hazard Identification and Risk Assessment Section.
- May 9, 2017: Primary topic was the review of the Introduction and Capabilities sections. Participant next steps were to provide up-dates on those sections.
- August 24, 2017: Primary topic was to discuss the hazard prioritization process and review the Vulnerabilities Section. Participant next steps were to provide up-dates on the Vulnerabilities Section.
- November 15, 2017: Primary topic was to complete the hazard prioritization and review the Mitigation Strategies Section. Participant next steps were to return the completed hazard prioritization worksheet and to provide up-dates on the Mitigation Strategies Section. Descriptions of action description changes or implementation accomplishments were submitted by participants as part of the next steps.
- February 22, 2018: Primary topic was to rank the mitigation actions and review the Implementation Section of the Plan Update. Participant next steps were to provide up-dates for the Implementation Section.

Communication with the SHMPT continued throughout the remainder of the up-date process.

- April 6, 2018; Email sent to Team showing corrected mitigation actions ranking summary with request for feedback.
- June 1, 2018; Email sent to Team on the status of the FEMA review of the Plan Up-date. Also information on the 'Preparing for Large Wildfires in New Mexico Workshops' presentation was provided.
- July 6, 2018; Email sent to Team summarizing changes required by FEMA and requesting feedback on new goal added and sector matrix.

Process

The SHMPT Members and Subject Matter Experts addressed specific topics related to the 2018 State Natural Hazard Mitigation Plan Update. Between meetings, members provided information to the Mitigation Program for incorporation. During meetings, specific topics were discussed for consensus on the approach.

The Mitigation Program coordinated and implemented the planning process. Throughout the process, the Mitigation Program sent Plan sections, or parts of sections, to SHMPT Members and Subject Matter Experts. All participants were kept informed of the progress by email. Participants submitted revisions to the text. Revisions were integrated into the text. As a result, every section of the Plan Update has been revised and updated. The Mitigation Program subsequently incorporated changes and new information into the body of the Plan Update.

If there were conflicting comments, the Mitigation Program organized a sub-group of the key Subject Matter Experts to come to a consensus. For example, SHMPT Members and Subject Matter Experts that were involved with State-wide critical facility inventory or management met to discuss revisions to the definition of 'critical facilities' for the purpose of this Plan Update.

Two particularly important SHMPT and Subject Matter Expert activities were the ranking of hazards and the ranking of mitigation actions. The process followed for each of these activities is described in more detail in the respective sections of the Plan Update.

The general planning process followed is summarized below;

- <u>State profile</u>: Relevant data from the 2010 Census was integrated into the introduction of the Plan Update. This information was used for analysis of impacts in the vulnerability section of the Plan Update and is the best available data related to population statistics.
- <u>Hazard Identification and Risk Assessment:</u>
  - The SHMPT and Subject Matter Experts identified natural hazards that potentially threaten all or portions of New Mexico. There is a total of 14 hazards profiled in the Plan Update.
  - Where possible, specific geographic areas subject to the impacts of the identified hazards were mapped. Subject Matter Experts provided hazard specific maps and data whenever possible.
  - A description of the previous occurrence was edited based on updated mapping and data.
  - The probability of each hazard occurring in each Preparedness Area was evaluated and calculated.

    - The impact of each hazard on public health, safety, property, the economy, and the environment was also evaluated and documented.
    - The HMPT agreed that the reference data and charts should be removed from the body of the document and moved into an Appendix specific to the HIRA. The hope was that by removing the long listings, reading the document would be less cumbersome.
- Capabilities and Resources:
    - The 2013 Capabilities and Resources Section of the Plan Update was reviewed and updated. Existing codes, plans, policies, programs, and regulations were described for the update of this section of the Plan Update.
    - The HMPT agreed that the reference data and charts should be removed from the body of the document and moved into an Appendix specific to the Capabilities Section. The hope was that by removing the long listings, reading the document would be less cumbersome.
    - The list of reference documents was also updated.
- Vulnerabilities
    - Critical Facilities: The Subject Matter Experts agreed upon a definition for critical facilities for this specific Plan Update. They agreed to keep the definition the same as that used for the 2013 Plan. The SHMPT and Subject Matter Experts then reviewed the 2013 list of Critical Facilities and made up-dates.
    - The SHMPT agreed that the reference data should be removed from the body of the document and moved into an Appendix specific to the Vulnerability Section. The hope was that by removing the long listings, reading the document would be less cumbersome.
    - FEMA's Hazus software was utilized for the modeling (more detail can be found in the earthquake and flood risk assessment sections of the Plan Update). The Mitigation Program developed summaries and analysis of the Hazus results including:
        - Critical facilities listed in this Plan Update;
        - FEMA mapped floodplains;
        - Fire Management Assistance Grant burn perimeters;
        - Peak Ground Acceleration for the maximum probable magnitude earthquake; and
        - Compilation maps including all of the above analysis.
    - Vulnerability by Preparedness Area: Overlays of the available hazard maps allowed for an analysis of the location of critical facilities at risk in each Preparedness Area. The vulnerability identified in local and tribal mitigation plans was also incorporated into the discussion for each Preparedness Area.
- Mitigation Strategy: The Mitigation Strategy from 2013 was reviewed and edited. The concepts of the over-arching goals did not change. Based on the natural hazard vulnerabilities and the capability to manage the impacts, a series of mitigation actions were identified. The SHMPT and Subject Matter Experts revised mitigation actions based on the type of damage caused by past events plus the vulnerability and capability identified in Sections of the Plan Update. There were no actions deleted and none added. The HMPT added narrative to describe changes in action description and progress in action implementation.

- Monitor, Evaluate and Update: The final section of the Plan Update reviews the monitoring, evaluation and updating process that will be followed between Plan Update approval and the next Plan update. This section was drafted by the Mitigation Program and reviewed by the SHMPT and Subject Matter Experts for feedback.
- Review, Adoption, Approval: The final draft of the Plan Update was made available by Plan Section in Word format for SHMPT Members and Subject Matter Experts. Comments were integrated into the final draft. The SHMPT agreed by consensus that the final approved Plan Update should be made available on the NM DHSEM website for public reference. After all final draft comments were incorporated, the document was submitted to FEMA for approval. The Approval Pending Adoption Letter was received. The Governor's Authorized Representative (GAR) then signed the Plan Update and FEMA accepted the adopted Plan Update.

Contractor Assistance

NM DHSEM secured assistance from a contractor to complete the 2018 State Natural Hazard Mitigation Plan Update using Hazard Mitigation Grant Program funds. Wood Environment & Infrastructure Solutions, Inc. (previously Amec Foster Wheeler Environment & Infrastructure, Inc.) and H2O Parterns, Inc. provided technical assistance to NM DHSEM through Hazard Mitigation Grant Program funding. Services included the following:

- Analysis and integration of the Hazus data;
- Analysis and integration of local and tribal mitigation plans;
- Formatting and graphic layout;
- Integration of comments by the SHMPT and Subject Matter Experts; and
- Response to FEMA reviews and comments on the final draft.

4 HAZARD IDENTIFICATION/RISK ASSESSMENT (HIRA)

This section summarizes the results of the first fundamental task in the planning process wherein hazards that may affect the State of New Mexico (and Preparedness Areas) are identified, profiled, and their potential effect quantified. It describes previous occurrences, physical characteristics, the likelihood of future occurrences, and the potential severity of an occurrence using the following process:

Hazard identification–*Hazard identification* was compiled by investigating the various natural hazard occurrences within the State, as well as adjoining states, over the past several decades. The hazard identification also included hazard information from local mitigation plans. Because it is assumed that hazards that occurred in the State in the past may be experienced in the future, the hazard identification process includes a history and an examination of various hazards and their occurrences. Information of past hazards was obtained from historical documents and newspapers, State and County plans and reports, interviews with State agencies and local experts, and internet websites.

Hazard Profiles– *Hazard profiles* determine the frequency or probability of future events, their severity, and factors that may exacerbate their severity. The State Hazard Mitigation Planning Team (SHMPT) and hazard mitigation planners used national maps available online from sources such as the U.S. Geological Survey (USGS), ESRI (a GIS software development firm), and the University of New Mexico to further investigate the possible implications of a range of hazards. The data sets used to generate the assessment were sometimes out of date or lacked sufficient data. In those cases, hazard probabilities and severities identified in this document are discussed in broad terms, reflecting the lack of available detailed information. These data limitations are discussed in the appropriate sections.

Vulnerability Assessment – The results of the hazard identification indicate that some of the hazards warrant a vulnerability assessment due to their frequency of occurrence or the fact that those hazards have caused major damage in the State. A vulnerability assessment was performed to determine the impact of frequently occurring hazards on the built environment and how they can affect the safety of the residents of New Mexico. The vulnerability assessment used the information generated in the hazard identification and hazard profile to identify locations where the State could suffer the greatest injury or property damage in the event of a disaster. This assessment identified the effects of hazard events by estimating the relative exposure of people, buildings, and infrastructure to hazardous conditions. For this Plan Update, the vulnerability assessment is in its own section, Vulnerabilities.

Risk Assessment – *Risk Assessments* in hazard events requires a full range of information and accurate data. Several site-specific characteristics—first-floor elevations for flooding, the number of stories, construction type, foundation type, and the age and condition of the structure for multiple hazards—determine a structure's ability to withstand hazards. In the State of New Mexico, much of this type of detailed information is not yet available. Projected loss estimates used in this document are based on 2010 U.S. Census data and Hazus analysis. The percentage of potential damage to structures varies depending upon the specific hazard. For example, drought will have no impact on residential structures, while wildfires typically destroy the entire structure. The risk assessment was not updated based on changes in development or land use. It was determined that there were no changes in development or land use that caused increased risk from hazards on a Preparedness Area level since the 2013 Plan.

Individual local or tribal plans include mower detailed information on changes in development for individual communities.

This Hazard Identification and Risk Assessment (HIRA) is an update to the 2013 New Mexico State Hazard Mitigation Plan (2013 Plan) and the foundation upon which the state mitigation strategies and actions are based.

4.1 Hazard Identification

The geographic area of the State of New Mexico is exposed to a number of natural hazards that have sufficient likelihoods of occurrence to warrant discussion. Information about potential hazards was obtained in a number of ways, including: reviewing past State and Federal Declarations of disasters; conducting searches of State and Federal resources, such as the NOAA's National Centers for Environmental Information (NCEI/NCDC), and US Army Corps of Engineers (USACE); reviewing historic records; and reviewing archived newspaper articles.

The State Hazard Mitigation Plan Update (Plan Update) will address the following 14 hazards:

- Dam Failure
- Drought
- Earthquake
- Extreme Heat
- Expansive Soils
- Flood/Flash Floods
- High Wind
- Landslide
- Land Subsidence
- Severe Winter Storms
- Thunderstorms (including Lightning and Hail)
- Tornadoes
- Volcanoes
- Wildland/Wildland-Urban Interface Fire

4.2 FEMA Disaster Declarations

Disaster Declarations, for the State affected by a disaster, are declared by the President of the United States under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. FEMA then manages the entire process, including making Federally-funded assistance available in declared areas; coordinating emergency rescue and response efforts; providing emergency resources; and providing other related activities/funding in the process of aiding citizens and local governments in a nationally-declared disaster.

The State of New Mexico is exposed to multiple hazards and has experienced thousands of hazard events, resulting in millions of dollars in losses and casualties, and numerous major Federal disaster and emergency Declarations. Figure 4-1 identifies the major Federal Disaster Declarations in the State since the 1950's.

Figure 4-1 State of New Mexico Major Disaster Declarations: 1954 - 2017[5]

Year	Date	Disaster Type	Disaster Number
2017	12/20/2017	Severe Storms, Flooding	4352

[5] Source: FEMA online: https://www.fema.gov/disasters/grid/State-tribal-government/62?field_disaster_type_term_tid_1=All

Year	Date	Disaster Type	Disaster Number
2014	10/29/2014	Severe Storms, Flooding	4199
2014	10/06/2014	Severe Storms, Flooding	4197
2014	10/29/2014	Severe Storms, Flooding	4199
2014	10/6/2014	Severe Storms, Flooding	4197
2013	10/29/2013	Severe Storms, Flooding, Mudslides	4152
2013	10/24/2013	Severe Storms, Flooding	4151
2013	09/30/2013	Severe Storms, Flooding	4148
2013	09/27/2013	Severe Storms, Flooding	4147
2012	08/24/2012	Flooding	4079
2011	11/23/2011	Flooding	4047
2011	03/24/2011	Severe Winter Storms and Extreme Cold Temperatures	1962
2010	09/13/2010	Severe Storms, Flooding	1936
2008	08/14/2008	Severe Storms, Flooding	1783
2007	04/02/2007	Severe Storms, Tornadoes	1690
2006	08/30/2006	Severe Storms, Flooding	1659
2004	04/29/2004	Severe Storms, Flooding	1514
2000	05/13/2000	New Mexico Wildfire	1329
1999	09/29/1999	Severe Storms, Flooding	1301
1998	01/29/1998	Severe Winter Storms	1202
1993	06/07/1993	Flooding, Severe Storm	992
1992	06/18/1992	Flooding, Hail, Thunderstorms	945
1985	01/18/1985	Severe Storms, Flooding	731
1984	09/06/1984	Severe Storms, Flooding	722
1983	10/24/1983	Severe Storms, Flooding	692
1979	06/23/1979	Severe Storms, Snowmelt, Flooding	589
1979	01/29/1979	Flooding	571
1973	05/11/1973	Severe Storms, Snow Melt, Flooding	380
1972	11/20/1972	Heavy Rains, Flooding	361
1972	09/20/1972	Heavy Rains, Flooding	353
1972	08/01/1972	Severe Storms, Flooding	346

Year	Date	Disaster Type	Disaster Number
1965	07/01/1965	Severe Storms, Flooding	202
1955	08/15/1955	Flooding	38
1954	10/13/1954	Flooding	27

Figure 4-2 identifies the major emergency Declarations in the State since 1950.

Figure 4-2 State of New Mexico Emergency Declarations: 1954 - 2017[6]

Year	Date	Disaster Type	Disaster Number
2005	09/07/2005	Hurricane Katrina Evacuation	3229
2000	05/10/2000	New Mexico Fire	3154
1998	07/02/1998	Extreme Fire Hazard	3128
1997	03/02/1977	Drought	3034

Based on the information in Figure 4-1 and Figure 4-2, floods, severe storms, wildfire hazards, and mudslides played a role in the majority of disasters in the State. There have been five Federal Disaster Declarations in the State of New Mexico since development of the 2013 State Hazard Mitigation Plan. Four were the result of severe storms and flooding, and one was the result of severe storms, flooding, and mudslides.

Figure 4-3 catalogues the Fire Management Assistance Declarations in the State since 1950.

Figure 4-3 State of New Mexico Fire Management Assistance Declarations: 1954 - 2018[7]

Year	Date	Fire Incident Name	Disaster Number
2018	6/8/2018	Soldier Canyon Fire	5240
2018	6/1/2018	Ute Park Fire	5239
2017	06/15/2017	El Cajete Fire	5184
2016	07/14/2016	Timberon Fire	5134
2016	06/16/2016	Dog Head Fire	5127
2013	06/05/2013	Tres Lagunas Fire	5026
2012	06/20/2012	Romero Fire	2982

[6] Source: FEMA online: https://www.fema.gov/disasters?field_State_tid_selective=62&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=EM&items_per_page=20

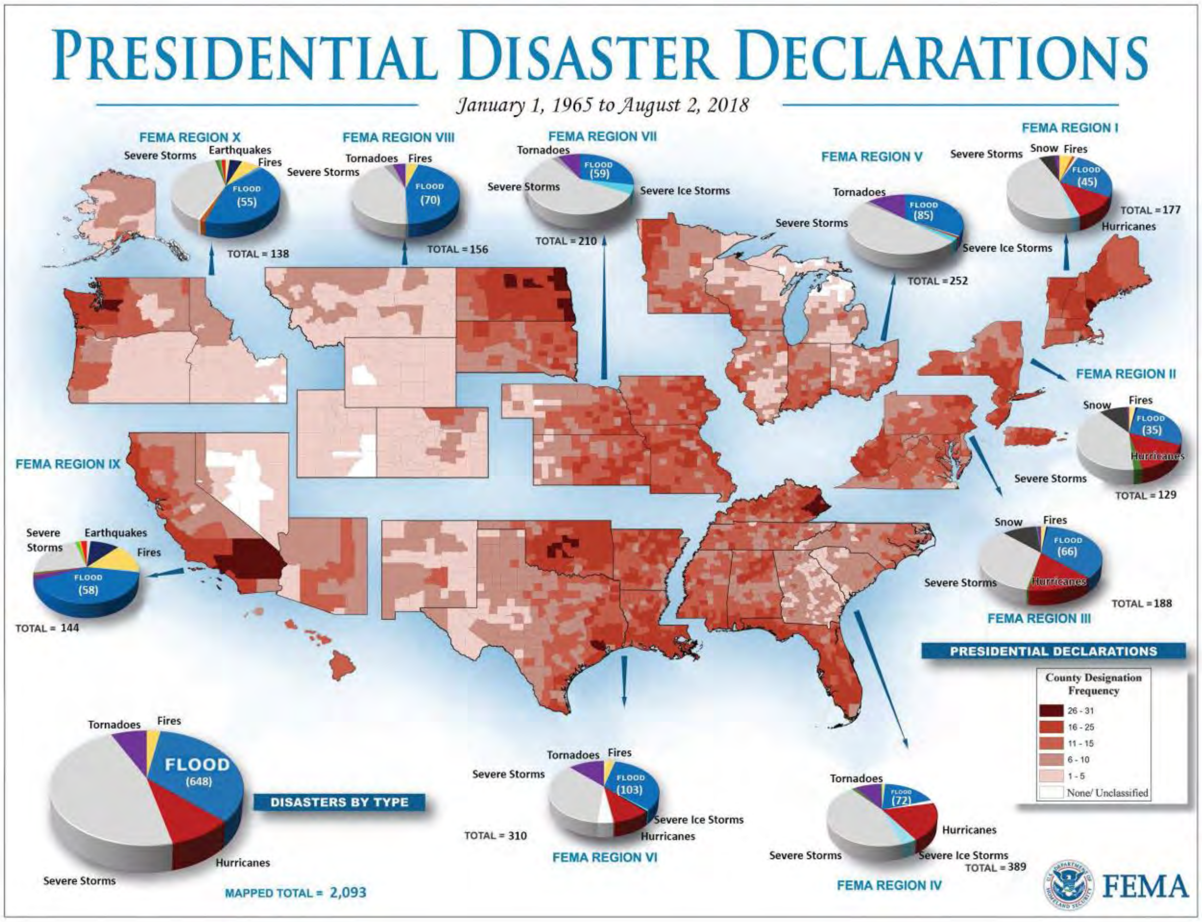
[7] Source: FEMA online: https://www.fema.gov/disasters?field_State_tid_selective=62&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=FM&items_per_page=20

Year	Date	Fire Incident Name	Disaster Number
2012	06/18/2012	Blanco Fire	2981
2012	06/09/2012	Little Bear Fire	2979
2012	05/26/2012	Whitewater-Baldy Fire	2978
2011	06/30/2011	Donaldson Fire	2935
2011	05/29/2011	Little Lewis Fire	2934
2011	06/29/2011	Little Lewis Fire	2933
2011	06/26/2011	Las Conchas Fire	2933
2011	06/12/2011	Track Fire	2918
2011	06/10/2011	Wallow Fire	2917
2011	04/17/2011	Tire Fire	2897
2011	04/03/2011	White Fire	2880
2011	03/08/2011	Quail Ridge Fire	2866
2010	06/02/2010	Rio Fire	2843
2010	05/24/2010	Cabazon Fire	2842
2009	05/07/2009	Buckwood Fire	2818
2008	06/25/2008	Big Springs Fire	2777
2008	04/21/2008	Trigo Fire	2762
2007	11/21/2007	Ojo Peak Fire	2741
2007	02/24/2007	Belen Fire	2682
2006	06/21/2006	Rivera Mesa Fire	2647
2006	06/16/2006	Malpais Fire	2644
2006	04/12/2006	Ojo Feliz Fire	2636
2006	03/01/2006	Casa Fire	2631
2006	01/02/2006	Southeast New Mexico Fire	2600
2004	06/18/2004	Bernardo Fire	2522
2004	05/25/2004	Peppin Fire	2518
2003	06/25/2003	Atrisco Fire (Formerly Bosque Fire)	2472
2003	05/10/2003	Walker Fire	2467
2002	08/26/2002	Lakes Fire Complex	2459
2002	06/13/2002	Roybal Fire Complex	2424
2002	06/06/2002	Ponil Fire	2416

Year	Date	Fire Incident Name	Disaster Number
2002	06/04/2002	Cerro Pelado Fire	2415
2002	06/04/2002	Turkey Fire	2414
2002	05/23/2002	Borrego Fire	2408
2002	05/07/2002	Dalton Fire	2404
2002	05/01/2002	Penasco Fire	2402
2002	03/23/2002	Kokopelli Fire Complex	2398
2001	06/03/2001	Trap and Skeet Fire	2364
2000	05/15/2000	La Cueva Fire	2310
2000	05/14/2000	Scott-Able Fire	2297
2000	05/08/2000	Cree Fire	2296
2000	04/20/2000	Rio Grande Fire Complex	2295
1998	05/26/1998	Osha Canyon Complex	2213
1996	05/05/1996	Hondo Fire	2177
1977	05/18/1977	Barker Fire	2025
1974	05/21/1974	Guadalupita Fire	2015

New Mexico's Disaster Declaration profile differs slightly from the FEMA Region in which the State is located. In FEMA Region VI, the top four hazards in terms of the source of Disaster Declarations are severe storms, flood, hurricanes, and tornados (see Figure 4-4). Although it is located in Region VI, the State of New Mexico is rarely affected by hurricanes or tornados. Flooding and severe storms do, however, account for the majority of Disaster Declarations in the State. Additionally, compared to the other States in Region VI, far fewer Presidential Disaster Declarations have been made in New Mexico since 1964.

Figure 4-4 National Map of Presidential Disaster Declarations – 1964 to 2018[8]



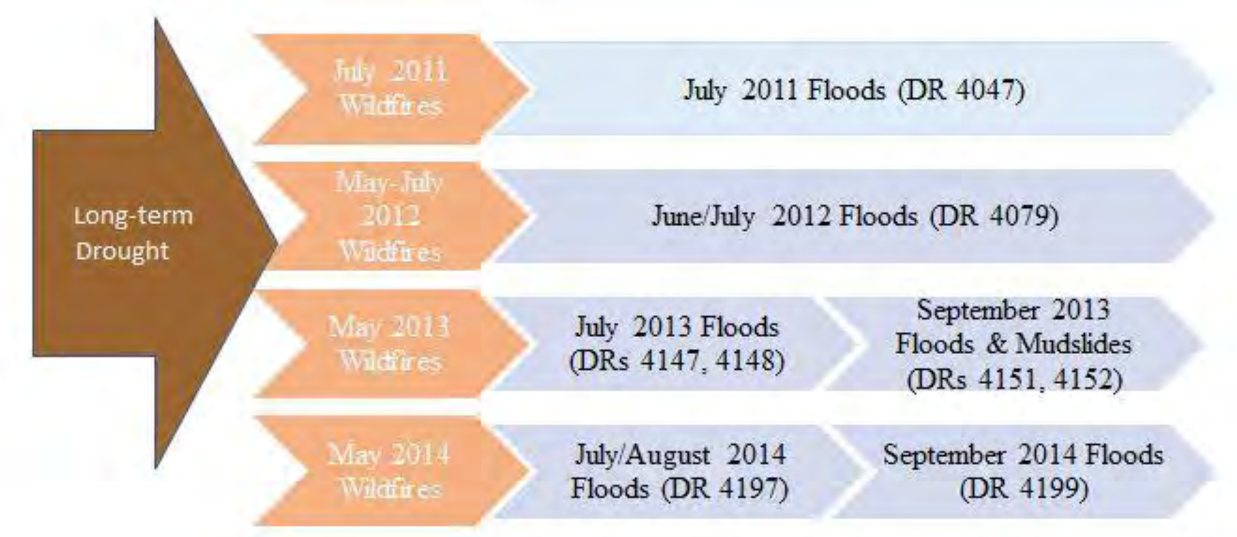
4.3 Drought – Wildfire – Flood Cycle[9]

New Mexico's Disaster Declarations are unique. In particular, New Mexico's hazard identification/risk assessment integrates several hazards referred to in this report as the "drought-wildfire-flood cycle". The drought-wildfire-flood cycle includes dam failure, drought, flood/flash floods, landslide and wildland/wildland-urban interface fire. This unique combination of hazards is connected to ecosystem health and land management practices, particularly to historic wildfire suppression. New Mexico has experienced nine flood, severe storm and debris flow federal disaster declarations since 2010. There have also been 21 FMAG declarations since 2010. A description of the drought-wildfire-flood cycle is shown below in Figure 4-5 with reference to federal disaster declarations since 2010.

[8] Source: FEMA Region VI Diaster_1965-2018.pdf

[9] Information for this section is from the 2004 New Mexico Forest and Watershed Health Plan and the NM National Disaster Resilience Competition application from DHSEM as referenced in Appendix G.

Figure 4-5 Drought, Wildfire, Flood Cycle



The drought-wildfire-flood cycle is in part caused by long-term drought which is discussed in length in the Hazard Identification and Risk Assessment Drought section (4.5.2). As it relates to this multi-hazard cycle, drought can be a contributor to an unhealthy ecosystem. Unhealthy ecosystem traits may include: 1) high density vegetation, 2) biodiversity degradation and 3) habitat fragmentation and deterioration. These traits are also caused by settlement patterns, human disruption and intervention of natural fire and flood cycles, unsustainable use of natural resources and natural climatic variations. The result is New Mexico's susceptibility to catastrophic wildfire, compromised watersheds, decreased water supply, accelerated erosion and desertification hazards.

New Mexico's ecosystems have departed from their original, or reference conditions. This departure is due to past land management activities and fire suppression which have decreased the forests, grasslands and riparian areas natural resilience to wildfire, drought and water stress. Historically, New Mexico's arid ponderosa pine and dry mixed conifer forests were dominated by large fire-resistant tree species which were naturally maintained by frequent low-intensity fires. Regular, low-intensity wildfire cleared the forest understory, leaving stands less dense than they are today. Current forest resilience has been depleted by the decline of mature canopy structures, open meadows, understory shrubs and ground cover resulting in young, dense, homogeneous closed-canopy stands that are extremely susceptible to catastrophic wildfire.

Catastrophic wildfire occurs when vegetation is consumed at a high-intensity leaving the forest floor susceptible to erosion and is referred to as the burn scar area. The burn scar area is where topsoil, duff, woody materials and ash from the catastrophic wildfire event can intensify post-fire flooding. Large-scale erosion from burn scars can lead to the degradation of water resources for an entire region due to sediment transport. This type of sedimentation is due in part to soil damage during catastrophic wildfire. Organic components of the soil are lost and burnt which creates a soil condition called "hydrophobic." Hydrophobic soils lack the ability to infiltrate water which in turn can increase the potential for post-wildfire flooding events by a four-hundred fold increase. Monsoon rainstorms can amplify the poor soil condition with high volumes of precipitation which is then transported during flood events settling in arroyos, ditches and flood control infrastructure.

Vegetation loss from wildfire can also increase flooding potential and water stress. When New Mexico's coniferous dominated forest communities burn, their natural ability to absorb and deflect the precipitation load is lost. The combination of vegetation loss, hydrophobic soils and monsoon rainstorms can lead to highly destructive flooding events called "debris flows." Debris flows are a long-term risk to watersheds that have experienced wildfire. Loss of life, damage to property and significant infrastructure impacts are commonplace when debris flow flooding events occur. More than 30% of the State's water supply is affected adversely by debris flow-laden runoff throughout the Upper Rio Grande watershed. Debris flows move high amounts of sediment leading to sedimentation issues, including temporary dams or sediment plugs along existing waterways which can have further flooding impacts to downstream ecosystems and communities when the dams or plugs fill and break, resulting in a flood wave. The waterway is also damaged limiting its functionality as a both a natural water storage and/or water delivery conveyance for communities, thus increasing water stress.

Healthy forest ecosystems are less susceptible to the drought-wildfire-flood cycle. They function properly to capture winter precipitation in the form of snow and in turn, release it in the spring either to natural waterways or into regional aquifers, alleviating drought-related water stress. This basic watershed regulation function provided by healthy forests is compromised when catastrophic wildfire occurs, creating large scale impacts on the landscape. Freshly burned landscapes are at risk to burn scars, debris flow and flooding. Damages due to floods originating in areas burned during wildfire lead to cascading impacts to ecosystems, infrastructure, and water quality downstream. Flooding is exacerbated by post-fire conditions such as loss of protective vegetative cover, large volumes of ash and burn debris, and hydrophobic soils.

The following is an excerpt from the Ute Park Fire Damage Assessment and Burned Area Emergency Rehabilitation Plan. "The potential for soil to erode is based on slope gradient, hillslope length, sediment texture, burn severity, and vegetation. Based on modeling scenarios: for pre-fire conditions, and a 30% exceedance design storm, there is a 30% chance that the modeled hillslope will deliver 0.01 ton/acre. In the same scenario at post-fire and high-burn severity, the same hillslope will have a 30% chance of delivering 3.41 tons/acre of sediment during the first year following the fire, which is a 34,000% increase in sediment to the system. However, as vegetation becomes established the model shows sediment delivery recovers to pre-fire conditions after 3 years. In scenarios with high burn severity, slopes equal to or greater than 1000 linear feet in length, with gravelly and sandy loam soils, do not show recovery to pre-fire conditions for 5 years."

The complexity of this hazard cycle has led to New Mexico's determination that a targeted, 10 -year approach is necessary to correct it. The New Mexico Forest and Watershed Health Plan was developed to facilitate, streamline and strengthen current forest restoration work. The Plan includs an integrated and collaborative approach to ecosystem restoration which includes a three-part vision:

- diverse ecosystems are characterized by integrity and resiliency;
- diverse human communities are sustained by ecologically healthy landscapes that provide resources and amenities; and
- economies thrive by using the inherent productivity of healthy ecosystems.

The connections described above between ecosystem health and land management practices have identified the exact forest type where ecological restoration treatments are needed to protect communities, infrastructure and water quality. Efforts across multiple federal and state agencies, local communities and research institutions are already underway in New Mexico. Millions of dollars are spent each year in ecological restoration efforts however these efforts are only able to address a very small percentage of the overall work that needs to be done.

4.4 Local Plan Integration

The 2018 State Hazard Mitigation Plan Update builds and expands upon the 2013 State Hazard Mitigation Plan's risk, vulnerability, and capability assessment and mitigation strategy. In addition to gleaning information from the previous State Hazard Mitigation Plan, Disaster Declaration data and subject matter experts, information about New Mexico's hazard risks was obtained by consulting local hazard mitigation plans.

The State Hazard Mitigation Plan update process is closely integrated with other mitigation programs and initiatives, including local jurisdiction and Tribal planning efforts. The 2018 update includes an analysis and roll-up of risk assessment information (damage/loss information, hazard prioritization) from local hazard mitigation plans. Based on the results of the roll-up, the relevant portions from local plans are incorporated in to the write up for each hazard and the vulnerability assessment. The planning process began in January 2017 and the SHMPT fully assessed each hazard.

It is the role of the State to provide assistance to local governments for plan development and, ultimately, to use local plans to improve the State-wide plan. The success of the New Mexico mitigation program depends on the degree to which stakeholders work together toward the common goal of reducing future disasters. This is accomplished, in part, by involving as many stakeholder groups as possible in the planning process and integrating mitigation efforts both large and small. Therefore, mitigation staff coordinated with jurisdictions as needed throughout the process of updating the 2018 Plan. Additionally, the State will continue to coordinate and link local plans into the State Mitigation Plan by continuing the process of rolling up information from local plans (Roll Up). As was the process for the 2013 Plan, the 2018 Roll Up includes a review of all local hazard mitigation plans. The State reviews risk assessments from all available local plans to summarize how local governments rank hazards in their jurisdictions relative to all of the hazard risks they face.

Similar to the 2013 Plan update process, the 2018 Plan Update incorporates potential losses reported in local plans into the vulnerability assessment portions of the plan. In addition to including hazard risk data from local plans into Preparedness Area vulnerability assessments, the 2018 Plan Update includes a review of local plan capability assessments in order to develop a comprehensive picture of Preparedness Area capabilities. Local mitigation strategies were also assessed and is presented later on in this document at the Preparedness Area level.

Summary information related to hazard ranking, mitigation priorities, potential losses and social vulnerability were compiled into a spreadsheet to facilitate detailed review and comparison between jurisdictions and Preparedness Areas. The information from the local plan Roll Up has been used to reassess State hazard vulnerability, risk-reduction priorities and the progress towards Statewide mitigation efforts. Specifically, the State is interested in:

- Identifying mitigation strategies that prove successful at the local level
- Researching development of mitigation initiatives that address local concerns
- Reviewing State initiatives to determine if they are meeting the overall mitigation needs of local jurisdictions

The State enlisted a qualified contractor to assist with the local plan Roll Up process during the 2018 State Mitigation Plan Update effort. These efforts included the creation and population of a Roll Up database where the local plan content was captured and analyzed. All local plans and Tribal plans approved since December 2012 were reviewed for relevant information. The results were summarized by Preparedness Area with tables, narrative and graphics incorporated into the State plan Up-date. Examples of locations for this type of summary are;

- Hazard Identification – Pervious occurrence data reported in local or tribal plans that elevated to the level of State-wide importance was included in the previous occurrence data tables. State-wide importance means significant property damage or injury.
- Vulnerability Section - prioritized hazards are analyzed by Preparedness Area for all local and tribal plans
- Strategy Section – mitigation strategy type is analyzed by Preparedness Area for all local and tribal plans

4.5 Hazard Profiles

Hazard profiles describe different hazard characteristics. In some cases, hazards affect specific geographic areas, i.e. floods and landslides. When this is the case, the hazard profile includes a map identifying areas of the State where the hazard could occur. For hazards that could occur anywhere, such as tornadoes and winter storms, the hazard profile identifies which portions of the State may be more vulnerable to the hazard.

The remainder of this section presents hazard profiles for 14 hazards. It includes a description of each hazard and historical reviews of hazard occurrences in the State of New Mexico. The order in which the hazards are presented does not reflect the relative levels of risk they pose to the State.

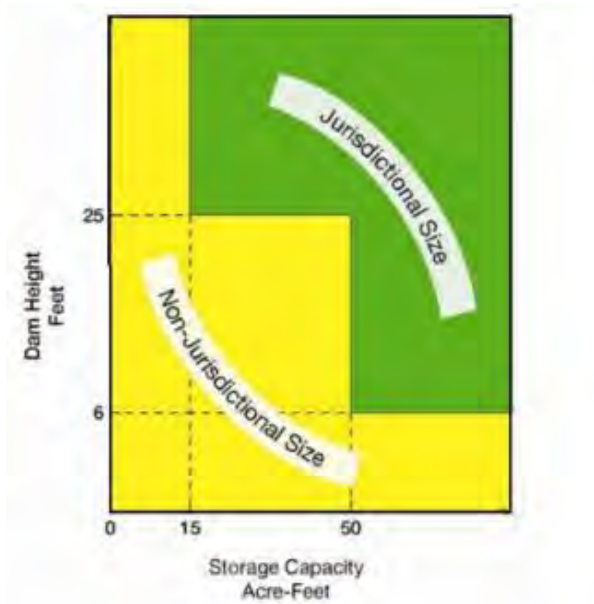
4.5.1 Dam Failure

4.5.1.1 Hazard Characteristics

Any malfunction or abnormality outside the design assumptions and parameters that adversely affects a dam’s primary function is considered a dam failure. A catastrophic dam failure is characterized by a sudden, rapid, and uncontrolled release of impounded water. The sudden release of water may result in downstream flooding affecting life, property, and agriculture. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or acts of terrorism can cause dam failures. The sudden release of the impounded water can occur during a flood that overtops or damages a dam, or it can occur on a clear day if the dam has not been properly constructed or maintained. Dam failures can occur anywhere there is a dam, but the threat from dam failures can increase as existing dams age. In New Mexico, floodplain maps do not include a dam breach inundation map, where applicable, because the probability of occurrence is not the same. Therefore, downstream residents can be unaware of the potential dangers.

The Office of the State Engineer (OSE) Dam Safety Bureau regulates the design, construction, reconstruction, modification, removal, abandonment, inspection, operation, and maintenance of dams 25 feet or greater in height with more than 15 acre-feet of storage or dams that store 50 acre-feet or more with at least six feet in height. Dams that fall below these height and storage criteria are considered non-jurisdictional dams. While the Office of the State Engineer does not regulate non-jurisdictional dams, the Office of the State Engineer can exercise authority over a non-jurisdictional dam if it is considered unsafe and a threat to life or property. The jurisdictional size chart is shown in Figure 4-6. Federal dam owners are required to obtain a permit for a new dam. However, the Office of the State Engineer by law does not ensure the continued safety of Federal dams.

Figure 4-6 Jurisdictional Dam Size



Standard practice among Federal and State dam safety offices is to classify a dam according to the potential impact a dam failure (breach) or mis-operation (unscheduled release) would have on downstream areas. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental and lifeline facilities. The Dam Hazard Potential Classification definitions are shown in Figure 4-7 and are based on the probable loss of human life and the impacts of economic, environmental, and lifeline facilities. These classifications were provided by the OSE and may be used as a tool to exercise authority over non-jurisdictional dams to determine safety and potential threat to life.

Figure 4-7 Dam Hazard Potential Classification

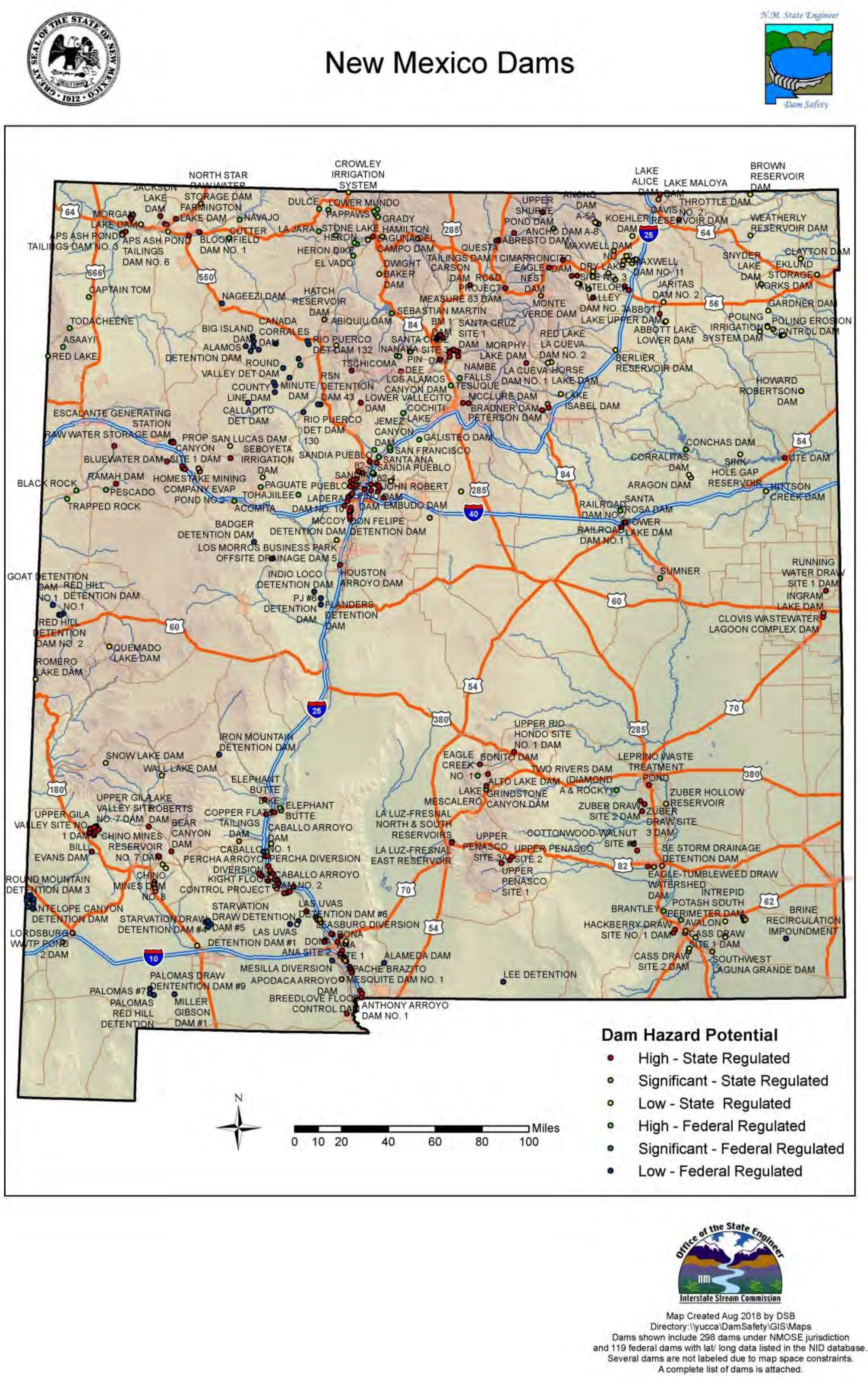
Category	Loss of Life	State Ranking
Low	None Expected	Low economic or environmental losses. Losses Principally Limited to Dam Owner's property
Significant	None Expected	Economic Loss, Environmental Damage and disruption of lifeline facilities. Predominantly located in rural areas
High	Expected	Based only on Loss of Life

According to the 2016 National Inventory of Dams, there are 492 dams in the State; 256 are classified as high hazard potential, 72 are classified as significant hazard potential, and 163 are classified as low hazard potential. The remaining one dam has been listed as undetermined. Ownership of the dams is distributed as follows: 212 are owned by local government, 131 are privately owned, 21 are owned by public utilities, 15 are owned by the State, and 113 are federally-owned.[10] According to the Association of State Dam Officials from the updated statistics in 2015, of the 491 dams in the state, 298 come under the jurisdiction of the Office of the State Engineer Dam Safety Bureau.[11]

Figure 4-8 shows New Mexico Dam Hazard Potential. The map identifies State and federally regulated low, significant and high hazard dams. A detailed listing of both State and federally regulated dams can be found in Appendix Hand is For Official Use Only. To access Appendix H for official use only, please contact the Dam Safety Bureau of the New Mexico Office of the State Engineer at 505-827-6122 or nm.damsafety@state.nm.us. Other contacts available at http://www.ose.state.nm.us/DS/dsIndex.php

[10] Source: http://nid.usace.army.mil/cm_apex/f?p=838:3:0::NO
[11] Source: Association of State Dam Officials, http://damsafety.hostguardian.com/community/states/?p=2827bd14-b6e3-49a9-a465-b2a3531afe5c

Figure 4-8 New Mexico Dams: Dam Hazard Potential



In 2005, the Office of the State Engineer adopted new regulations for dams. The regulations were updated in 2010 to address changes in State law and to improve areas of the regulations. The regulations address the requirements for design and construction of new dams, modifications or alterations to existing dams and the continued safe operation and maintenance of existing dams. A new requirement for owners of dams classified as high or significant hazard potential is the preparation, maintenance and exercise of an Emergency Action Plan (EAP) and Operation and Maintenance Manual. The EAP identifies defensive action to prevent or minimize property damage, injury or loss of life due to an emergency at the dam.

According to the 2016 National Inventory of Dams and the Office of the State Engineer inventory, there are 99 high hazard dams with an Emergency Action Plan. This continues to be a significant improvement from past years. Many of the EAPs are for high hazard potential dams where failure or mis-operation is expected to place lives at risk. The OSE requires EAPs for dams that are classified as high and significant hazard potential. Figure 4-9 displays the dams by hazard potential as classified in Figure 4-7, and Figure 4-10 and Figure 4-11 illustrate the number of high and significant hazard dams that have an EAP. Details of the characteristics of dams in the state are included on the following pages which illustrate dams by height (Figure 4-12), owner type (Figure 4-13), type of dam (Figure 4-14), and primary purpose (Figure 4-15).

Figure 4-9 Dams by Hazard Potential

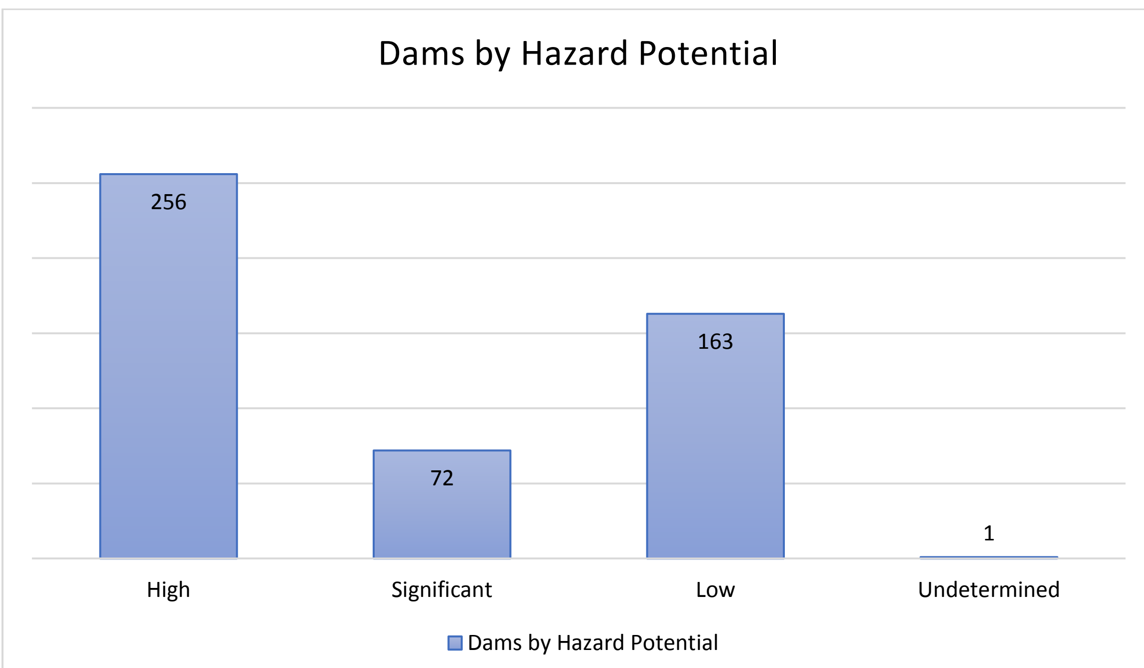


Figure 4-10 Number of High Hazard Potential Dams with an Emergency Action Plan (EAP)

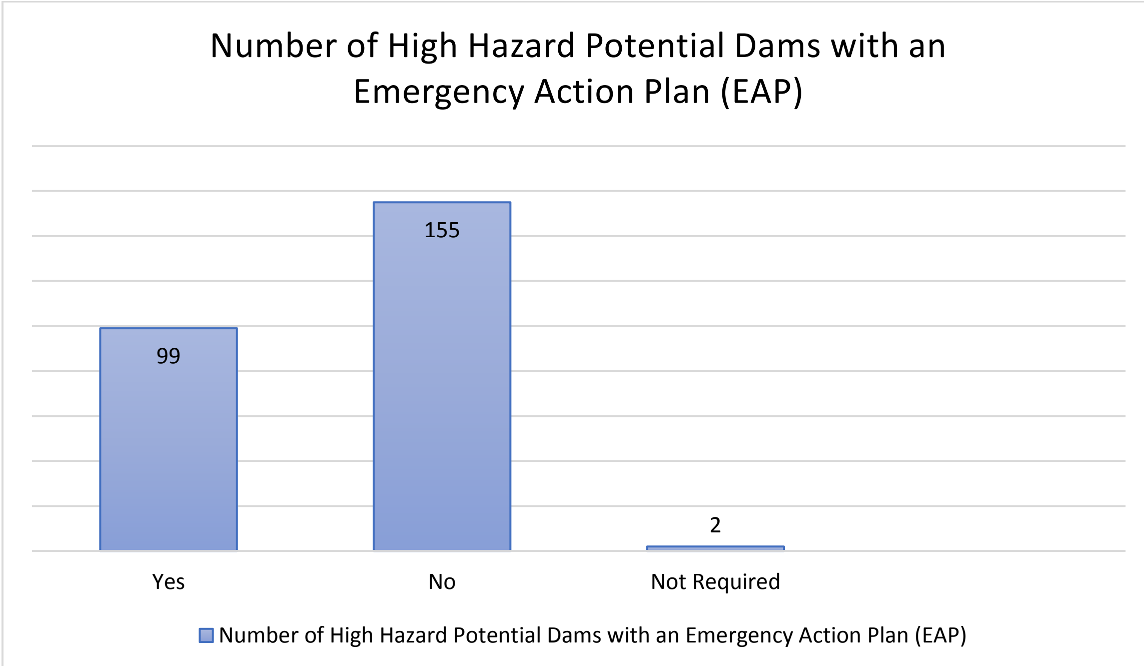


Figure 4-11 Number of Significant Hazard Potential Dams with an Emergency Action Plan (EAP)

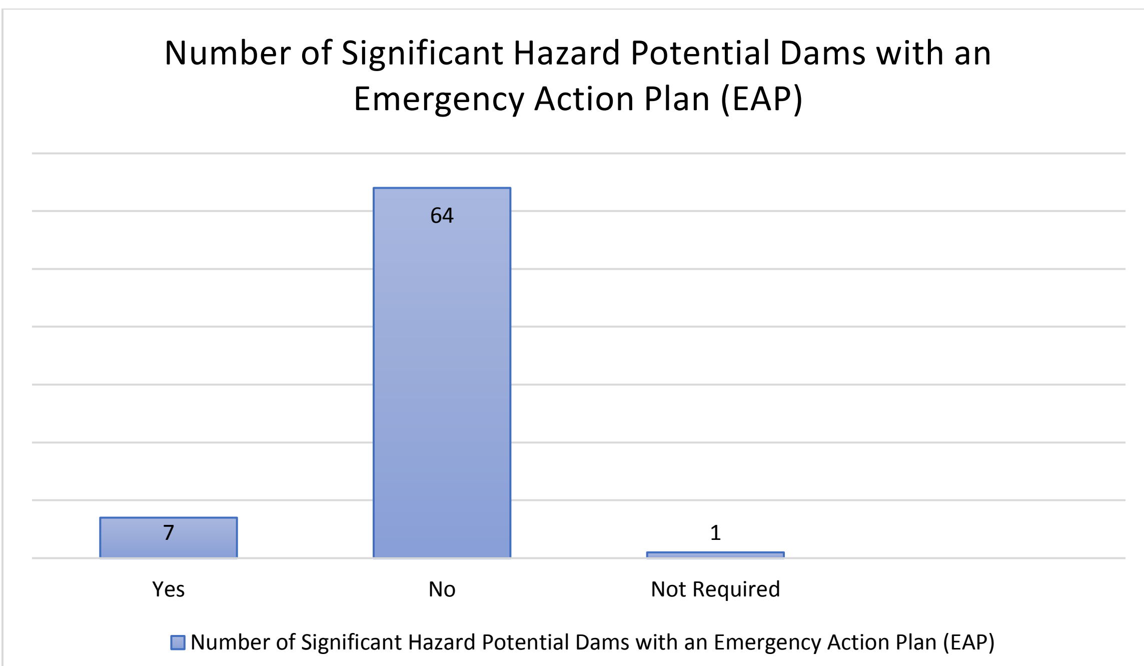


Figure 4-12 Dams by Height

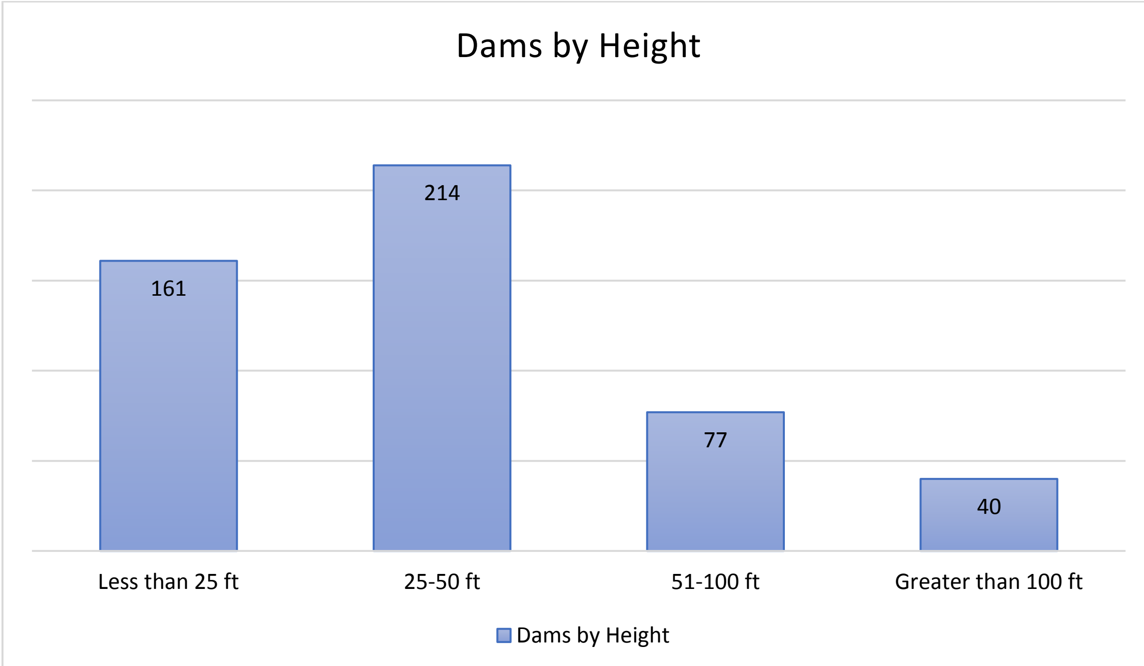


Figure 4-13 Dams by Primary Owner Type

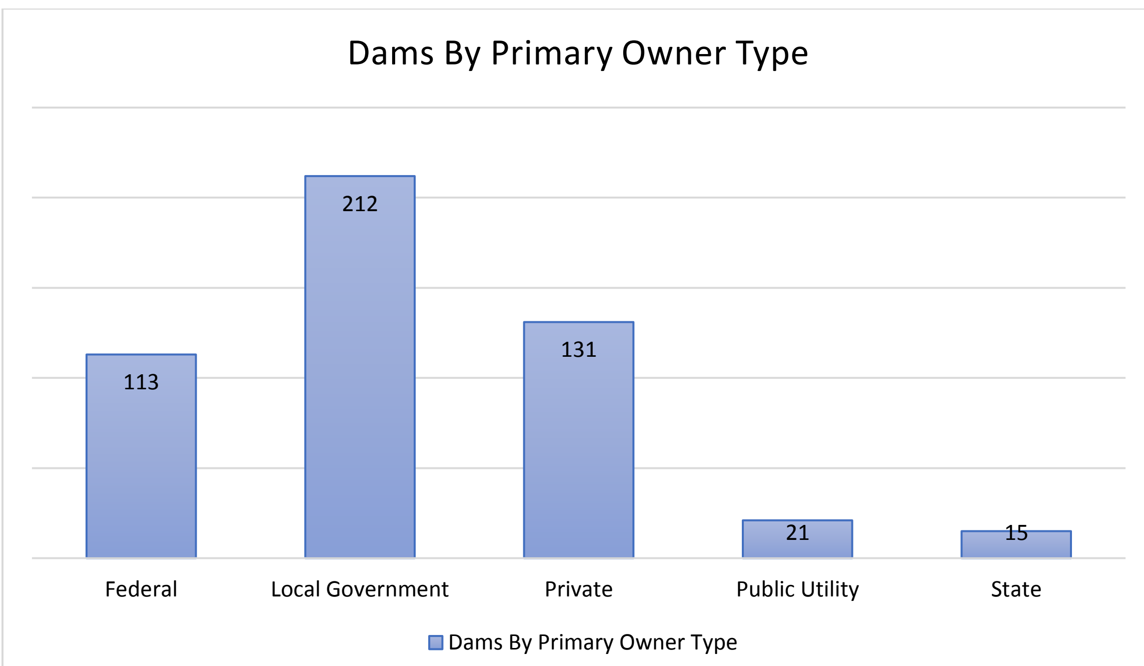


Figure 4-14 Dams by Primary Type

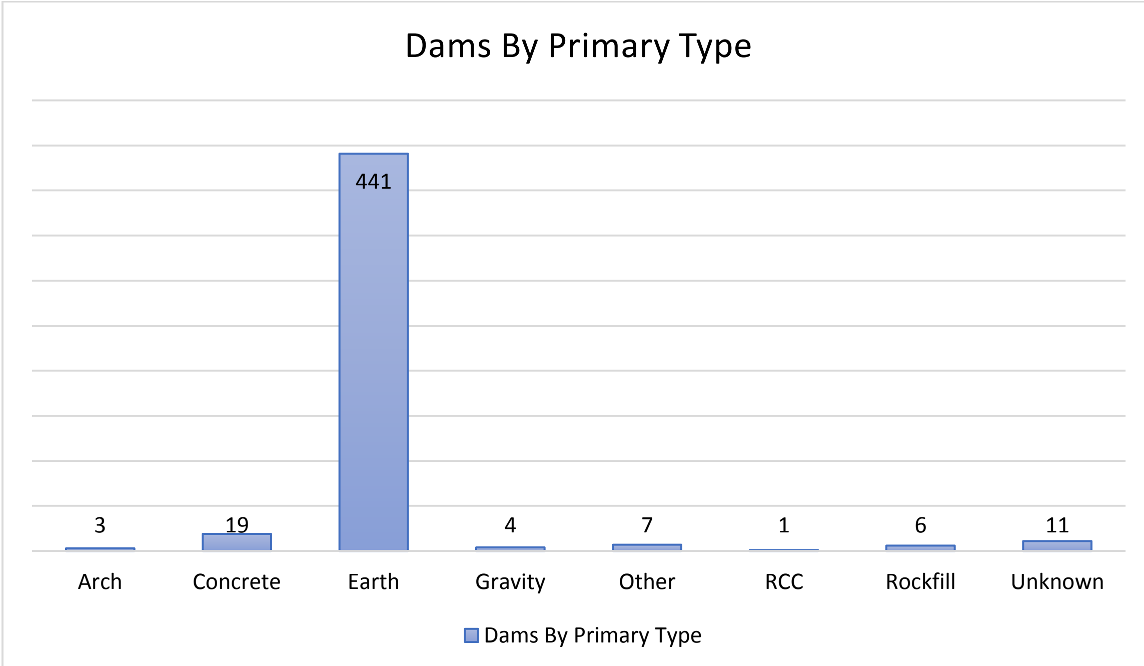
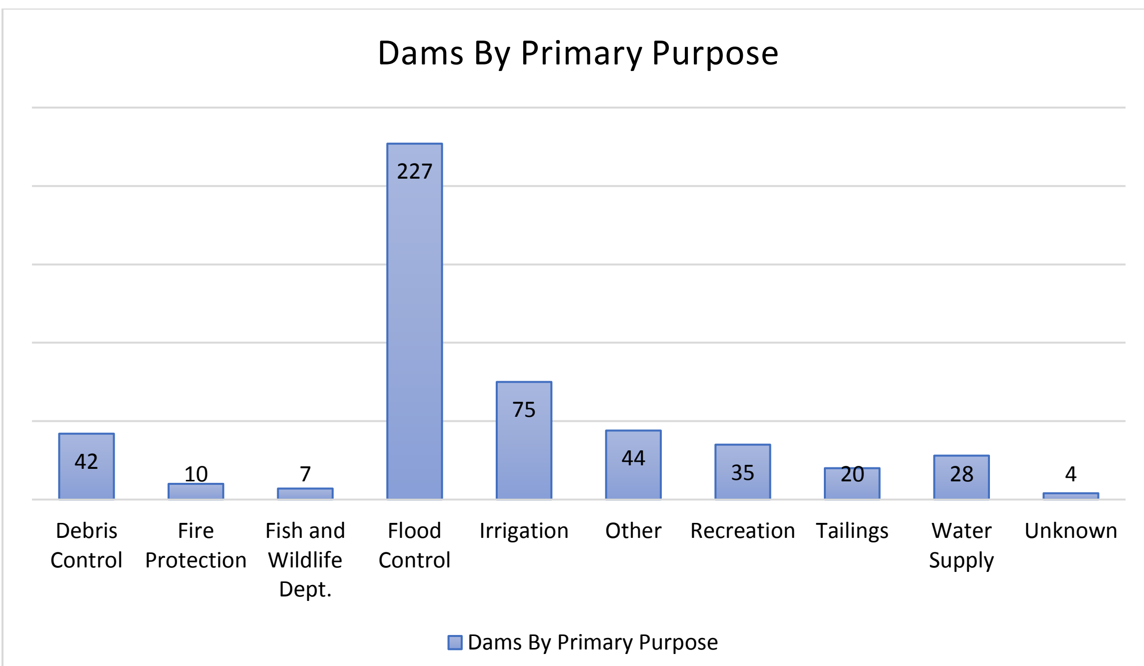


Figure 4-15 Dams by Primary Purpose



The development of missing EAPs was addressed in the Mitigation Strategies in the 2013 Plan as assistance for dam owners is needed to accomplish this goal. Each EAP has an inundation map based on modeling the dam failure under various operation conditions. An evacuation map is then prepared from the inundation map. In 2014, the New Mexico Department of Agriculture (NMDA) received grant funding through the New Mexico Department of Homeland Security and Emergency Management's

(DHSEM) Hazardous Mitigation Grant Program to assist in completing five inundation maps and two regional workshops for the Caballo and Santa Fe-Pojoaque Districts. Once complete, this project will provide a total of 24 Inundation Maps and 13 EAPs to many Districts across the state. New Mexico Department of Agriculture received HMGP funding which will leverage the technical expertise of Local, State, and Federal partners to ensure that inundation maps are prepared for at least five dams. The lack of adequate maps is also a focus of the U.S. Department of Homeland Security (DHS). In the fall of 2012, DHS introduced a software application, DSS-WISE Lite, to perform first-tier dam breach simulation and inundation mapping. The software was developed by the National Center for Computational Hydro science and Engineering at the University of Mississippi. DSS-WISE Lite has been implemented in the Dams Sector Analysis Tool. This application may provide owners with a resource to prepare a basic level dam breach analysis and evaluate if a more detailed analysis is required. FEMA has also developed a dam breach and inundation mapping software tool called GeoDam BREACH in 2013 that may be able to assist owners in EAP development. The software is regularly updated in order to provide the most current data available for breach analysis.[12].

Local mitigation plans will contain information on dams classified as high and significant hazard potential and inundation maps within their jurisdictions as the information becomes available. An example EAP is available on the Office of the State Engineer website to assist owners in preparing their EAP.[13] A comprehensive list of the 492 Dams in New Mexico is provided in Appendix A, Section 1.1.

Examples of impacts of several recent dam incidents includes;

1. Following the 2012 Little Bear Fire that burned a significant portion of the watershed of Bonito Lake Dam, increased hydrologic-induced problems were experienced.
2. Overtopping of a small earthen dam in Dona Ana County resulted in flooding and loss of power on September 12, 2013.

4.5.1.2 *Previous Occurrences*

There have been 52 Dam Incident Notifications in New Mexico from 1890 to 2017, with 25 total failures. Of those, 15 dams are ranked as high hazard, four are ranked as low hazard and one dam no longer exists. Figure 4-16 provides an overview of those notifications by date of occurrence while Figure 4-17 provides high hazard dam failures by Preparedness Area.

Figure 4-16 Previous Occurrence - Dam Incidents 1890 - 2017

Preparedness Area	County	Dam Name	Date	Type of Incident	Dam Failure
Preparedness Area 1	Eddy	Intrepid South Perimeter Dam	2017	Internal Erosion	No
Preparedness Area 3	Rio Arriba	Unnamed Chamita Dam (Ohkay Owingh)*	2016	Overtopping Presumed	Yes
Preparedness Area 1	Eddy	Intrepid Potash West Plant Dam	2015	Internal Erosion	Yes
Preparedness Area 6	Dona Ana	La Union B*	2013	Overtopping	Yes

[12] GeoDam Breach is available at: https://www.fema.gov/media-library/assets/documents/94670
[13] Source: http://www.ose.State.nm.us/DS/References/EAP-Model.pdf

Preparedness Area	County	Dam Name	Date	Type of Incident	Dam Failure
Preparedness Area 1	Guadalupe	Power Lake Dam	2013	Overtopping	No
Preparedness Area 6	Dona Ana	Earthen Dam	2013	Overtopping	Yes
Preparedness Area 3	Los Alamos	Los Alamos Canyon Dam	2011	Potential Overtopping	No
Preparedness Area 6	Dona Ana	Little Halla Wilson Dam	2007	Spillway Unsafe	No
Preparedness Area 3	Taos	Cabresto Dam	2005	Seepage	No
Preparedness Area 2	Cibola	San Mateo Lake Dam	2001	Crack & Seepage	No
Preparedness Area 6	Grant	Cobre Main Tailings Dam	1999	Uncontrolled Release	Yes
Preparedness Area 2	Colfax	Miami Lake Dam No. 2	1999	Crack	No
Preparedness Area 2	Colfax	McCrystal Dam	1994-95	Seepage	No
Preparedness Area 6	Otero	Nahtzilee Dam	1996	Unknown	Yes
Preparedness Area 6	Otero	Solon Dam	1996	Unknown	Yes
Preparedness Area 2	Colfax	Throttle Dam No. 2	1988	Overtopping	No
Preparedness Area 5	Bernalillo	Renaissance Detention Basin*	1987	Piping	Yes
Preparedness Area 6	Dona Ana	Mclead Flood Control Dam	1987	Piping	Yes
Preparedness Area 2	Colfax	Ute Creek Dam	1982	Slope Failure	No
Preparedness Area 6	Dona Ana	Caballo Arroyo Dam No. 4	1981	Crack	No
Preparedness Area 6	Grant	Phelps Dodge Tailings Dam No. 3	1980s	Uncontrolled Release	Yes
Preparedness Area 6	Dona Ana	Little Halla Wilson Dam	1980s	Spillway Failed	No
Preparedness Area 2	San Miguel	Bradner Dam	1980s	Seepage	No
Preparedness Area 4	San Juan	Beeline Farmington Dam	1980s	Seepage	No
Preparedness Area 2	Colfax	Lake Maloya Dam	1979	Conduit Failed	No
Preparedness Area 1	Eddy	Hackberry Draw Site No. 3	1975	Sinkholes	No
Preparedness Area 2	San Miguel	Rito Manzanares	1975	Unknown	Yes

Preparedness Area	County	Dam Name	Date	Type of Incident	Dam Failure
Preparedness Area 4	Cibola	United Nuclear Homestake*	1970s	Overtopping	Yes
Preparedness Area 6	Luna	Merrell Dam	1967	Unknown	
Preparedness Area 2	Colfax	Cimarroncito Dam	1965	Overtopping	No
Preparedness Area 3	Taos	Cabresto Dam	1950s	Spillway Failed	No
Preparedness Area 2	Colfax	Lake Alice Dam	1942	Overtopping	No
Preparedness Area 2	Colfax	Lake Maloya Dam	1942	Overtopping	No
Preparedness Area 3	Rio Arriba	Crowley Irrigation System	1941	Overtopping	Yes
Preparedness Area 2	Colfax	Throttle Dam No. 2	1941	Overtopping	No
Preparedness Area 2	Colfax	Rito Del Plano Reservoir	1940	Failed	Yes
Preparedness Area 2	Colfax	Springer Dam No. 1*	1937	Failed	Yes
Preparedness Area 4	McKinley	Ramah Dam*	1937	Failed	Yes
Preparedness Area 4	McKinley	Black Rock Dam*	1936	Seepage	Yes
Preparedness Area 3	Taos	Carson Dam	1935	Sinkhole	No
Preparedness Area 4	McKinley	Black Rock Dam*	1932	Seepage	Yes
Preparedness Area 1	Lincoln	Bonito Dam*	1930	Overtopping	Yes
Preparedness Area 2	Colfax	Springer Lake Dam*	1928-29	Dam Failed	Yes
Preparedness Area 2	Colfax	Ute Creek Dam	1913	Outlet Failure	No
Preparedness Area 6	Eddy	McMillan Dam	1911	Unknown	Unknown
Preparedness Area 4	McKinley	Ramah Dam	1910	Slope Failure	No
Preparedness Area 4	McKinley	Black Rock Dam*	1909	Seepage	Yes
Preparedness Area 4	Cibola	Bluewater Dam*	1909	Breach	Yes
Preparedness Area 3	Taos	Cabresto Dam*	1907	Overtopping	Yes
Preparedness Area 1	Eddy	Avalon Dam*	1893	Overtoppping	Yes

Preparedness Area	County	Dam Name	Date	Type of Incident	Dam Failure
Preparedness Area 3	Taos	Cabresto Dam	1890	Overtopping	Yes
Preparedness Area 5	Sandoval	Nacimiento Dam	-	Unknown	Yes
*Denotes a High Hazard Dam					

Figure 4-17 High Hazard Dam Failures 1890 to 2017 – Summary by Preparedness Area

Preparedness Area	Total High Hazard Dam Failures
Preparedness Area 1	2
Preparedness Area 2	2
Preparedness Area 3	3
Preparedness Area 4	6
Preparedness Area 5	1
Preparedness Area 6	1

Since 2005, the OSE Dam Safety Bureau has been assessing whether dams are deficient under the new Dam Safety Regulations. In 2008 the US Army Corps of Engineers introduced a condition assessment field for the National Inventory of Dams. The OSE adopted the definitions by the USACE in FY 2009, and during FY 2015 the OSE Dam Safety Bureau inspected 101 dams. According to the OSE Interstate Stream Commission Annual Report, as of 2015, a total of 224 dams are considered deficient dams with, 122 high hazard dams as deficient and 38 significant hazard dams[14]. One-hundred and sixty dams total, ranked as high or significant, are considered deficient. Many of these deficiencies can be corrected with an engineering evaluation. Figure 4-18 Dam Condition Classifications below provides the definitions for the condition assessment classification along with the OSE Spillway Risk Guidelines associated with each condition.

Figure 4-18 Dam Condition Classifications

Condition Assessment	2008 USACE Criteria	OSE Spillway Risk Guidelines
Satisfactory	No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions in accordance with State Engineer rules and regulations for dams or tolerable risk guidelines.	Spillway capacity ≥ 70% of the spillway design flood (SDF).

[14] Source: http://www.ose.state.nm.us/Plans/AnnualReports/FINAL%20annual%20repot%2011%2021%2016.pdf

Condition Assessment	2008 USACE Criteria	OSE Spillway Risk Guidelines
Fair	No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range [for the owner] to take further action.	Spillway capacity < 70% but ≥ 25% of the SDF.
Poor	A dam safety deficiency is recognized for loading conditions, which may realistically occur. Remedial action is necessary. A poor condition is also used when uncertainties exist as to critical analysis parameters that identify a potential dam safety deficiency. In such cases further investigations and studies are necessary.	Spillway capacity < 25% of the SDF.
Unsatisfactory	A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.	

The State Engineer has taken action against unsafe water storage dams that pose an immediate threat to life and property by ordering storage restrictions. Unfortunately, storage restrictions are not an option for flood control dams because the normal operating condition of the reservoir is empty. Safety deficient flood control dams still offer some flood protection but will likely fail and cause catastrophic consequences during extreme storm events. Where owners are unwilling or unable to upgrade their flood control dams a dilemma exists whether to order the dam breached resulting in flooding or allow the unsafe dam to remain knowing that an extreme storm will fail the dam.

Figure 4-19 provides a summary of the condition rating by types for the state.

Figure 4-19 Condition Rating Summary for Jurisdictional Dams

Hazard Class	Satisfactory	Fair	Poor	Unsatisfactory
High 167 Dams	45 (27%)	25 (15%)	94 (56%)	3 (2%)
Significant 47 Dams	9 (19%)	4 (9%)	34 (72%)	0 (0%)
Low 84 Dams	20 (24%)	11 (13%)	51 (61%)	2 (2%)

During FY 2015 the OSE Dam Safety Bureau inspected 101 dams. The budgetary performance goal for the Bureau is 100 dams per fiscal year. The Bureau added an entry-level dam safety additional engineer to its staff in FY15, which filled all of the Bureau's positions.

4.5.1.3 *Frequency*

Based on State-wide data related to past dam incident notifications, the frequency of notification is expected to be once in every 2.44 years (52 notifications in 127 years). The frequency of high hazard dam failures is expected to be once every 8.47 years (15 notifications in 127 years).

4.5.1.4 *Probability of Occurrence*

To determine the probability of each Preparedness Area experiencing future dam failure, the probability or chance of occurrence was calculated based on historical data provided by local authorities. Probability was determined by dividing the number of events (52 total incidents) by the number of years (2017-1890=127 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. In addition to calculating the number of incidents, SHMPT also calculated the probability of dam failure at a high hazard dam (15 high hazard dam failures). Figure 4-20 identifies the probability for each Preparedness Area experiencing a dam Incident notification and experiencing a high hazard dam failure on an annual basis.

Figure 4-20 Probability of Occurrence - Dam Incident

Probability of Occurrence		
Preparedness Area	**Dam Incident Notification**	**High Hazard Dam Failure**
Preparedness Area 1	4%	1.6%
Preparedness Area 2	13%	1.6%
Preparedness Area 3	6%	2%
Preparedness Area 4	6%	5%
Preparedness Area 5	2%	< 1%
Preparedness Area 6	10%	< 1%

The SHMPT will continue to monitor the availability of levee data, and will base future probability estimates on updated, more robust data.

4.5.1.5 *Risk Assessment*

The rate of failure of a dam is difficult to predict, although sudden failure is certainly a possibility. Preventive measures such as proper maintenance, sound design, and proper construction can limit the probability of a dam failure. A screening summary of dam failure consequences can be found in Appendix H and is For Official Use Only. To access Appendix H for official use only, please contact the Dam Safety Bureau of the New Mexico Office of the State Engineer at 505-827-6122 or nm.damsafety@state.nm.us. Other contacts available at http://www.ose.state.nm.us/DS/dsIndex.php.

Figure 4-21 identifies impacts from Dam Failures in New Mexico for the purposes of EMAP compliance.

Figure 4-21 Dam Failure Impacts

Subject	Potential Impacts

Subject	Potential Impacts
Agriculture	Sudden failure of a dam can cause significant short-term damage and long-term damage. Short term, crops, livestock and agriculture infrastructure can be destroyed. Long term a water supply for irrigation and livestock water can be eliminated. The potential also exists that an approved irrigation water supply in compliance with the Food Safety and Modernization Act can be contaminated from floodwaters causing the crops to not be certified for market or consumption.
Health and Safety of the Public	A large dam failure may wipe out everything and everyone downstream for many miles. Drowning is likely.
Health and Safety of Responders	Same as for the public.
Continuity of Operations	A dam failure may shut down normal operations and can impact other critical infrastructure which may impact other operations.
Delivery of Services	Service delivery may be impossible.
Property, Facilities, Infrastructure	Total loss of the entire built environment is possible depending on the size of the dam and the severity of the failure.
Environment	Environmental effects from a dam failure would be similar to those of a flash flood: erosion, downed vegetation, loss of habitat. Certain dams associated with mining activities could have environmental impacts that may need to be considered.
Economic Condition	A dam failure may cause severe impacts as residences and businesses may be entirely destroyed. The survivors may not remain in the area to bolster the local economy.
Public Confidence	Public confidence would likely be severely impacted. The public expects the government to regulate the safety of dams.

4.5.1.6 *Data Limitations*

The 2008 Dam Condition Classifications address the lack of data and require a dam to be rated in poor condition when "uncertainties exist as to critical analysis parameters." The lack of inundation maps also impacts the ability to evaluate the consequences of dam failure which is used to define the risk related to dams. All high hazard dams should have an EAP in order to better prepare the dam operators and the downstream public in case there is a breech. Data from the EAPs will contribute to risk reduction.

4.5.1.7 *What Can Be Mitigated?*

Potential areas for mitigation activities include identifying tools for evaluating uncertainties in dam data, preparation of EAPs for all high hazard dams and rehabilitation of existing dams. These actions will contribute to dam failure risk reduction.

4.5.1.8 *Changing Weather Patterns*

At the time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of dam failures in the state of New Mexico.

4.5.2 Drought

4.5.2.1 *Hazard Characteristics*

In New Mexico, drought is a regular event. Experts predict that periodic drought conditions are likely to continue for the foreseeable future. Drought increases the probability and severity of wildfire. Drought also increases the severity of flash flooding due to soils becoming hydrophobic, repelling or incapable of dissolving in water, resulting in increased runoff and erosion. Economically, prolonged drought can have devastating effects on agriculture and the food supply.

The State of New Mexico most recently recorded periods of drought from approximately 2011 through 2014. In every drought, agriculture is adversely impacted, especially in non-irrigated areas such as dry land farms and rangelands. Droughts impact individuals (farm owners, tenants, and farm laborers), the agricultural industry, other agriculture related sectors, and other industries such as tourism and recreation. Drought also has the potential to increase the incidences and severity of other hazard events such as wildfire and flooding.[15] There is increased danger of forest and wildland fires. Loss of forests and trees increases erosion, causing serious damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers.

Being in a drought magnifies the challenge of balancing limited water supplies with growing demand. A drought is caused by a variety of factors. Climate scientists believe that conditions in the North Atlantic Ocean and the Eastern Pacific Ocean play a significant role in determining the amount of precipitation that New Mexico and the rest of the country receive.

Drought is a condition of climatic dryness that reduces soil moisture, water or snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Drought conditions are usually not uniform over the entire State. Local and regional differences in weather, soil condition, geology, vegetation, and human influence need to be considered when assessing the impact of drought on any particular location.

The most commonly used drought definitions are based on meteorological, agricultural, hydrological, and socio-economic effects.

- **Meteorological** drought is defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.
- **Agricultural** drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought and can affect livestock and other dry-land agricultural operations.

[15] Source: FEMA Drought Resilience Fact Sheet

- **Hydrological** drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, snow pack, and as lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurements tend to lag behind other drought indicators.
- **Socio-economic** drought occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

Although different types of drought may occur at the same time, they can also occur independently of one another. Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering of effects of an occcurence after its apparent end. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Given that drought is a slow-moving hazard without an occurence to mark its arrival, a one-time drought can be difficult to define. However, the consequences of a severe to extreme drought in the State pose significant challenges. Long-term solutions for coping with a limited water supply will require increased cooperation between urban users and agricultural use.

Water Use in New Mexico

As the population of the State increases so does water usage/withdrawal, which is distributed among nine categories including public water supply, domestic, irrigated agriculture, livestock, commercial, industrial, mining, power, and reservoir evaporation. The New Mexico Office of State Engineer collects water use data for these nine categories. According to the Office of the State Engineer, irrigated agriculture accounts for more than 78% of water usage.[16] The changes in population and increased awareness over drought conditions and climate variability are addressed in the New Mexico State Water Plan, which was updated in 2013[17] and another update is scheduled for 2018.

4.5.2.2 *Previous Occurrences*

According to the New Mexico Drought Plan, the State has experienced droughts since prehistoric times. Extended drought conditions in the region evidently led to the collapse of many early civilizations. Periods of drought since 1950 have been documented during 1950-1957, 1963-1964, 1976-1978, 1989, 1996, 1998-1999, 1999-2003, 2003-2006, 2011-2013 and 2017-2018.

All Preparedness Areas in New Mexico have experienced drought conditions over the last 11 years, but much of the State experienced exceptional drought in 2013.

The Palmer Drought Index is used to assess the extent of drought by measuring the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, with the intensity of drought during the current month dependent upon the current weather patterns plus the cumulative patterns of previous months. The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop. Figure 4-22 depicts magnitude of drought while Figure 4-23 describes the classification descriptions.

[16] Source: http://www.ose.state.nm.us/Pub/TechnicalReports/TechReport%2054NM%20Water%20Use%20by%20Categories%20.pdf
[17] New Mexico State Water Plan 2013 is available at: http://www.ose.state.nm.us/Planning/SWP/PDF/2013_NM_Water_Plan_ReviewWEB.PDF

Figure 4-22 Palmer Drought Index

DROUGHT INDEX	DROUGHT CONDITION CLASSIFICATIONS						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
Z Index	-2.75 and below	-2.00 to -2.74	-1.25 to -1.99	-1.24 to +.99	+1.00 to +2.49	+2.50 to +3.49	n/a
Meteorological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above
Hydrological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

Figure 4-23 Palmer Drought Category Descriptions[18]

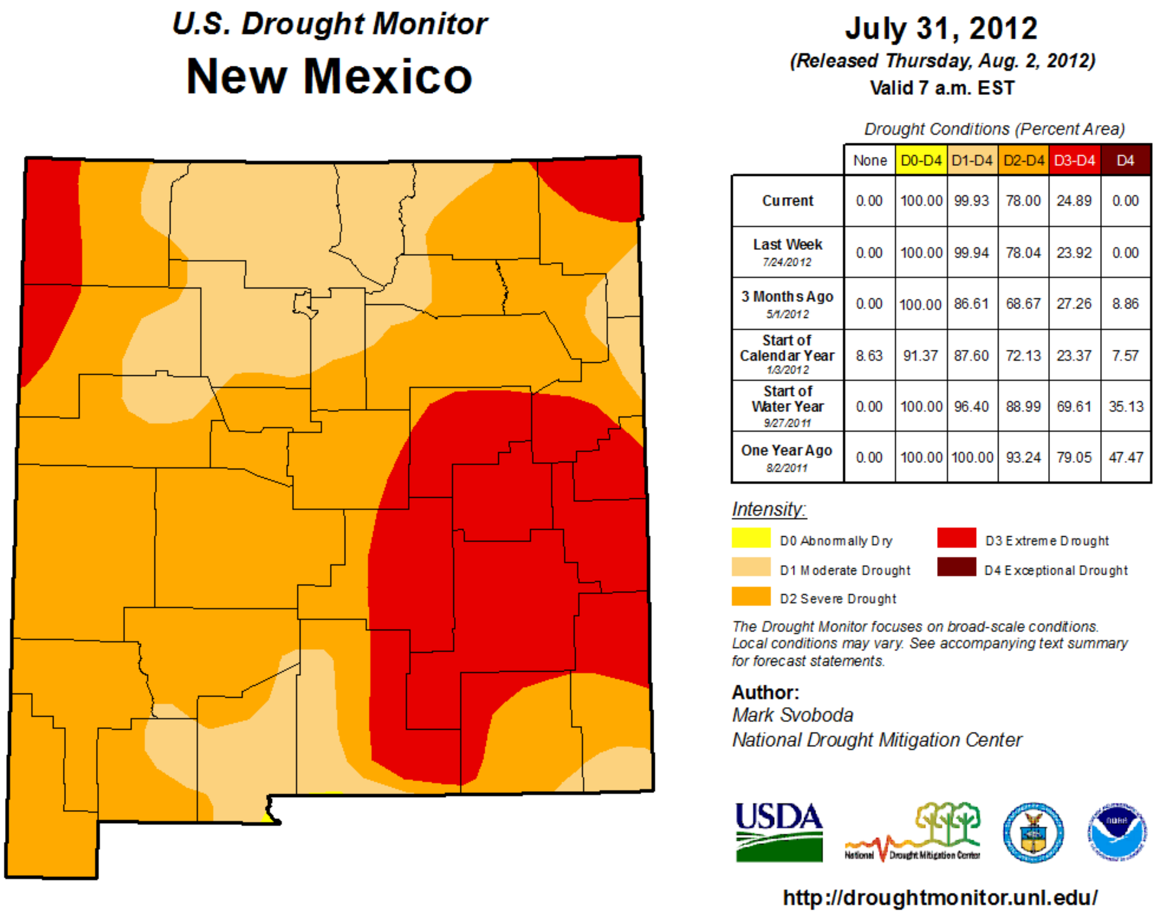
CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT INDEX
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	-5.0 or less

Drought is monitored nationwide by the National Drought Mitigation Center (NDMC). Indicators are used to describe broad scale drought conditions across the U.S. Indicators correspond to the intensity of drought.

The National Drought Mitigation Center provides a snapshot of drought per month. As July is typically the hottest and driest month of the year, Figure 4-24 to Figure 4-29 provide a comparison for the drought in New Mexico and across the United States each July from 2012 to 2017. [19]

[18] Source: National Drought Mitigation Center - http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

Figure 4-24 Drought Monitor – July 2012

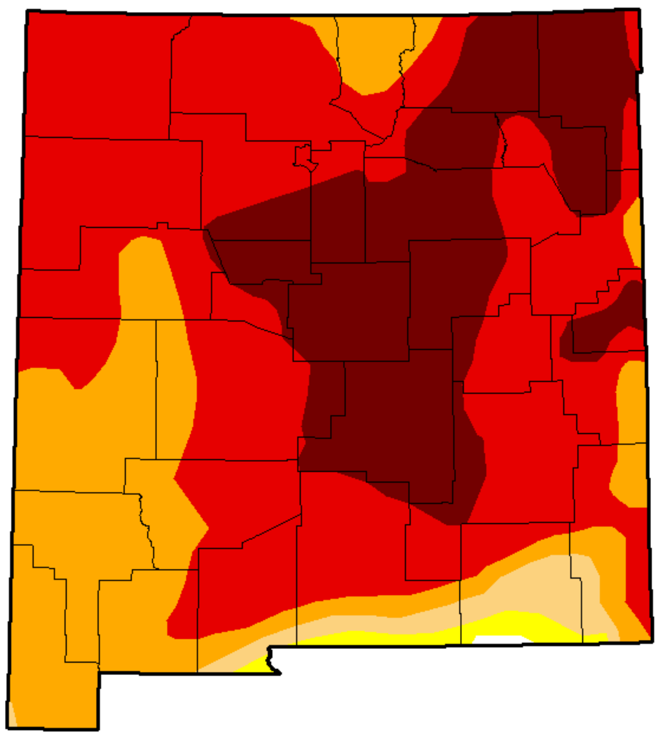


[19] Source: https://www.climate.gov/maps-data/data-snapshots/usdroughtmonitor-weekly-ndmc-2017-07-11?theme=Drought

Figure 4-25 Drought Monitor – July 2013

U.S. Drought Monitor

New Mexico



July 30, 2013

(Released Thursday, Aug. 1, 2013)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	98.49	95.50	73.55	24.84
Last Week 7/23/2013	0.00	100.00	100.00	97.29	80.07	35.14
3 Months Ago 4/30/2013	0.00	100.00	99.04	97.75	81.82	24.89
Start of Calendar Year 1/1/2013	0.00	100.00	98.83	94.05	31.88	0.97
Start of Water Year 9/25/2012	0.00	100.00	100.00	62.56	12.25	0.66
One Year Ago 7/31/2012	0.00	100.00	99.93	78.00	24.89	0.00

Intensity:

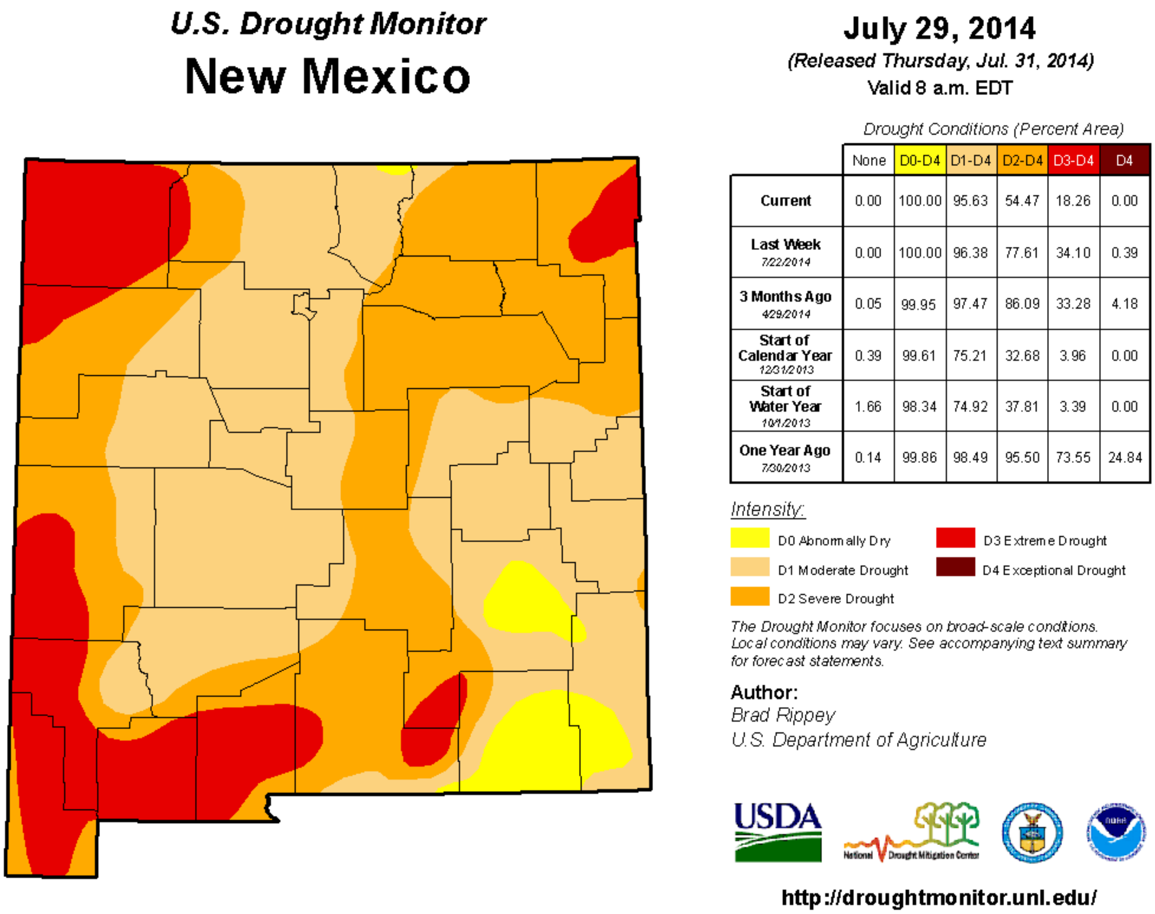
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Figure 4-26 Drought Monitor – July 2014



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	95.63	54.47	18.26	0.00
Last Week 7/22/2014	0.00	100.00	96.38	77.61	34.10	0.39
3 Months Ago 4/29/2014	0.05	99.95	97.47	86.09	33.28	4.18
Start of Calendar Year 12/31/2013	0.39	99.61	75.21	32.68	3.96	0.00
Start of Water Year 10/1/2013	1.66	98.34	74.92	37.81	3.39	0.00
One Year Ago 7/30/2013	0.14	99.86	98.49	95.50	73.55	24.84

Figure 4-27 Drought Monitor – July 2015

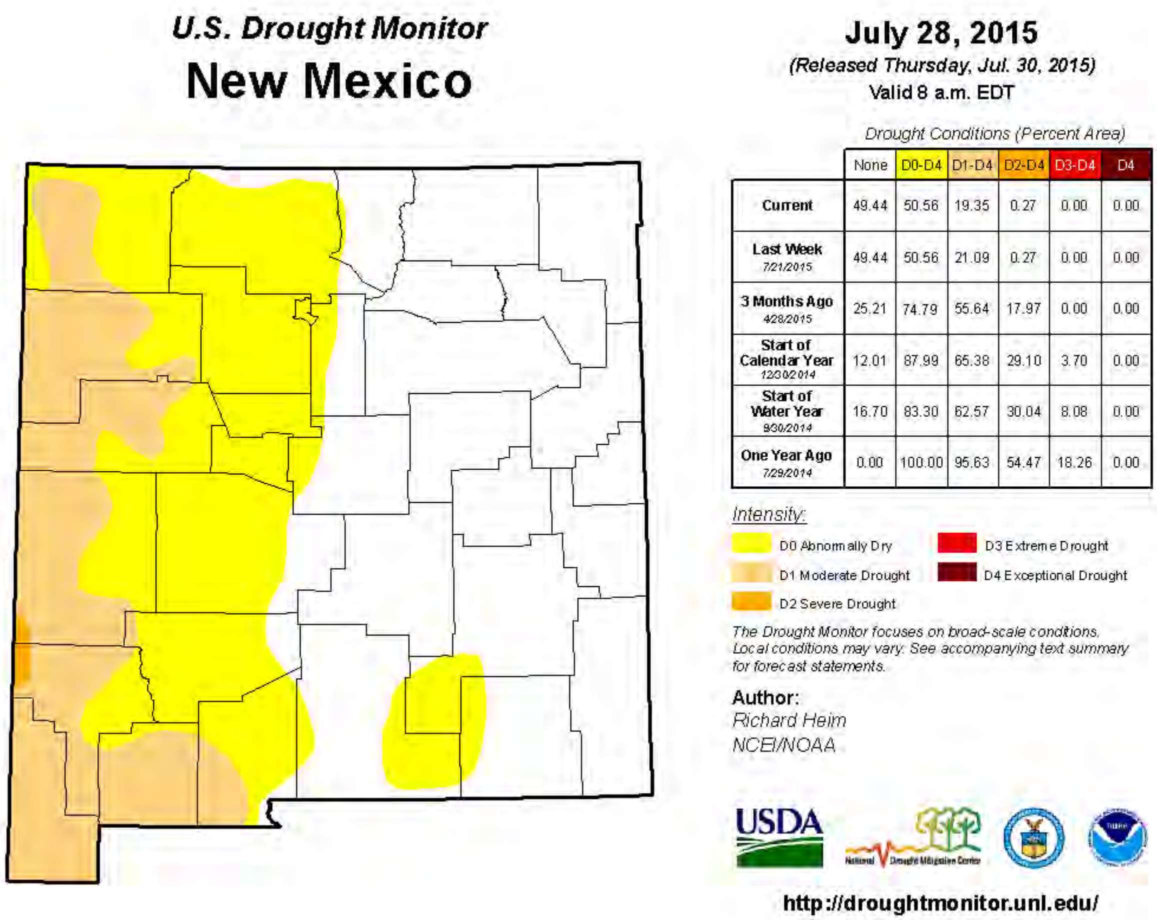
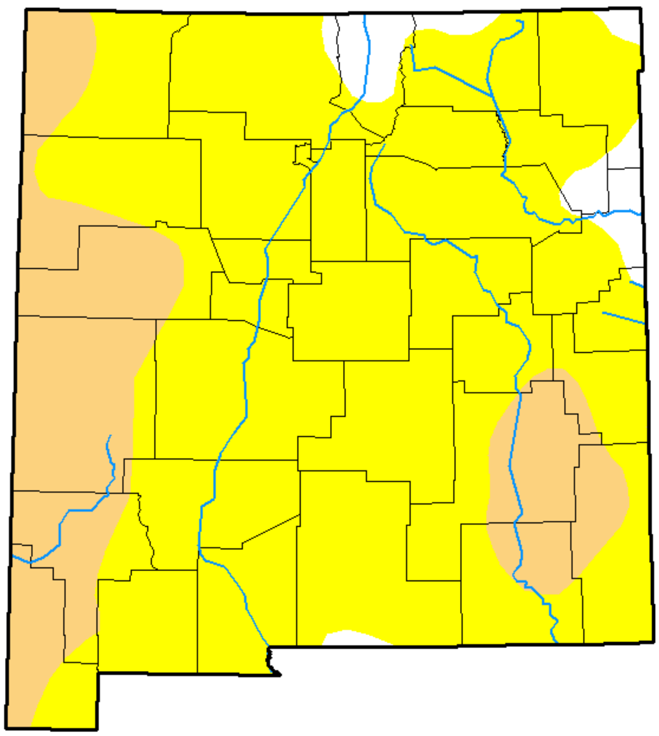


Figure 4-28 Drought Monitor – July 2016

U.S. Drought Monitor

New Mexico



July 26, 2016

(Released Thursday, Jul. 28, 2016)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	4.00	96.00	21.46	0.00	0.00	0.00
Last Week *07-19-2016*	23.13	76.87	15.62	0.00	0.00	0.00
3 Months Ago *04-26-2016*	3.36	96.64	43.56	0.00	0.00	0.00
Start of Calendar Year *12-29-2015*	73.76	26.24	0.00	0.00	0.00	0.00
Start of Water Year *09-29-2015*	56.70	43.30	7.94	0.00	0.00	0.00
One Year Ago *07-28-2015*	49.44	50.56	19.35	0.27	0.00	0.00

Intensity:

D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

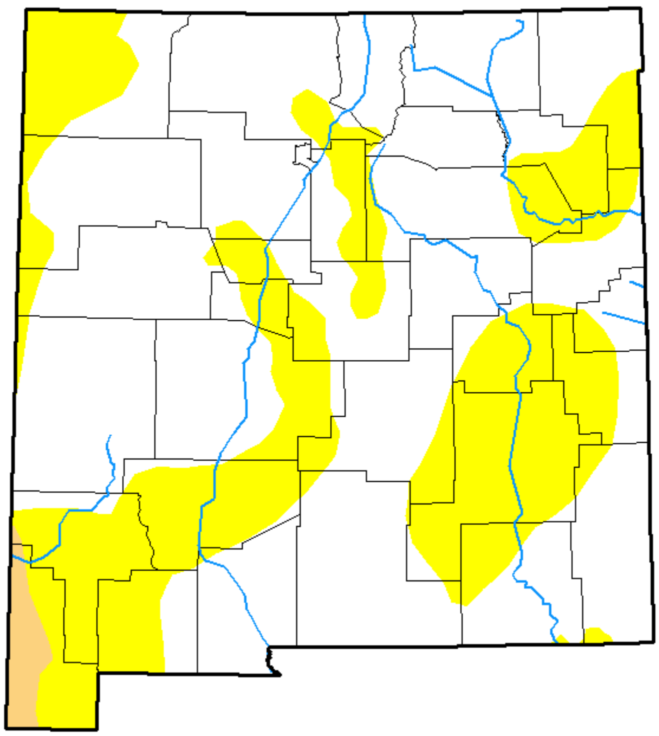
Brad Rippey
U.S. Department of Agriculture

http://droughtmonitor.unl.edu/

Figure 4-29 Drought Monitor – July 2017

U.S. Drought Monitor

New Mexico



July 25, 2017

(Released Thursday, Jul. 27, 2017)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	66.49	33.51	1.34	0.00	0.00	0.00
Last Week 07-18-2017	72.95	27.05	6.56	0.00	0.00	0.00
3 Months Ago 04-25-2017	58.57	41.43	0.00	0.00	0.00	0.00
Start of Calendar Year 01-03-2017	66.20	33.80	4.28	0.00	0.00	0.00
Start of Water Year 09-27-2016	53.33	46.67	3.85	0.00	0.00	0.00
One Year Ago 07-26-2016	4.00	96.00	21.46	0.00	0.00	0.00

Intensity:

D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Richard Heim
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USDA NDMC NOAA

http://droughtmonitor.unl.edu/

For New Mexico, November 2015 to October 2017 have been the second driest 24-month period on record, just behind the period that ended in October 1956. Drought Monitor comparisons from December 2017 through July 2018 are below (Figure 4-30 through Figure 4-37). With low precipitation in the winter months, the snow pack was well below average leading to very dry conditions in the spring of 2018. The trend can be summarized as follows;

- November 2017 was the 10th driest November on record, and December 2017 was the 9th driest December.
- By the end of December 2017, most of the State was abnormally dry (62%) or in moderate drought (30%).
- By the end of January 2018 100% of the State was in some drought condition, with the majority of the State in severe drought (68%) or moderate drought (26%).
- By the end of February 2018 extreme drought conditions were reported (5%), with severe drought increasing (73%) and moderate drought slightly decreasing (21%).
- By the end of March 2018 extreme drought conditions worsened (34%), with severe drought decreasing (44%) and moderate drought staying the same (21%).

- By the end of April 2018 exceptional drought was reported (7%), extreme drought conditions worsened (39%), with severe drought decreasing (32%) and moderate drought slightly decreasing (20%).

Figure 4-30 December 2017 Drought Conditions

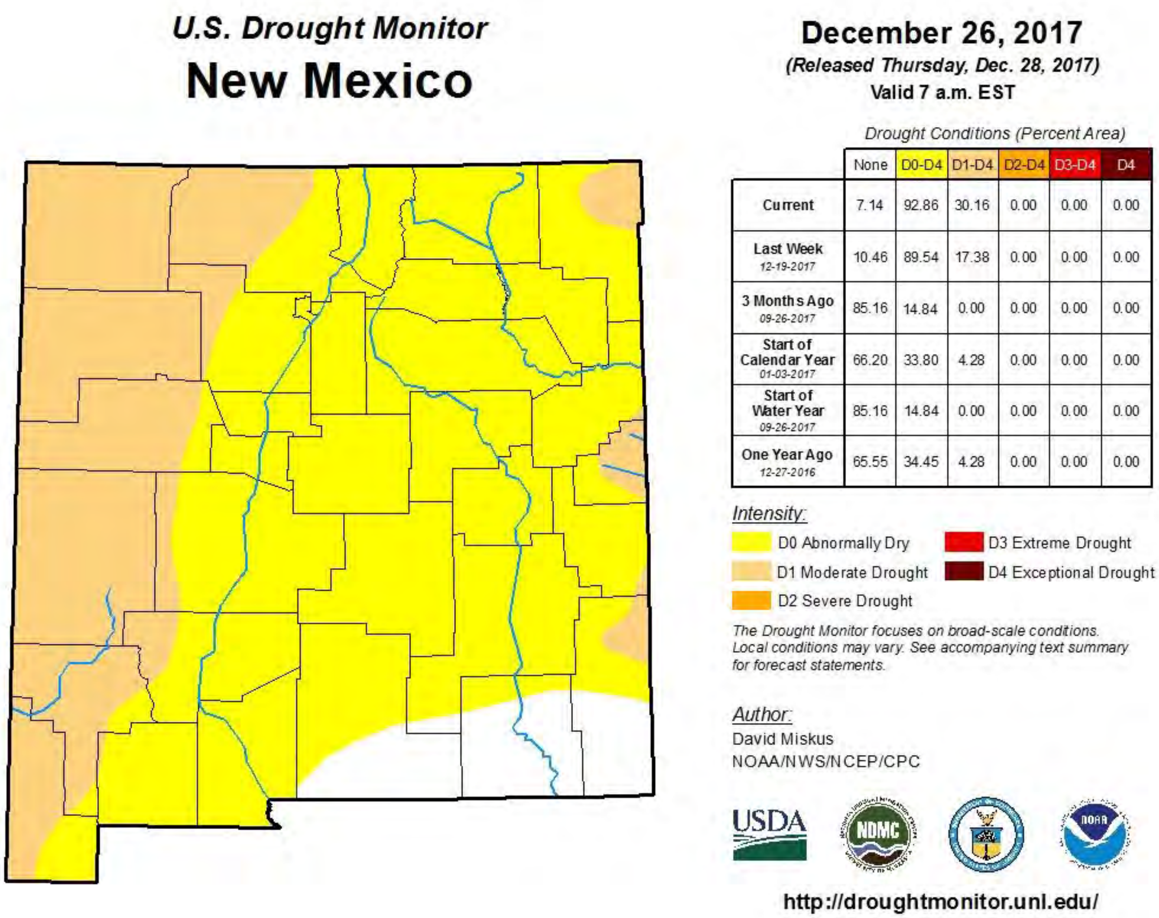
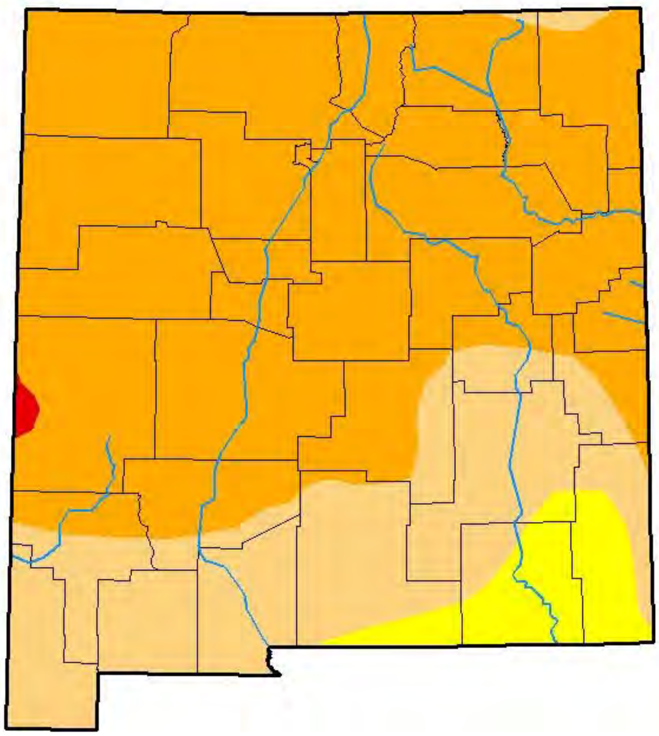


Figure 4-31 January 2018 Drought Conditions

U.S. Drought Monitor

New Mexico



January 30, 2018

(Released Thursday, Feb. 1, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	94.13	68.03	0.27	0.00
Last Week *01-23-2018*	0.00	100.00	93.78	59.96	0.00	0.00
3 Months Ago *10-31-2017*	83.45	16.55	1.88	0.00	0.00	0.00
Start of Calendar Year *01-02-2018*	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year *09-26-2017*	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago *01-31-2017*	88.05	11.95	2.49	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Richard Heim

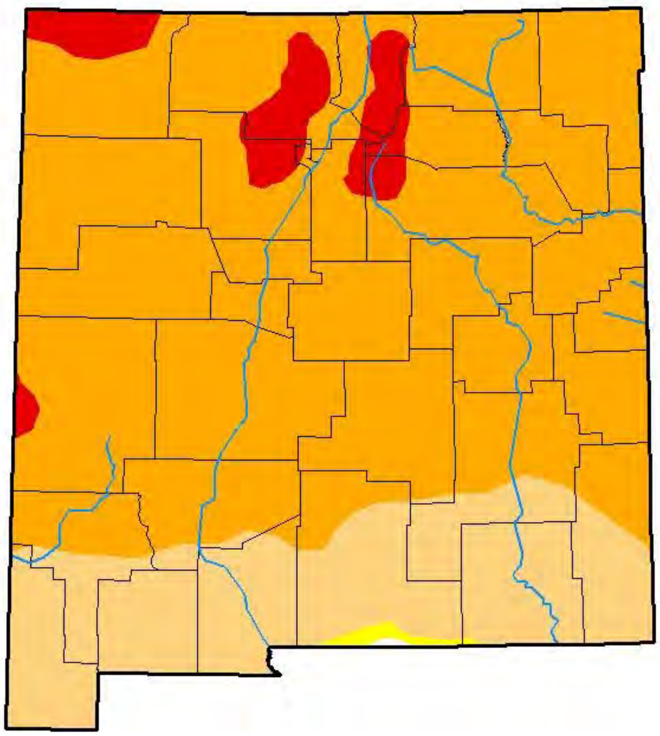
NCEI/NOAA

http://droughtmonitor.unl.edu/

Figure 4-32 February 2018 Drought Conditions

U.S. Drought Monitor

New Mexico



February 27, 2018

(Released Thursday, Mar. 1, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.08	99.92	99.51	77.99	5.23	0.00
Last Week *02-20-2018*	0.08	99.92	99.51	77.99	5.23	0.00
3 Months Ago *11-28-2017*	48.91	51.09	16.23	0.00	0.00	0.00
Start of Calendar Year *01-02-2018*	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year *09-26-2017*	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago *02-28-2017*	77.00	23.00	2.49	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

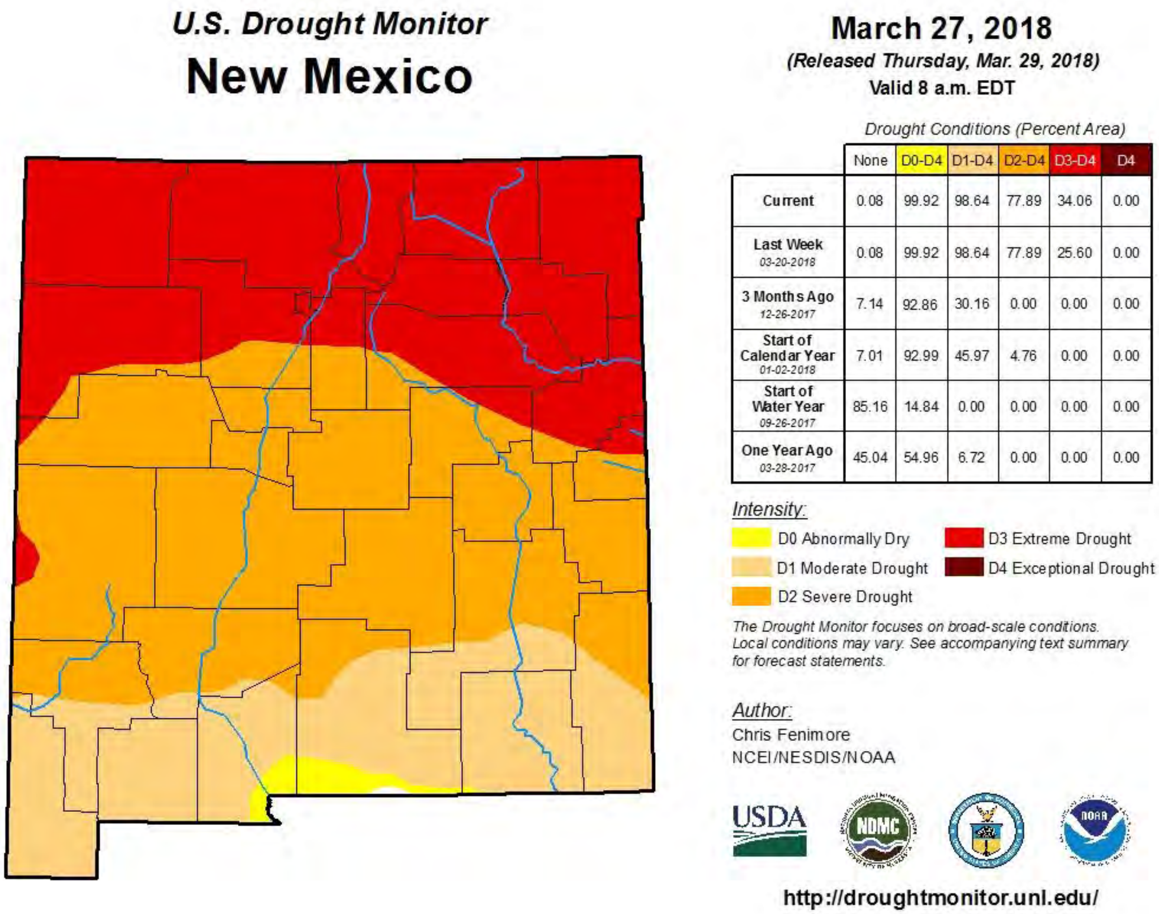
Author:

Deborah Bathke

National Drought Mitigation Center

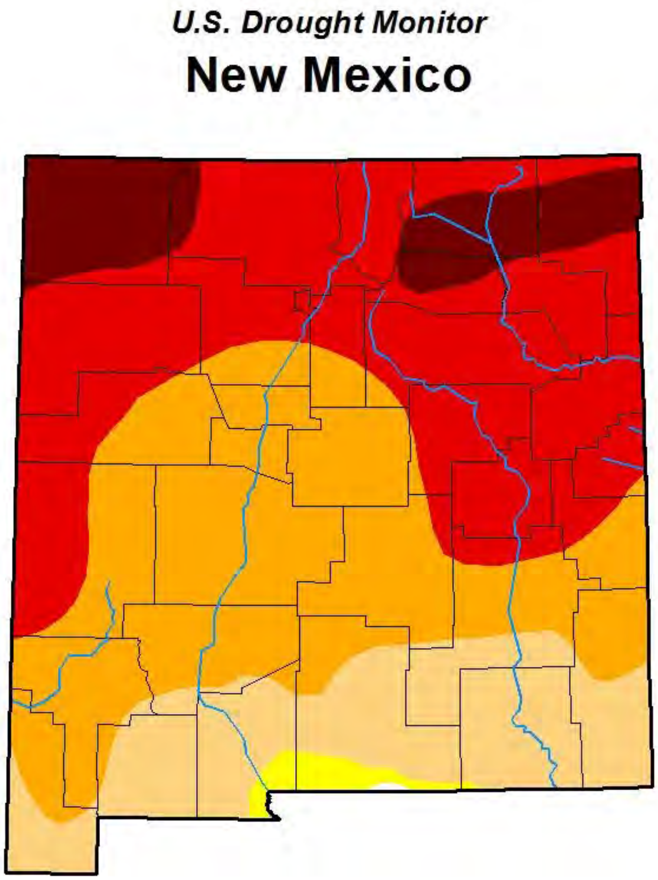
http://droughtmonitor.unl.edu/

Figure 4-33 March 2018 Drought Conditions



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.08	99.92	98.64	77.89	34.06	0.00
Last Week 03-20-2018	0.08	99.92	98.64	77.89	25.60	0.00
3 Months Ago 12-26-2017	7.14	92.86	30.16	0.00	0.00	0.00
Start of Calendar Year 01-02-2018	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year 09-26-2017	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago 03-28-2017	45.04	54.96	6.72	0.00	0.00	0.00

Figure 4-34 April 2018 Drought Conditions



April 24, 2018
(Released Thursday, Apr. 26, 2018)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.08	99.92	98.58	80.84	46.01	9.14
Last Week *04-17-2018*	0.08	99.92	98.57	78.12	45.97	6.63
3 Months Ago *01-23-2018*	0.00	100.00	93.78	59.96	0.00	0.00
Start of Calendar Year *01-02-2018*	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year *09-26-2017*	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago *04-25-2017*	58.57	41.43	0.00	0.00	0.00	0.00

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brad Rippey
U.S. Department of Agriculture

http://droughtmonitor.unl.edu/

Figure 4-35 May 2018 Drought Conditions

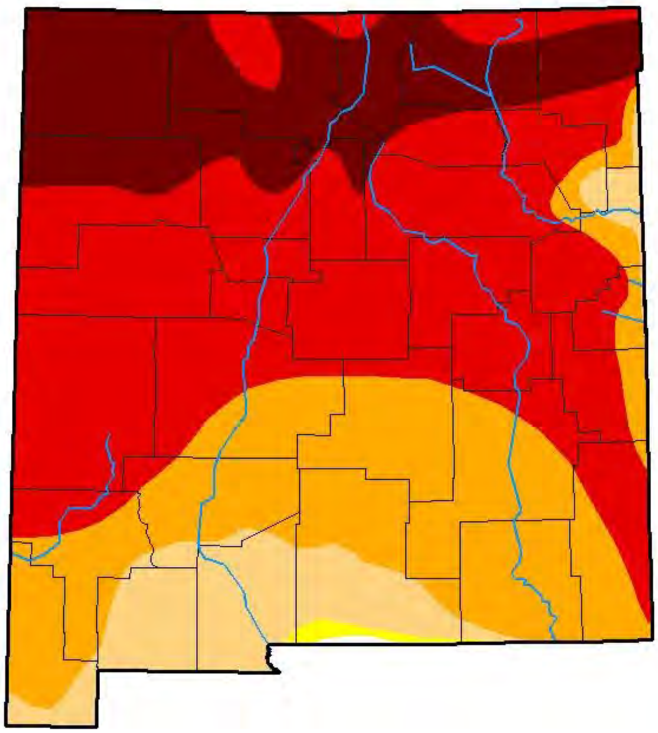
U.S. Drought Monitor

New Mexico

May 29, 2018

(Released Thursday, May. 31, 2018)

Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.16	99.84	99.35	89.39	62.86	18.27
Last Week *05-22-2018*	0.00	100.00	99.46	90.31	63.26	20.27
3 Months Ago *02-27-2018*	0.08	99.92	99.51	77.99	5.23	0.00
Start of Calendar Year *01-02-2018*	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year *09-26-2017*	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago *05-30-2017*	73.18	26.82	6.56	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

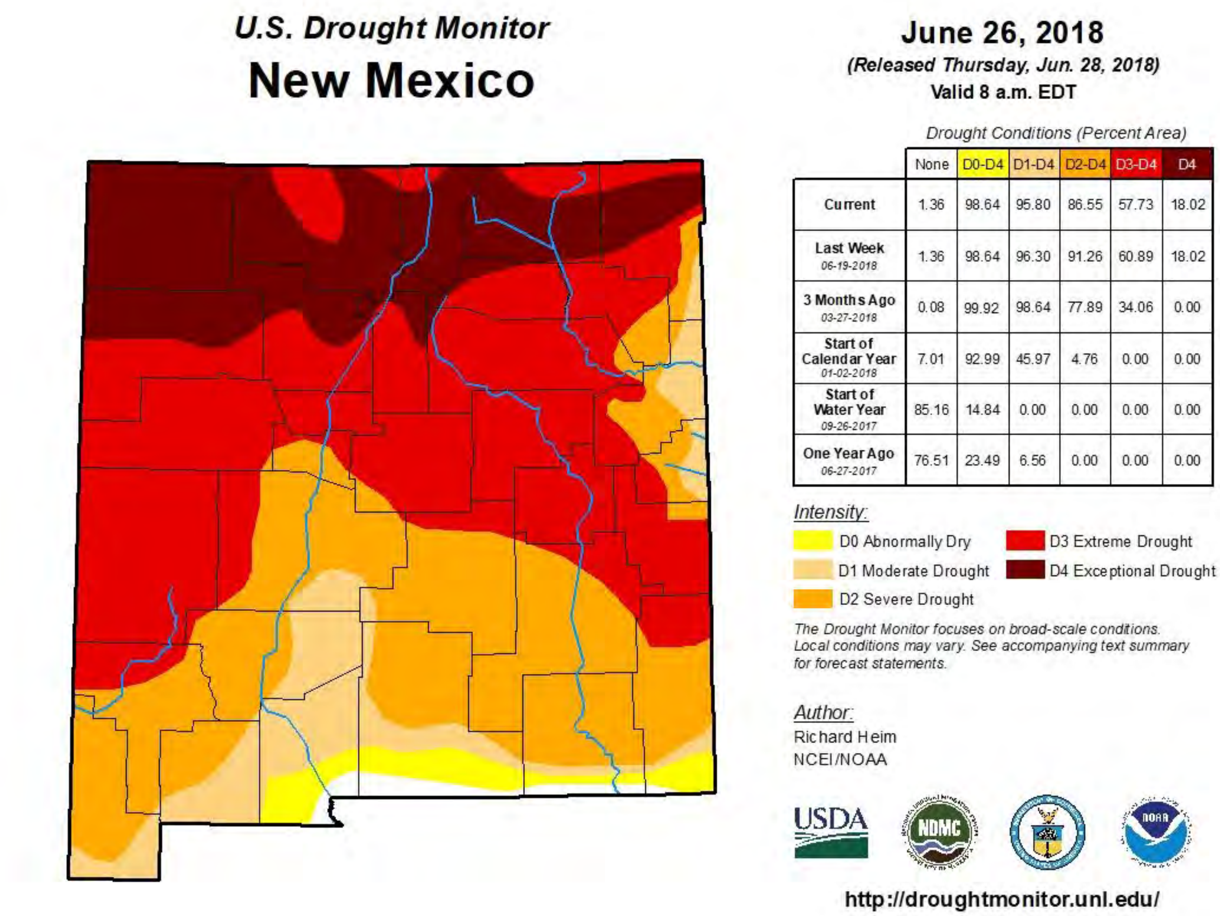
Author:

Anthony Artusa

NOAA/NWS/NCEP/CPC

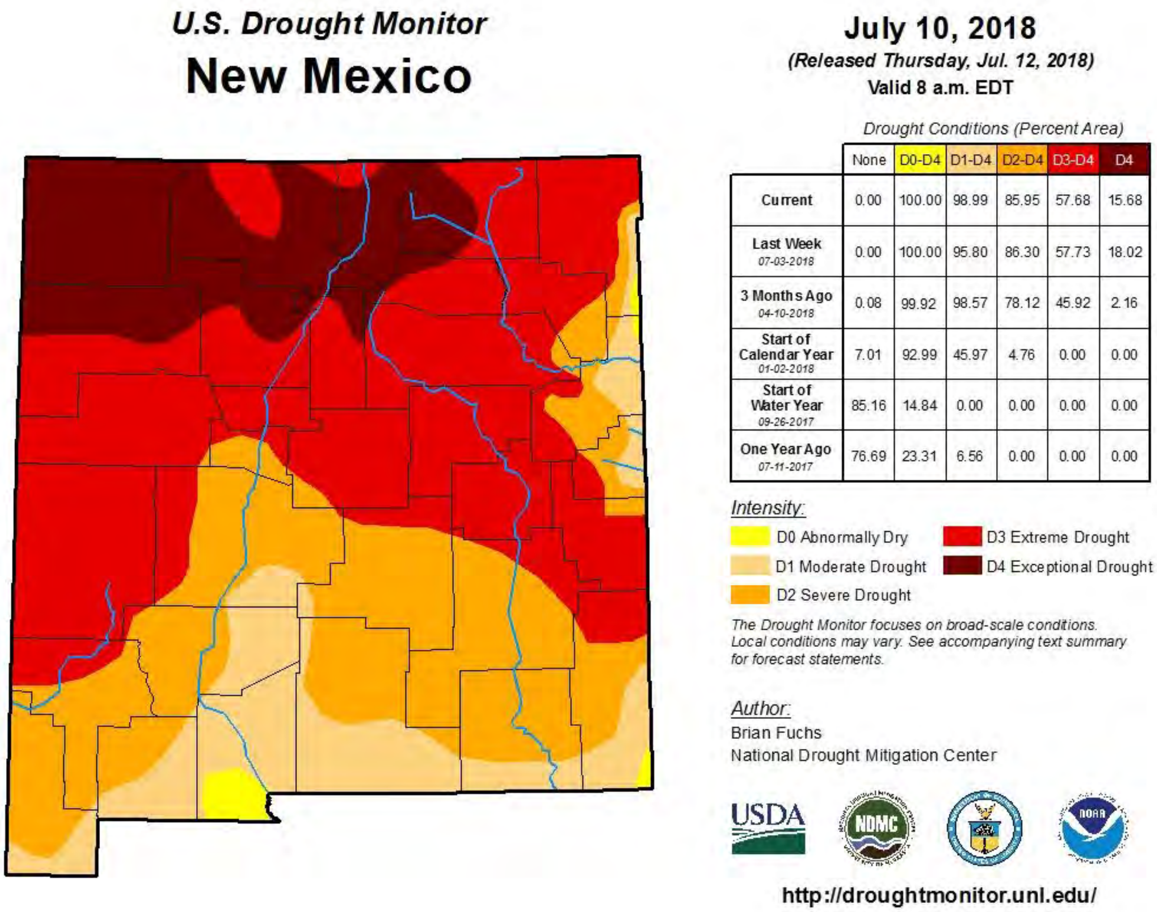
http://droughtmonitor.unl.edu/

Figure 4-36 June 2018 Drought Conditions



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.36	98.64	95.80	86.55	57.73	18.02
Last Week 06-19-2018	1.36	98.64	96.30	91.26	60.89	18.02
3 Months Ago 03-27-2018	0.08	99.92	98.64	77.89	34.06	0.00
Start of Calendar Year 01-02-2018	7.01	92.99	45.97	4.76	0.00	0.00
Start of Water Year 09-26-2017	85.16	14.84	0.00	0.00	0.00	0.00
One Year Ago 06-27-2017	76.51	23.49	6.56	0.00	0.00	0.00

Figure 4-37 July 2018 Drought Conditions



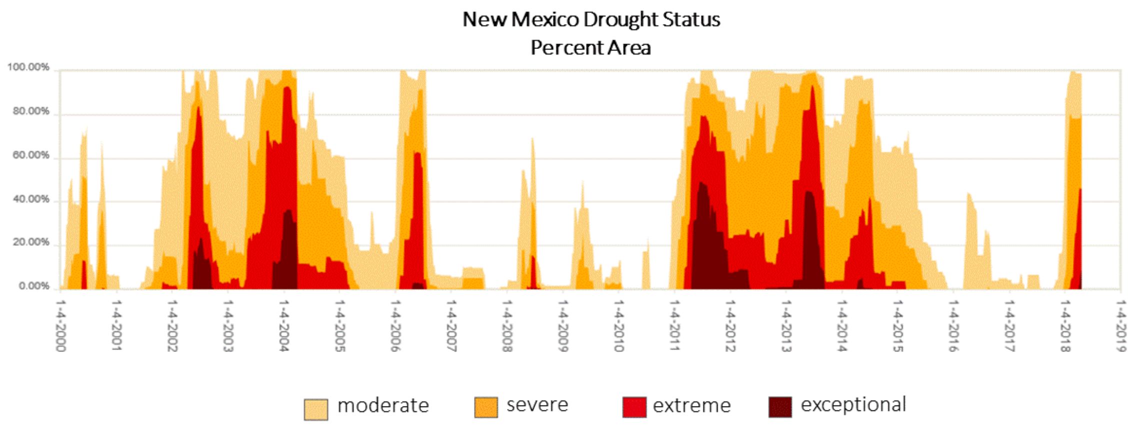
As of July 2018, all of New Mexico currently experiences some degree of drought. The southern region of Preparedness Areas 1 and 6 are experiencing moderate drought, and only a very small portion of Preparedness Areas 1 and 6 are experiencing abnormally dry conditions. All Preparedness Areas are experiencing severe and extreme drought, and parts of Preparedness Areas 2, 3, 4, and 5 are experiencing exceptional drought. Overall, the northern, and particularly northwest, portions of the State are experiencing worse drought conditions than the southern portions of the State.[20]

Another way to show drought over time is using the U.S. Drought Monitor Statistic Graph[21] shown in Figure 4-38 below.

20 Source: https://weather.nmsu.edu/

[21] Source: http://droughtmonitor.unl.edu/MapsAndData/Graph.aspx

Figure 4-38 Drought Monitor Statistic Graph



In comparing drought for the State from 2011 to 2017, the summers of 2011 and 2013 were the most extreme with significant areas of the State in the category of exceptional drought. While there were some occurrences of exceptional drought in 2014, there were no occurrences in 2015-2017, whereas the State experienced months of exceptional drought in 2013.[22]

The trend for drought for the State had been decreasing from 2013 to 2016 as the precipitation has increased over the past few years. Figure 4-39 to Figure 4-43 illustrate observed precipitation for New Mexico from 2013 to 2016. Comparing all five years, the precipitation has increased resulting in the level of drought decreasing, however, precipitation varies regionally within the state[23]

[22] Source: http://droughtmonitor.unl.edu/MapsAndData/DataTables.aspx?state,NM
[23] Source: http://water.weather.gov/precip/index.php?location_type=wfo&location_name=ABQ

Figure 4-39 Observed Precipitation – 2013

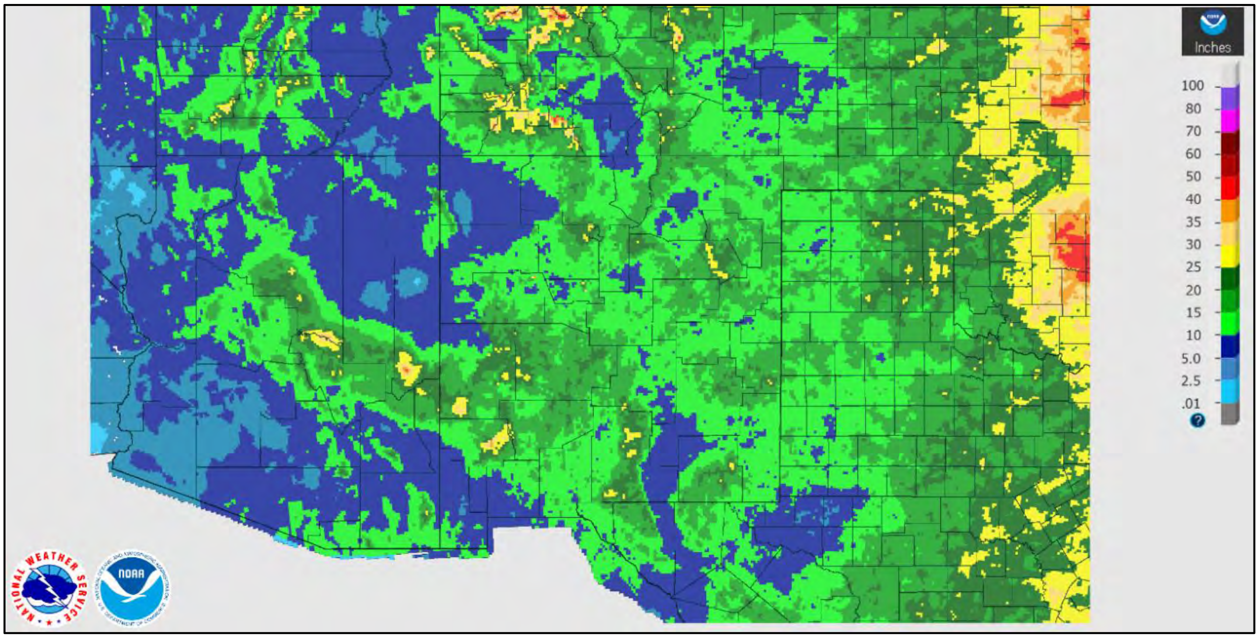


Figure 4-40 Observed Precipitation – 2014

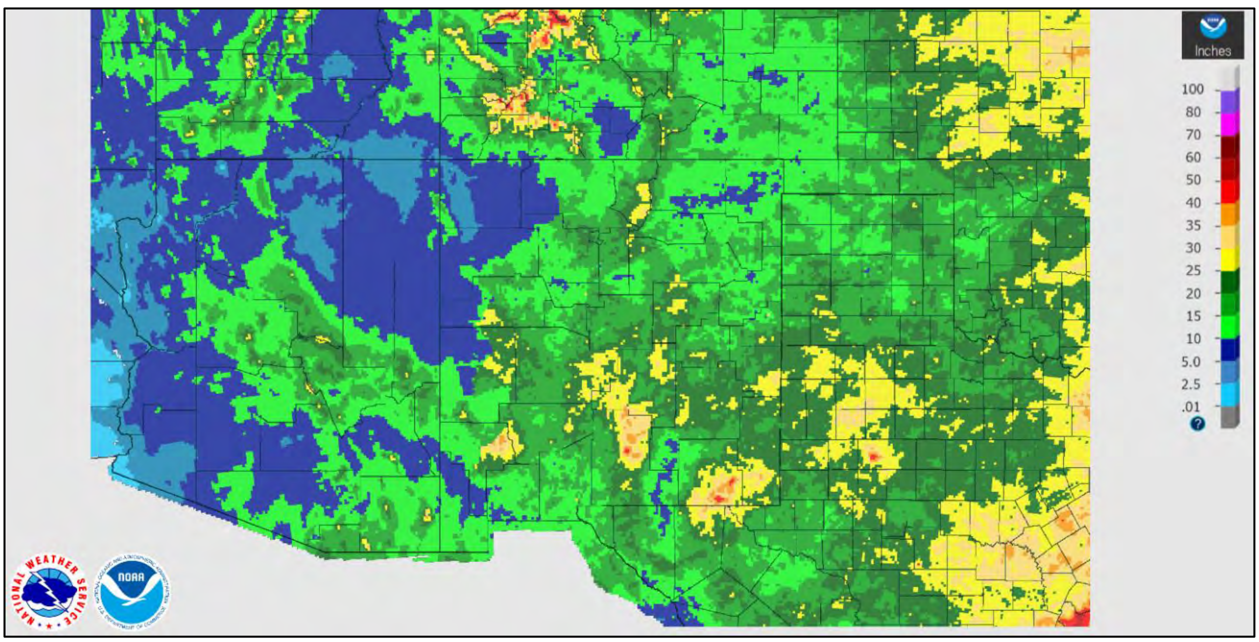


Figure 4-41 Observed Precipitation – 2015

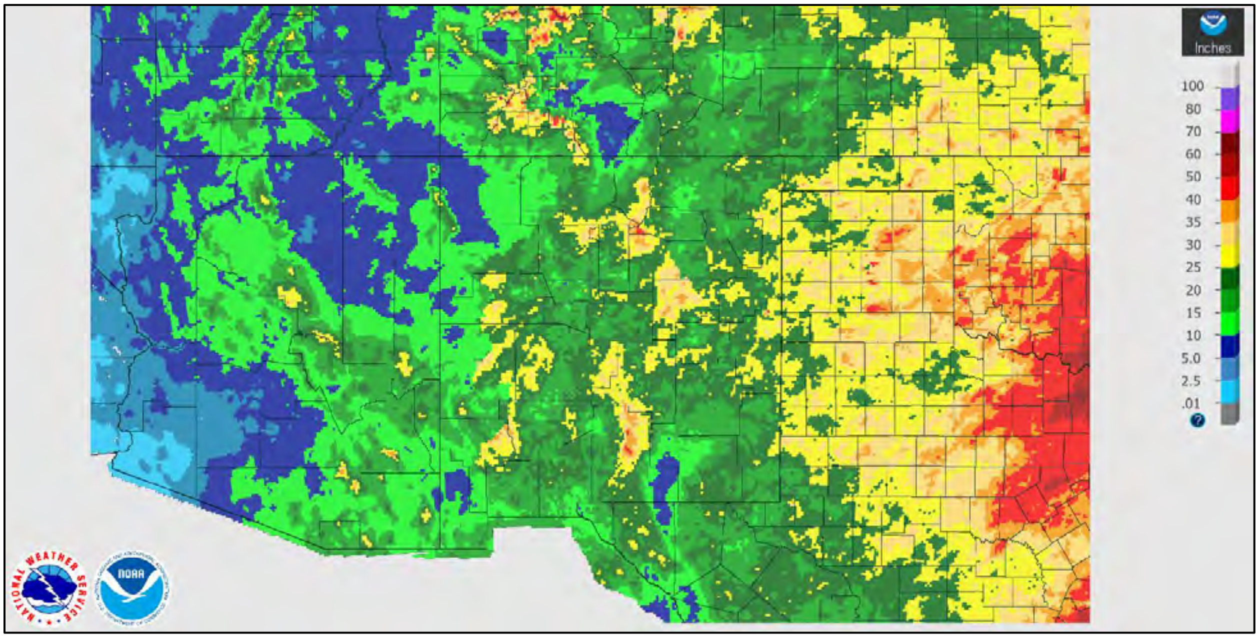


Figure 4-42 Observed Precipitation – 2016

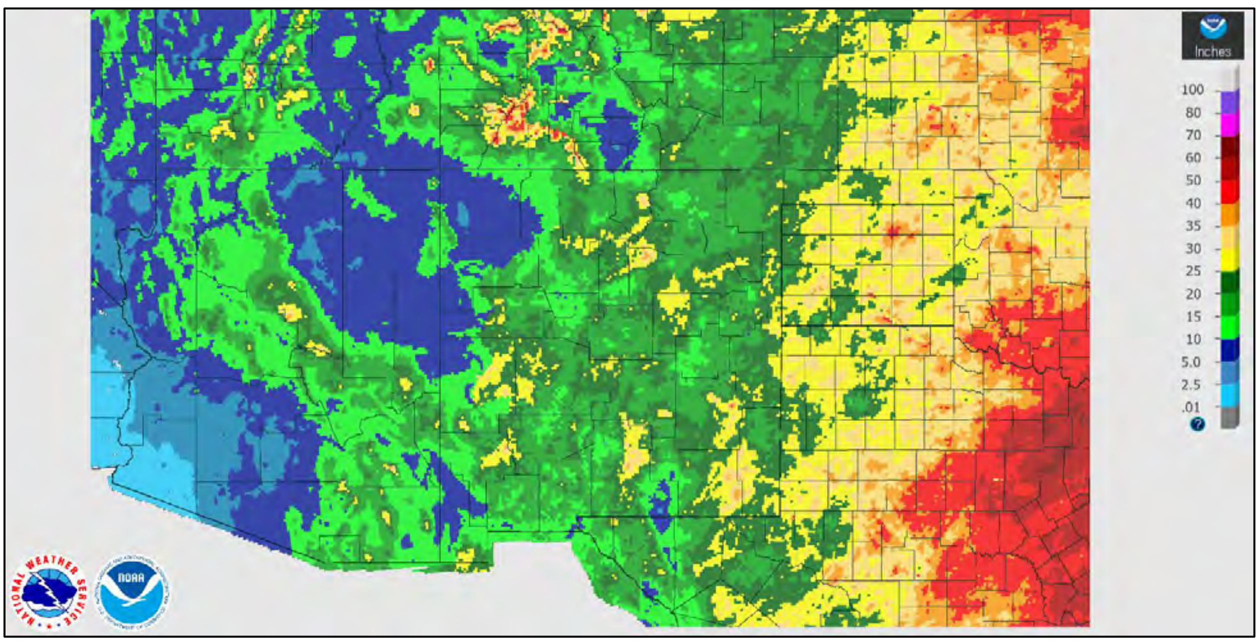
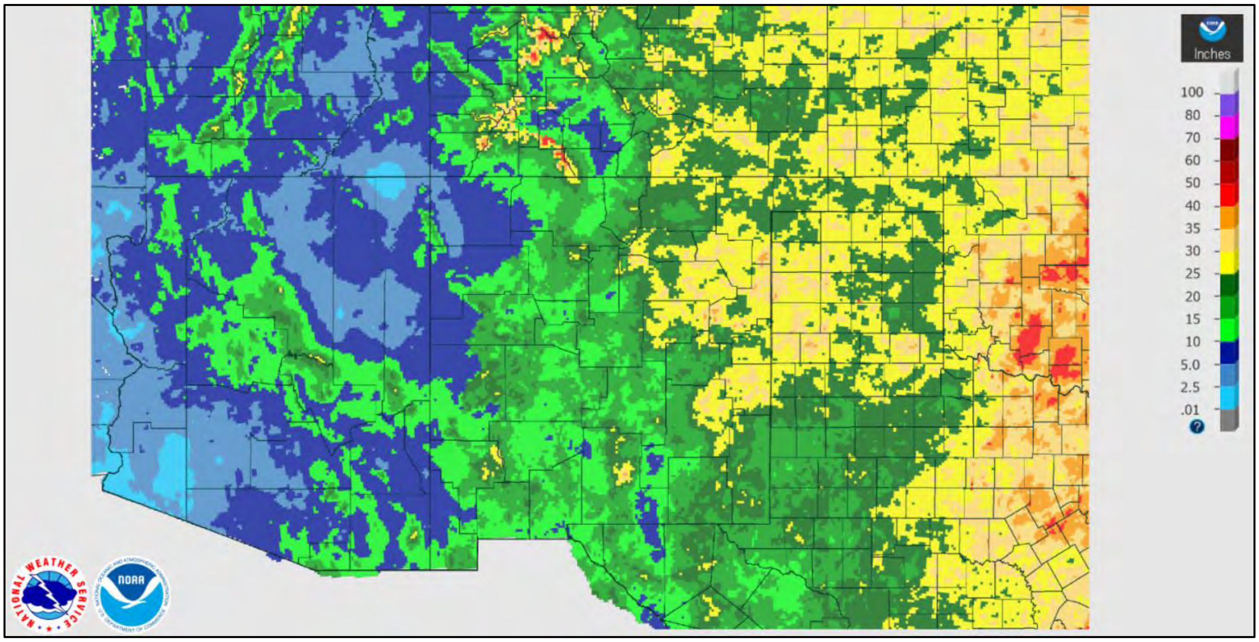


Figure 4-43 Observed Precipitation – 2017



The current online NCDC database contains data from March 1996 to April 2017, entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC shows that there have been 2,832 recorded drought events State-wide. These events have caused $2 million in property damage and over $14 million in crop damage. In addition, between 1995 and May 2007, there were three State declared disasters for effects related to drought, primarily for loss of domestic drinking water: May 1996, May 2000, and June 2002. The total cost estimated due to these events for this time period is $279,459. However, indirect costs are estimated to be between $50-100 million. Figure 4-44 highlights significant past droughts by Preparedness Area.

Figure 4-44 Significant Past Occurrences - Drought[24]

Date	Location	Significant Event

[24] Source: *Drought Task Force Report* - http://www.nmdrought.State.nm.us/ and https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index

Date	Location	Significant Event
January 2015	Bernalillo, Catron, Cibola, Colfax, DeBaca, Grant, Guadalupe, Harding, Hidalgo, Lincoln, Los Alamos, Luna, McKinley, Mora, Quay, Rio Arriba, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, and Valencia (Preparedness Areas 1, 2, 3, 4, 5, and 6	The US Department of Agriculture designated 26 counties statewide as natural disaster areas due to drought.
Winter 2014	Catron, Chaves, Colfax, Curry, DeBaca, Dona Ana, Grant, Guadalupe, Harding, Hidalgo, Lea, Lincoln, Los Alamos, Luna, Mora, Otero, Quay, Rio Arriba, Roosevelt, San Juan, San Miguel, Sandoval, Santa Fe, Sierra, Socorro, Taos, Torrance, Union, and Valencia (Preparedness Areas 1, 2, 3, 4, 5, and 6	The US Department of Agriculture designated 29 counties statewide as natural disaster areas due to drought.
Summer 2013	Bernalillo, Chaves, Eddy, Luna, Sierra, Catron, Hidalgo, Otero, Socorro, Dona Ana, Lincoln, Sandoval, Valencia, McKinley, Sante Fe, Cibola, Guadalupe, Rio Arriba, Torrance, De Baca, Los Alamos, and San Juan (Preparedness Areas 1,3, 4, and 5)	The US Department of Agriculture designated 19 counties, from Union and San Juan in the north to Eddy County in the southeast, as natural disaster areas due to heat and drought.
May 2010	Colfax and Harding County (Preparedness Area 3)	The US Department of Agriculture designated Colfax and Harding counties as natural disaster areas due to drought and high winds.

Date	Location	Significant Event
Summer 2008	Northern New Mexico (Preparedness Area 2 and 3)	In the summer of 2008, the agriculture community became concerned as the State was dealing with the endangered silvery minnow. Farmers were faced with a low snowpack that feeds irrigation reservoirs in northern New Mexico and low rainfall with forecasted continuing dry conditions cut irrigation supplies dramatically. Compounding issues more, legal issues were being considered ordering farmers to share the river supply to save the silvery minnow. This impacted financial capabilities in the agricultural community and decreased agricultural supply.

Emergency Management Agency Declared Disasters from Drought

New Mexico Department of Homeland Security and Emergency Management (DHSEM) reports one State Declared Disaster for drought between 2003 and 2017, which had State reimbursement funds available. According to DHSEM records, the total cost for the 2012 State declared drought event was $500,000 (Figure 4-45). Research into locations for each disaster would need to be completed prior to breaking-out the figures by Preparedness Area. In the State of New Mexico, there were no Presidential Disaster Declarations for drought from 2003 through 2017. From 2012 to 2018, there were 70 USDA Secretarial Disaster designations due to drought in New Mexico, as described in Figure 4-46. All Preparedness Areas have experienced an USDA Secretarial designation due to drought.

Figure 4-45 State Disaster Event Information 2003 through 2017

Event Type	State Executive Order	Dollar Loss*
Drought	2018-031	Not available
Drought	2012-006	$500,000.00
Total	**1**	**$500,000.00**

Figure 4-46 USDA Secretarial Drought Designations, 2012 - 2018

Date	Designation Numbers	Counties	Preparedness Areas
1/1/2012 - continuing	S3260, S3267, S3282, S3284, S3288	State-wide	1, 2, 3, 4, 5, 6
4/17/2012 - continuing	S3289	San Juan	4
5/22/2012 - continuing	S3295	Bernalillo, Catron, Cibola, McKinley, Sandoval, Socorro, Valencia	4, 5, 6
6/12/2012 - 8/6/2012	S3331	Bernalillo, Cibola, Los Alamos, McKinley, Rio Arriba, San Juan, Sandoval, Santa Fe	3, 4, 5
9/1/2012 - continuing	S3466	San Juan	4

Date	Designation Numbers	Counties	Preparedness Areas
10/1/2012 - continuing	S3461	State-wide	1, 2, 3, 4, 5, 6
11/1/2012 - continuing	S3465, S3456	Colfax, Union, Curry, Doña Ana, Eddy, Lea, Otero, Quay, Roosevelt, Union	1, 2, 6
11/15/2012 - continuing	S3463, S3474	Union, Bernalillo, Guadalupe, Lincoln, San Miguel, Santa Fe, Socorro, Torrance, Valencia	1, 2, 3, 5
1/1/2013 - continuing	S3455, S3490, S3494	State-wide, minus the northeast corner	1, 3, 4, 5, 6
4/1/2013 - 10/31/2013	S3681	Curry, Dona Ana, Eddy, Lea, Otero, Quay, Roosevelt, Union	1, 2, 6
4/30/2013 - continuing	S3546	Eddy	1
4/23/2013 - 6/24/2013	S3514	Hidalgo	6
5/1/2013 - continuing	S3518, S3548	Colfax, Taos, Rio Arriba	2, 3
6/4/2013 - continuing	S3539, S3541	San Juan, Lea	1, 4
6/18/2013 - continuing	S3545	Rio Arriba, San Juan	3, 4
9/1/2013 - 10/26/2013	S3634	San Juan	4
10/1/2013 - continuing	S3630	State-wide, minus the northwest corner	1, 2, 3, 5, 6
11/1/2013 - 1/6/2014	S3627, S3633	Colfax, Union, Curry, Lea, Quay, Roosevelt, Union	1, 2
11/15/2013 - continuing	S3632	Union	2
12/17/2013 - N/A	S3646	Chaves, Eddy, Lea, Roosevelt	1
1/1/2014 - continuing	S3651, S3653, S3781	State-wide	1, 2, 3, 4, 5, 6
1/28/2014 - N/A	S3645	State-wide, minus the southwest	1, 2, 3, 4, 5
2/18/2014 - N/A	S3649	Hidalgo	6
2/25/2014 - N/A	S3678	Catron, Dona Ana, Grant, Lincoln, Luna, Otero, Sierra, Socorro	1, 5, 6
3/4/2014 - N/A	S3658	Dona Ana, Grant, Hidalgo, Luna, Otero, Sierra	6
5/1/2014 - N/A	S3715	Rio Arriba, San Juan	3, 4
7/1/2014 - N/A	S3735	Dona Ana, Otero	6
7/15/2014 - N/A	S3740	Lea	1
9/4/2014 - N/A	S3792	San Juan	4
10/1/2014 - N/A	S3788	State-wide, minus the southwest	1, 2, 3, 4, 5
10/16/2014 - N/A	S3790	Union	2
11/1/2014 - N/A	S3785, S3791	Colfax, Union, Quay	1, 2
1/1/2015 - N/A	S3783, S3798, S3802	State-wide	1, 2, 3, 4, 5, 6
6/7/2016 - N/A	S4005	Hidalgo	6

Date	Designation Numbers	Counties	Preparedness Areas
11/15/2016 - N/A	S4145, S4152	Union	2
10/31/2017 - N/A	S4270	Hidalgo	6
11/14/2017 - N/A	S4287	Curry, Lea, Quay, Roosevelt, Union	1, 2
11/15/2017 - N/A	S4286	Union	2
1/1/2018 - N/A	S4279	Catron, Cibola, Grant, Hidalgo, McKinley, San Juan	4, 6
1/16/2018 - N/A	S4289, S4291	Colfax, Union, Chaves, Curry, De Baca, Guadalupe, Harding, Lea, Quay, Roosevelt, San Miguel	1, 2
1/23/2018 - N/A	S4294	Catron, Grant, Hidalgo, Luna, Sierra	6
1/30/2018 - N/A	S4300	State-wide	1, 2, 3, 4, 5, 6
2/6/2018 - N/A	S4280, S4307	Union, Lea	1, 2
2/13/2018 - N/A	S4285	Colfax, Harding, Mora, Taos, Union	2, 3
3/1/2018 - N/A	S4316	State-wide, minus the northeast corner	1, 3, 4, 5, 6
3/27/2018 - N/A	S4306	Bernalillo, Catron, Chaves, Cibola, De Baca, Guadalupe, Lincoln, McKinley, Quay, Roosevelt, Sandoval, Socorro, Valencia	1, 4, 5, 6
4/1/2018 - N/A	S4308	San Juan	4
4/10/2018 - N/A	S4310	State-wide, minus the northwest corner	1, 2, 3, 5, 6
5/1/2018 - N/A	S4320	Colfax, San Juan, Taos	2, 3, 4
5/15/2018 - N/A	S4329	Rio Arriba, San Juan, Taos	3, 4
5/29/2018 - N/A	S4335	Lea	1

Due to the extreme drought of the 2012 season, the Governor established a Drought Task Force, comprised of representatives from multiple State agencies, including the Office of the State Engineer, Interstate Stream Commission, Environment Department, Economic Development Department, Department of Health, Tourism Department, Department of Agriculture, Finance Authority, Department of Finance and Administration, Homeland Security and Emergency Management, Energy Minerals and Natural Resources Department, and the Office of the Governor.

The most recent Drought Executive Order was signed by Governor Martinez on July 11, 2018 (Executive Order 2018-031). This order summarizes the current drought conditions in New Mexico and declared a state of emergency State-wide. The Executive Order also directs the following actions:

- A review of the New Mexico Drought Plan and revisions as needed including an assessment of current conditions, evaluation of drought impacts and recommendations for response and mitigation actions to be taken.
- The New Mexico State Drought Task Force to review and recommend actions to the Governor and to other governing bodies in the State.

- For the New Mexico State Drought Task Force to recommend to the Governor recipients and objects of emergency funding.
- Firework bans and other reasonable fire prevention measures were to be implemented by local governing bodies.

4.5.2.3 *Frequency*

Drought is a regular occurence in all areas of New Mexico and visits the State in recurring cycles. Experts predict that drought conditions are likely to continue for the foreseeable future. Periods of recent extreme meteorological drought, as defined by a Palmer drought index of -4.0 or lower, have been noted in the mid-1930's in the Northeastern Plains and Central Highlands, in 1947 in the Central Highlands, in the 1950's throughout the State, in 1963-64 in the Northern Mountains, in 1964 in the Southeastern Plains, and in 1967 in the Northern Mountains. Drought again started in 2000 and continued till 2004. The longest general drought since 1930 was in the 1950's.

4.5.2.4 *Probability of Occurrence*

Drought conditions can create serious problems for many New Mexico communities, farms, ranches, and open spaces. Fire danger is high, water reservoirs run low, and in some cases, some towns have taken dramatic steps to reduce basic water consumption in their residents' homes and businesses. According to State Engineer's Office, 90% of New Mexico faced severe drought conditions at some point during 2012, with the remaining areas facing moderate drought. The 2011 water year was also the second driest on record. The probability for this hazard event is 100%.

4.5.2.5 *Risk Assessment*

The entire State of New Mexico is susceptible to some type of drought situation. Given that drought is a slow-moving hazard without an event to mark its arrival, a one-time drought can be difficult to define. However, the consequences of a moderate to severe drought in the State pose significant challenges. Long-term solutions for coping with a limited water supply will require increased cooperation between urban users and agricultural use. Critical facilities in rural parts of the State may need to increase or diversify their sources of water.

A prolonged drought also increases the probability of other hazards. Forests become more susceptible to wildfires and native vegetation dies, leaving exposed soils susceptible to erosion, flash flooding, and dust storms. Section 4.3 of this Plan describes the drought-wildfire-flood cycle experienced in the State. The SHMPT has identified drought as a priority hazard for each Preparedness Area in the State.

Figure 4-47 identifies potential impacts from a drought for the purposes of EMAP compliance.

Figure 4-47 Potential Impacts from Drought

Subject	Potential Impacts
Agriculture	Drought is one of the most devastating conditions to the agriculture industry. Food and fiber production is adversely affected in every way during a drought. Compounding that many agriculture crops are annual and one season lost is often times bankrupting.

Subject	Potential Impacts
Health and Safety of The Public	Increased number of wildfires; health problems related to low water flows and poor water quality; health problems related to dust.
Health and Safety of Responders	Increased wildfire risk coupled with limited water supply makes it more challenging for responders to fight fires and puts responders at greater risk.
Continuity of Operations	Impacts expected for operations that are dependent on water (hydro power).
Delivery of Services	Impacts expected for operations that are dependent on water.
Property, Facilities, Infrastructure	Potential impacts due to increase in dust and land subsidence.
Environment	Animal habitat and food supply can dwindle causing species die-off; poor soil quality; loss of wetlands; increased soil erosion; migration of wildlife.
Economic Condition	Decreased tourism; crop loss; decreased land prices; unemployment from drought-related declines in production; increased importation of food; rural population loss.
Public Confidence	Reduced incomes; fewer recreational activities; Increase in food costs due to loss of crops and livestock; loss of aesthetic values; loss of cultural sites.

4.5.2.6 *Data Limitations*

It is difficult to determine when a drought hazard event starts. In most cases, the dry weather conditions that cause droughts will need to persist for a while before it becomes clear that drought conditions exist. There are also data limitations in determining the available quantity and quality of groundwater. The costs associated with the drought are difficult to quantify. Crop losses are straightforward, but losses from tourism dollars due to drought and uncertainty about availability of water are more difficult to define.

4.5.2.7 *What Can Be Mitigated?*

Continuous monitoring of the drought situation is ongoing through the Governor's Drought Task Force Monitoring Working Group. The New Mexico Office of State Engineer continues to engage in various Federal drought groups such as the National Integrated Drought Information System (NIDIS) Drought Early Warning System and remains committed to drought assessment. In December 2016, the NIDIS published the Implementation Plan Update[25], which provides a comprehensive, interagency approach for drought monitoring, forecasting, and early warning planning and preparing.

Identifying the first phases of the drought and reacting with water conservation at the earliest time will help to mitigate drought later. Mitigation management for drought is a proactive process. The best practices include early assessment, public education, water conservation programs, and diversifying sources of water. However, most of the progress has been at the Local and State level since there is no Federal water conservation or drought policy.

Drought can have lasting impacts on a community, including contributing to the risk of other hazards such as wildfire and flooding. To prevent the cycle of drought, wildfire, and flooding, a systematic approach is needed that will institute a proactive method of mitigation. Two sources of information, developed by the USACE, to be evaluated include the Burn Scar Hydrology, and the Debris Flow Impact, which helps to establish non-regulatory corridors in areas where development is discouraged due to risk from increases of debris flow.

In March 2016, a presidentially declared memorandum and federal action plan was passed for Building National Capabilities for Long-Term Drought Resilience. This helped to established initiatives at all levels of government to better prepare communities for long-term drought and the associated impacts.[26]

The long-term future of water is a fundamental concern to all local governments in the State. Water use projections indicate that depletion of regional water resources will continue unless actions are taken to conserve and utilize water more efficiently with the ideal goal of balancing supply with demand.

4.5.2.8 *Changing Weather Patterns*

The frequency, duration, and intensity of episodic drought would likely increase in the presence of warmer mean annual temperatures due to long-term, changing weather patterns. It is important to note that climate change impacts will increase vulnerability to several natural hazards, including drought. Increased warming, drought, and insect outbreaks, all caused by or linked to climate change, have increased wildfires and impacts to people and ecosystems in the Southwest. The 2014 publication Climate Change Impacts in the United States cautions that climate change is exacerbating the major factors that lead to wildfire: heat, drought, and dead trees.

4.5.3 Earthquake

4.5.3.1 *Hazard Characteristics*

Earthquake hazards principally arise from ground motions due to seismic waves (elastic waves traveling through the earth). Such ground motions can be generated by explosions or by other phenomena that apply forces to the surface or interior of the earth. However, earthquakes are most commonly due to rapid slip along a zone of weakness in the Earth's crust (i.e., a fault). This process releases tectonic stress and converts a small portion (a few percent) of the associated strain energy into seismic waves that can propagate for great distances. Although earthquakes in the United States during the past few decades have caused less economic loss annually than other hazards, they have the potential to

[25] Source: https://www.drought.gov/drought/sites/drought.gov.drought/files/Implementation-Plan-December-2016-Update.pdf
[26] Source: https://www.fema.gov/media-library-data/1475601009941-73b6d676e32a3282f81ec06953f5d051/Drought_Planning_Fact_Sheet_Final_508.pdf

cause great and sudden losses. Within one to two minutes, an earthquake can devastate a city through ground shaking, surface-fault ruptures, and ground subsidence.

Earthquakes occur most frequently near tectonic plate boundaries, but may also occur within plate interiors. Tectonic plates include the Earth's crust and shallow mantle (lithosphere) that slowly move on top of a more ductile layer in the underlying mantle (aesthenosphere). High amounts of shearing occur where plates slide past each other near plate boundaries, and earthquakes are a consequence of the accompanying fault slip and release of elastic strain. However, damaging earthquakes can also occur within plate interiors in regions where elastic strain accumulates, or where the frictional properties of faults are perturbed due to volcanic, tectonic, or anthropogenic processes (e.g., fluid withdrawal or injection).

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties typically result from falling objects and debris, or from forces that damage or demolish buildings and other structures. Disruption of communications, electrical power supplies, and gas, sewer, and water lines should be expected in a large earthquake. Earthquakes can also trigger widespread fires, dam or levee failures, landslides, or releases of hazardous material.

The vibration or shaking of the ground during an earthquake is described by the time history of its ground motion (when recorded, this record is called a seismogram). The severity of ground motion generally increases with the amount of energy released and decreases with distance from the earthquake hypocenter (the geographic location and depth of the earthquake source). Earthquakes generate elastic waves, both in earth's interior (body waves, including P and S waves) and along the earth's surface (surface waves). P (primary) waves, also known as pressure waves, in the earth's interior are physically similar in character to sound waves in air. P waves have a back-and-forth (longitudinal) motion along their direction of travel. They move through the shallow earth at speeds between approximately 1 to 4 km/s (roughly 2000 to 9000 miles/hour). P waves typically produce predominantly vertical forces on buildings. S (secondary) waves, also known as shear waves, have a transverse (side-to-side relative to their propagation direction) motion and travel more slowly (by about a factor of 0.6) than P waves. S waves can cause significantly more damage than P waves because their amplitudes are typically larger and their shear motion produces horizontal forces, which structures are typically much less able to sustain without damage. Surface waves generate both shear and vertical forces. Surface waves can be highly damaging in areas where development has occurred in basins whose geometries and weakly consolidated sediment can cause amplification of these waves (the extensive damage to Mexico City in 1985 is a type example of this).

Earthquakes are commonly described in terms of magnitude and intensity. Magnitude is a fixed property of the earthquake source estimated from seismograms, and is proportional to the logarithm of the total energy released (an increase of one in earthquake magnitude indicates an approximately 32-fold increase in energy). Intensity, in contrast, varies spatially and with local geology, and describes the strength of ground motion at specific locations. Thus, a large, distant earthquake can generate the same intensity at a given site than a much smaller, local earthquake.

There are several generally consistent magnitude scales in use by the scientific and hazard community, based on different observable characteristics of seismic waves. The Richter Scale (also known as local magnitude, M_L) is the original magnitude scale, but it is technically applicable only to southern California and is scientifically obsolete. The three extensively quoted scales are the body wave magnitude, m_b, the surface wave magnitude, M_s, and the moment magnitude, m. Body and surface wave magnitudes vary because they are based on the amplitudes of observed body and surface waves, respectively. These components of the seismic wavefield can vary in relative size for a given earthquake (for example, earthquakes with shallower hypocenters generally produce corresponding larger surface waves than those with deeper hypocenters). The moment magnitude is based on the fundamental forces produced by the earthquake fault motion, and is coming into increasing use as the de facto measure of earthquake size. All three magnitudes usually agree to within 0.5 of a magnitude unit, with larger departures only commonly occurring for very large earthquakes (magnitudes in excess of 7.5) or earthquakes of magnitudes less than 5.7.

Empirical relationships suggest that earthquake magnitude is well-correlated (via log-linear regressions) to some rupture parameters (Wells and Coppersmith, 1994). These parameters include rupture length, downdip rupture width (i.e. along the fault plane), and rupture area. For example, estimated moment magnitudes (m) for earthquakes with surface rupturing lengths of 10 and 50 km are 6.24 and 7.05, respectively. Correlations between these parameters and magnitude are statistically significant across different tectonic and geographic areas.[27]

The commonly used Modified Mercalli Intensity (MMI) Scale is expressed in Roman numerals. It is based on the amount of shaking and specific kinds of damage to man-made objects or structures. This scale has 12 classes and ranges from I (not felt) to XII (total destruction). A quantitative method of expressing an earthquake's severity is to compare its acceleration history (commonly the peak acceleration) to the normal acceleration due to gravity (g=9.8 meters per second squared, or 980 cm/sec/sec). Peak ground acceleration (PGA) measures the rate of change of motion relative to the rate of acceleration due to gravity and is proportional to the forces exerted on a structure. For example, an acceleration of the ground surface of 244 cm/sec/sec equals a PGA of 25.0 percent. A higher PGA means a higher level of ground acceleration and a higher probability of structural damage. Ordinary structures typically begin to be damaged structurally at about 10% PGA. Figure 4-48 illustrates the comparison for scales of magnitude and intensity.

Figure 4-48 Different Magnitudes of Earthquakes[28]

PGA (% g)	Magnitude (Richter)	Intensity (MMI)	Description
<0.17	1.0 – 3.0	I	I. Not felt except by a very few under especially favorably conditions.
0.17 – 1.4	3.0 – 3.9	II – III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.

[27] Source: Wells, D.L., and Coppersmith, K.J., 1994, New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement: Bulletin of the Seismological Society of America, v. 84, no. 4, p. 974-1002.
[28] Source: http://pubs.usgs.gov/fs/fs030-01/

PGA (% g)	Magnitude (Richter)	Intensity (MMI)	Description
1.4 – 9.2	4.0 – 4.9	IV – V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 – 34	5.0 – 5.9	VI – VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damaged negligible in buildings of good design and construction; slight to moderate in well-build ordinary structures; considerable damage in poorly built or badly designed structures; chimneys broken.
34 – 124	6.0 – 6.9	VIII – IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
>124	7.0 and higher	X or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed and foundations. Rails bent. XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown in the air.

4.5.3.2 *Historic and Prehistoric Earthquakes in New Mexico*

The Rio Grande rift is a major tectonic feature of western North America created by crustal stretching over the past 28 million years. It is expressed on the surface of the earth as a series of elongated, north-south trending basins that run from central Colorado, through the central parts of New Mexico, into northern Mexico where it merges with the greater Basin and Range Province. Because the rift guides the path of the Rio Grande in New Mexico, it is the most highly populous sector of the State. Much of New Mexico’s historical seismicity has been concentrated in the Rio Grande Valley between Socorro and Albuquerque, with about half of the earthquakes of intensity VI or greater (MMI) that occurred in the State between 1868 and 1973 being centered in this region.

Several major fault lines in the Rio Grande rift occur within 10 miles of several New Mexico cities, and studying their past activity is critical to understand their potential for future earthquakes and ground rupture. Paleoseismic studies constrain the age and number of prehistoric earthquakes that rupture the Earth's surface. Such studies incorporate observations and geologic data from outcrops of fault lines or trenches dug across fault lines. Based on these studies, several fault lines have been interpreted to have ruptured in the last 20,000 years and commonly have rupture recurrence intervals of about 10,000 to 40,000 years. These fault lines include the Sangre de Cristo fault near Taos, the Pajarito fault system near Los Alamos, several faults in the Albuquerque area, the Hubbell Spring fault east of Los Lunas and Belen, the Socorro Canyon and La Jencia faults near Socorro and Magdalena, the Alamogordo fault along the foot of the Sacramento Mountains, and the Organ fault near the White Sands Missile Range headquarters 18 miles east of Las Cruces. These faults can be considered to be capable of producing powerful earthquakes in the future.[29]

Historic earthquakes in the southwestern U.S. and northern Mexico region include a magnitude ~7.5 earthquake in northern Mexico in 1887 (the Sonoran Earthquake), numerous magnitude four to six earthquakes in the Socorro areas throughout the 20th century (most notably two earthquakes near magnitude six in 1906), and magnitude four to 5+ events in Cerrillos and Dulce in 1918 and 1966, respectively. The net earthquake threat to the State is considered moderate from a national perspective. However, the Sonoran Earthquake (magnitude of ~7.5) illustrates the damage incurred from an earthquake involving faults which last ruptured >100,000 years ago. This earthquake serves as a worst-case analogue for the hazards posed by Rio Grande rift faults, which also have relatively high rupture recurrence intervals (10,000 to 40,000 years) and similar lengths as the faults involved in the Sonoran Earthquake.[30]

Thousands of recorded earthquakes have been measured in New Mexico and analyzed in recent decades by the New Mexico Institute of Mining and Technology and/or the U.S. Geological Survey. Figure 4-50 depicts the approximate epicenters for past earthquakes in New Mexico and surrounding areas between 1962 and 2012. The Socorro area has been the most active earthquake region of the State during at least the past 150 years. During the past 45 years, approximately 50% of the seismic energy generated by earthquakes in New Mexico has been released in a region centered near Socorro, encompassing only about 2% of the State's total land area. This relatively high rate of earthquake activity in the Socorro region is due to a slowly inflating (~2 mm/year) sill of molten rock (magma) that is roughly 1,300 square miles in area and lies approximately 12 miles beneath the surface of the fault-bounded Rio Grande rift.

Some small earthquakes in New Mexico have also been triggered by human activity. Earthquake-like ground shaking is created by atomic bomb testing, including the explosion of the first atomic bomb at the Trinity Site in 1945 and subsequent underground explosions near Carlsbad in 1961 and east of Farmington in 1967. Many earthquakes in southeastern New Mexico may be related to oil and gas production and fluid reinjection. Earthquakes near Raton, NM and Trinidad, CO, show correlations with water injection associated with natural gas production, and a series of earthquakes recorded near the Heron and El Vado reservoirs in northern New Mexico may have been caused by the weight of the water in the reservoirs.

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[29] Source: Van Wijk, J., Axen, G., Koning, D., Sion, B., Gragg, E., Coblentz, D., and Abera, R., Opening history of the Rio Grande rift, southwestern United States, submitted to Geosphere and in review.

[30] Source: Bull, W.B., and Pearthree, P.A., 1988, Frequency and size of Quaternary surface ruptures of the Pitaycachi fault, northeastern Sonora, Mexico: Bulletin of the Seismological Society of America: vol. 78, no. 2, p. 956-978. Suter, M., 2013, Rupture of the Pitaycachi fault in the 1987 Mw 7.5 Sonora, Mexico Earthquake (southern Basin-And-Range Province): Geological Society of America Abstracts with Programs, vol. 45, no. 7, p. 607.

Figure 4-49 shows the identified faults located in the State of New Mexico.[31] Faults and associated folds are included that are believed to be the source of earthquakes with a magnitude greater than six during the Quaternary Period (the past 1,600,000 years).[32]

Figure 4-49 Preparedness Areas and Fault Lines in New Mexico

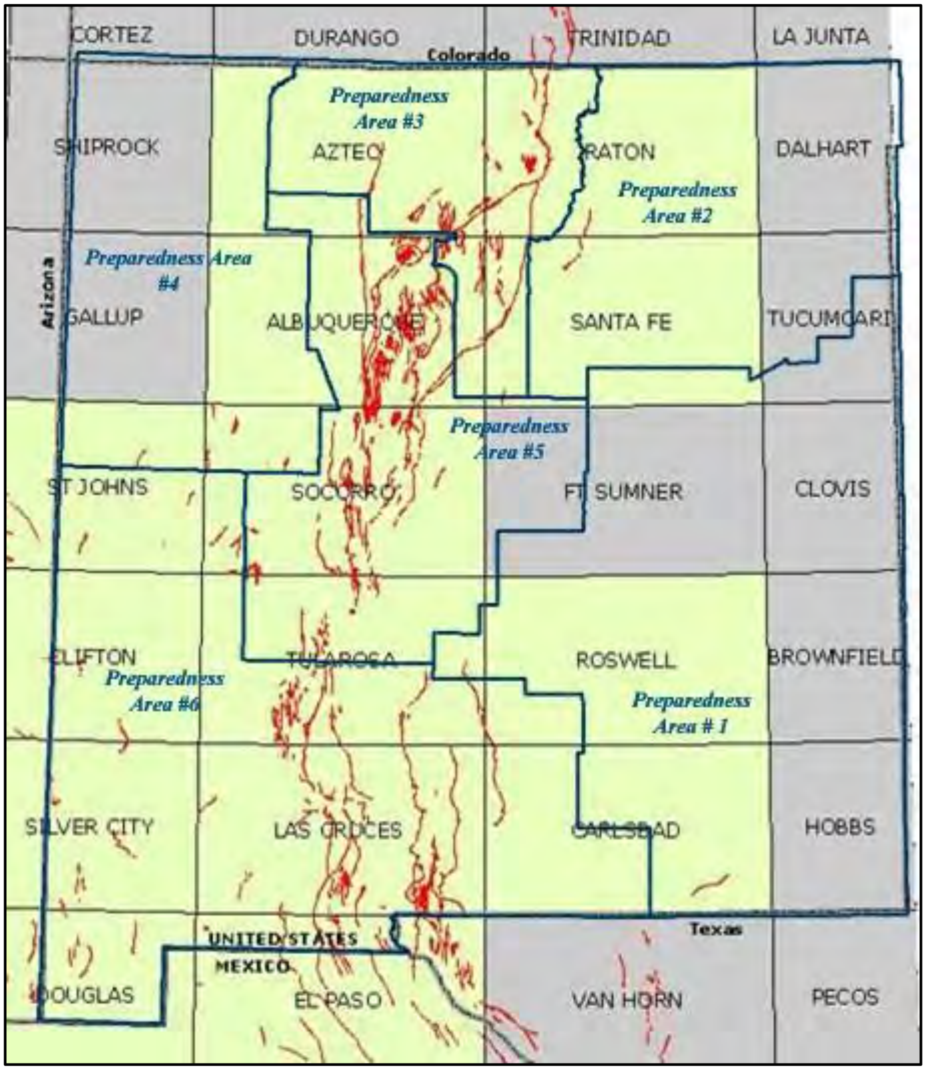
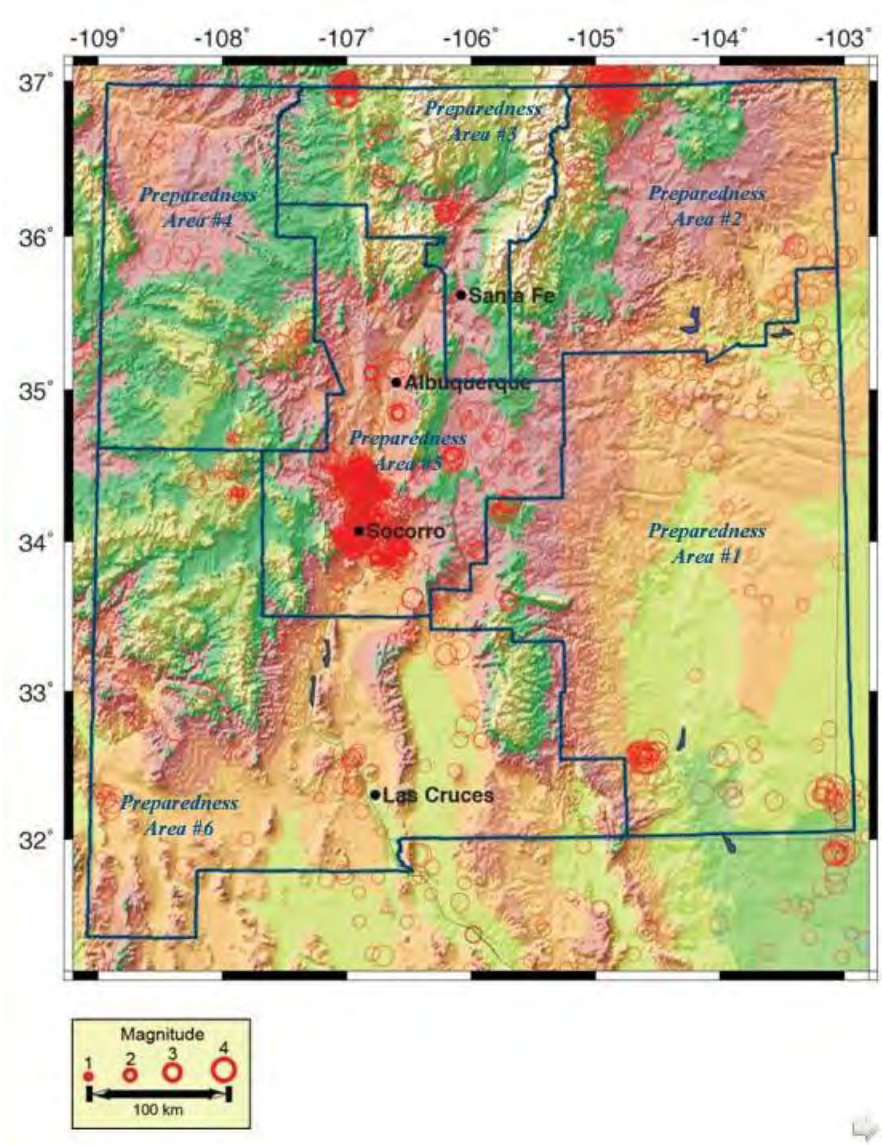


Figure 4-50 illustrates the earthquake hazard areas in the State of New Mexico. There has been a clustering of earthquake activity around the cities of Socorro and Albuquerque (both located in Preparedness Area 5). Additionally, significant amounts of high-magnitude seismic activity have been recorded in the northeast area of the State in Preparedness Areas 2 and 3.

[31] Source: http://earthquake.usgs.gov/hazards/qfaults/map/#qfaults
[32] Source: http://earthquake.usgs.gov/hazards/qfaults/

Figure 4-50 Earthquakes in New Mexico, 1962 - 2012[33]

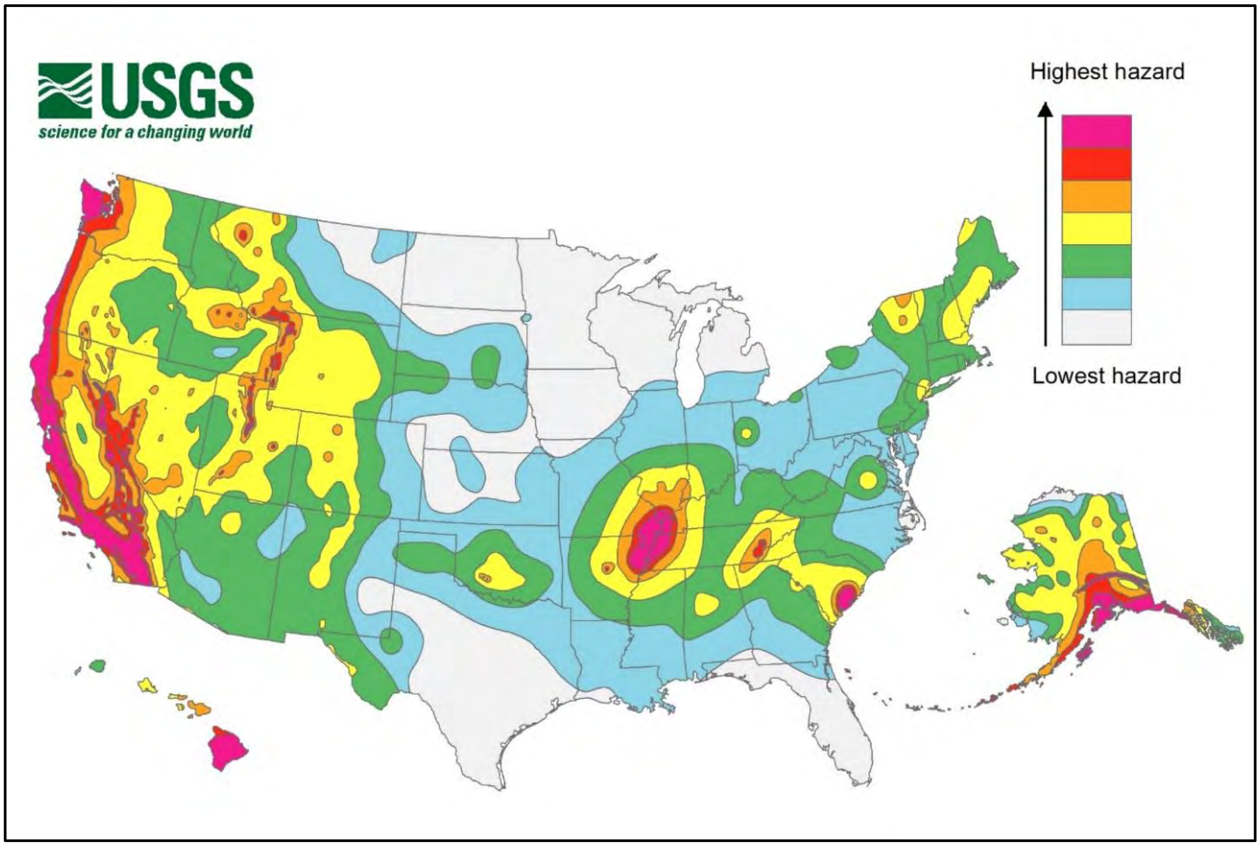


The historic area of seismicity includes most of New Mexico's major population and transportation centers. The record of damaging earthquakes in the State does not support extreme earthquake mitigation measures, as are common in States like California or Nations like Japan. However, the lack of serious earthquake damage in the past should not be interpreted as evidence that such damage will not occur in the future.

Figure 4-51 illustrates the relative seismic risk for New Mexico as compared to the United states overall. While the risk is low to moderate, almost the entire state is potentially affected by an earthquake.

[33] Source: Aster, R., Bilek, S., Stankova, J., Morton, E., Earthquakes in the central Rio Grande rift and the Socorro magma body, Proc. Volcanism in the American Southwest, USGS Open File Report, Flagstaff, AZ, 2012.

Figure 4-51 Seismic Risk 2014[34]



The State of New Mexico Construction Industries and Manufactured Housing Division of the Regulations and Licensing Department uses the following figure (Figure 4-52), which is included in the 2015 International Building Code, to evaluate structural design of buildings. This demonstrates areas in New Mexico that are susceptible to higher levels of ground motion.

[34] Source: https://earthquake.usgs.gov/hazards/hazmaps/conterminous/index.php#2017

Figure 4-52 Ground Motion Response for Western US

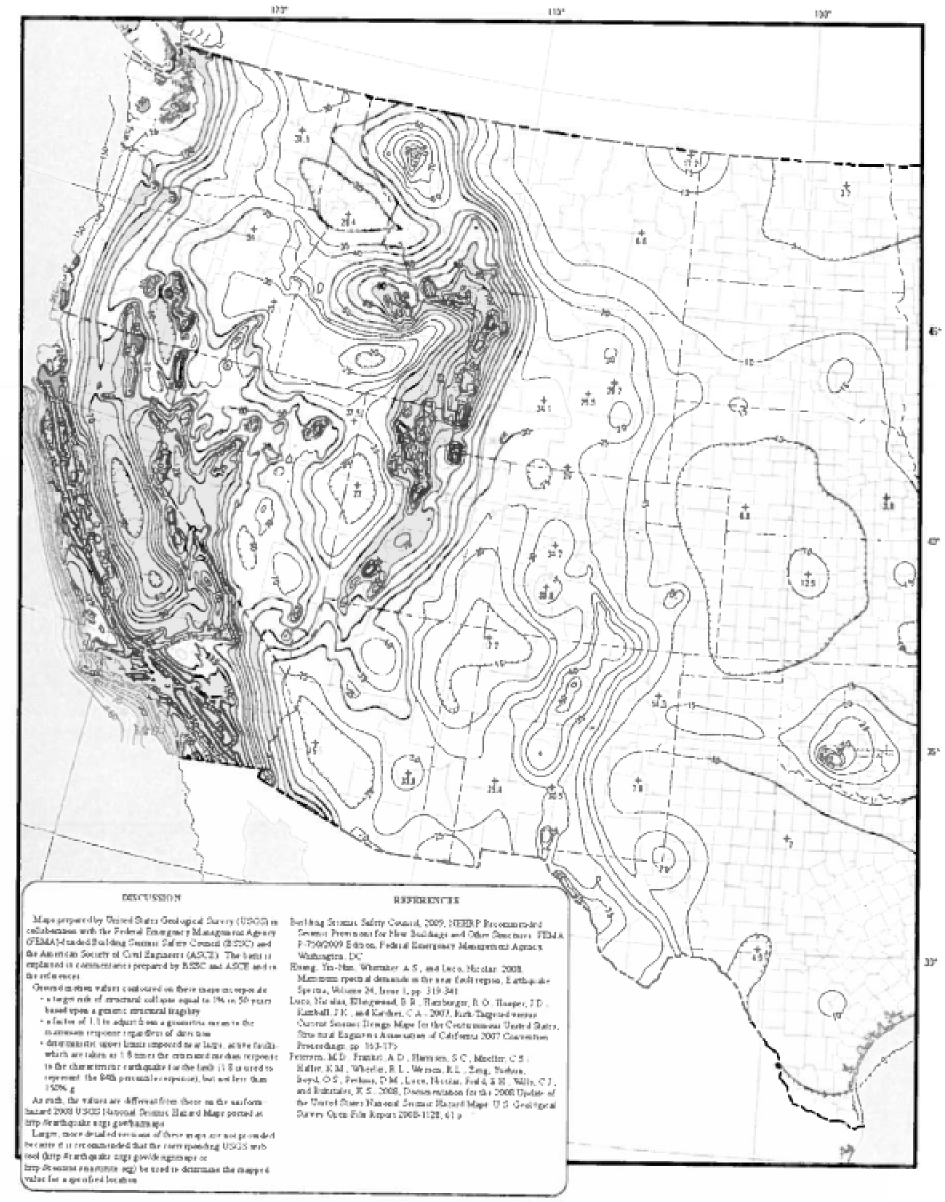


FIGURE 1613.3.1(1)
RISK-TARGETED MAXIMUM CONSIDERED EARTHQUAKE (MCE_R) GROUND MOTION RESPONSE ACCELERATIONS FOR THE CONTERMINOUS UNITED STATES OF 0.2-SECOND SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

4.5.3.3 *Previous Occurrences*

During October 1, 2010 – September 30, 2011, the New Mexico Bureau of Geology and Mineral Resources and Department of Earth and Environmental Science, both being part of the New Mexico Institute of Mining and Technology, conducted a seismic and geophysical study focused on earthquakes located in or immediately adjacent to New Mexico. The majority of these events were distributed among three main regions: the northeast border of NM near Raton, NM (Preparedness Area 2); the Dagger Draw area in the Delaware Basin, Eddy County (Preparedness Area 1); and the

Socorro Magma Body region (Preparedness Area 5). All of these regions are long-standing locations of prolonged seismicity. Events in the Raton area (Preparedness Area 2) include a continuing swarm that began in 2001 a 5.3 earthquake near Trinidad, CO (North of Raton) on August 22nd, 2011. The Dagger Draw area in the Delaware Basin in Eddy County (Preparedness Area 1) area has produced 13 Md > 3.0 (duration magnitude) earthquakes since 2002, and the Socorro Magma Body region has produced continuing activity since at least the mid-19th century, including earthquakes as large as an estimated magnitude six in 1906. The largest events in these regions are the following: Md 3.7 in Raton region south of the Colorado border (Preparedness Area 2); Md 2.3 near Dagger Draw (Preparedness Area 1); and Md 2.3 in the Socorro magma body region (Preparedness Area 5).

The City of Socorro (Preparedness Area 5) is the "earthquake capital" of New Mexico. A 5,000 km^2 (1,931 mi^2) area, less than 2% of New Mexico, surrounding the town has produced nearly 50% of the 30 natural earthquakes of magnitude 4.5 or greater (up to 5.8) in the State since 1869. Earthquake swarms, defined as a series of earthquakes recurring for days in nearly the same location within minutes of each other, are very common in this region. Historical accounts of these swarms date back to 1849, and they have been recorded on local seismic instruments since the early 1960s. The majority of the earthquakes in these swarms are shallow (three to eight miles beneath the surface) and relatively small (M < 1.0). These small earthquakes are not damaging. However, based on historic seismicity and geologic evidence, there is a chance for a larger, possibly damaging event in the future (Wong, 2009).[35] According to the US Geological Survey, there is an 18% chance of a large earthquake (M > 6.0) in the Socorro region in the next 100 years.

Twelve strongly felt earthquakes with estimated magnitudes of 4.5 or greater occurred in the Socorro area (Preparedness Area 5) from 1869 through 1961. Unlike the instrumental data from 1962 through 2004, nearly all of these strong shocks appear to have had epicenters near Socorro rather than north of San Acacia (Preparedness Area 5). Also, the statistics for earthquakes with magnitudes of 4.5 or greater from 1869 to the present indicated the Socorro-area seismic activity before the 1930s was significantly higher primarily because of prolonged earthquake swarm of 1906-1907. During this swarm, earthquakes were felt as early as July 2, 1906 and continued almost on a daily basis well into 1907. Information on these shocks comes from newspaper accounts and notably from a published paper by the noted seismologist H. F. Reid. His paper on the 1906–1907 swarm in the first issue of the Bulletin of the Seismological Society of America presents Rossi-Forel earthquake intensity observations out to distances of several hundred kilometers for the three strong earthquakes of the swarm.[36]

Three shocks in the 1906-1907 Socorro swarm had likely magnitudes of 5.5 to 6.1, strong enough to significantly damage some adobe and masonry structures. These were the strongest earthquakes in the State from 1869 through present. The most unusual characteristic noted of the swarm was the exceptionally large number of felt earthquakes over a six-month period beginning in July 2, 1906. It is suspected that weak shocks probably related to the swarm continued into 1909. These earthquakes increased the property damage already sustained at Socorro from previous earthquakes. Four rebuilt chimneys were shaken off the Socorro County Courthouse, and two others were cracked severely. Plaster fell at the courthouse, and a cornice on the northwest corner of the two-story adobe Masonic

[35] Source: *https://geoinfo.nmt.edu/publications/periodicals/earthmatters/9/n1/em_v9_n1.pdf*

[36] Source: Reid, H.G. Remarkable earthquakes in central New Mexico in 1906 and 1907, Bulletin of the Seismological Society of America, 1, 10-16, 1911.

Temple was thrown onto its first floor. Several bricks fell from the front gable on one house. Plaster was shaken from walls in Santa Fe, about 200 kilometers from the epicenter. This earthquake was felt over most of New Mexico and in parts of Arizona and Texas.[37]

The earliest recorded earthquake swarm in Socorro occurred between December 11, 1849, to February 14, 1851. Documentation for this swarm comes from a report by John Hammond, who was an army surgeon stationed in Socorro during that time. He recounts 29 quakes on 18 different days on seven different months. At least six earthquakes could not be felt more than 15 miles away from Socorro. Most were severe shocks and were accompanied by a rumbling noise; he estimates that most probably would have damaged a house of three stories. Two houses were nearly destroyed in a subsequent earthquake on April 19, 1855.[38]

There have been at least eight earthquakes felt by the residents of Los Alamos since its creation during World War II. The largest of these registered a magnitude four that occurred in 1952 and a magnitude 3.3 in 1971; both earthquakes had reported MMIs of V in Los Alamos. More recently, Los Alamos experienced very small magnitude (<2) earthquakes (1991 and 1998) that produced unusually high MMIs (up to V). Recent paleoseismic studies on the Pajarito fault systems indicated that a large earthquake of approximately magnitude seven occurred in recent prehistoric times. An October 17, 2011 magnitude 3.8 earthquake generated MMI levels of III-IV in the Espanola Basin/Pojoaque/Santa Fe region.

Figure 4-53 lists the locations and dates of the 31 strongest earthquakes that have occurred in New Mexico since 1869. There have been no earthquakes reported in the State larger than 4.5 since 2014.

Figure 4-53 Strongest Earthquakes 4.5 and Greater in New Mexico (1869 - 2017)[39]

Date	Time			Approx. Location		MMI	Moment Magnitude	Nearby City
	Hr.	Min	Sec	Lat.	Long.			
1869	-	-	-	34.1	106.9	VII	5.2	Socorro
7-Sept-1893	-	-	-	34.7	106.6	VII	5.2	Belen
31-Oct-1895	12	-	-	34.1	106.9	VI	4.5	Socorro
1897	-	-	-	34.1	106.9	VI	4.5	Socorro
10-Sep-1904	-	-	-	34.1	106.9	VI	4.5	Socorro
2-Jul-1906	10	15	-	34.1	106.9	VI	4.5	Socorro
12-Jul-1906	12	15	-	34.1	106.9	VII	5.5	Socorro
16-Jul-1906	19		-	34.1	106.9	VII	5.8	Socorro
15-Nov-1906	2	15	-	34.1	106.9	VII	5.8	Socorro
19-Dec-1906	12		-	34.1	106.9	VI	4.5	Socorro
28-May-1918	11	30	-	35.5	106.1	VII	5.5	Cerrillos
5-Feb-1931	4	48	-	35	106.5	VI	4.5	Albuquerque
21-Feb-1935	1	25	-	34.5	106.8	VI	4.5	Bernardo

[37] Source: http://earthquake.usgs.gov/regional/States/events/1906_11_15.php;Reid, 1911
[38] Source: Hammond, John Fox, 1966, A Suregeon's Report on Socorro, NM, 1852: Stagecoach Prss, 47 p.
[39] Source: Sanford et al., Earthquake Catalogs for New Mexico and Bordering Areas: 1869-1998, https://earthquake.usgs.gov/earthquakes/browse/significant.php?year=2009

Date	Time			Approx. Location		MMI	Moment Magnitude	Nearby City
	Hr.	Min	Sec	Lat.	Long.			
22-Dec-1935	1	56	-	34.7	106.8	VI	4.5	Belen
17-Sep-1938	17	20	-	33.3	108.5	VI	4.5	Glenwood
20-Sep-1938	5	39	-	33.3	108.5	VI	4.5	Glenwood
29-Sep-1938	23	35	-	33.3	108.5	VI	4.5	Glenwood
2-Nov-1938	16	0	-	33.3	108.5	VI	4.5	Glenwood
20-Jan-1939	12	17	-	33.3	108.5	VI	4.5	Glenwood
4-Jun-1939	1	19	-	33.3	108.5	VI	4.5	Glenwood
6-Nov-1947	16	50	-	35	106.4	VI	4.5	Albuquerque
23-May-1949	7	22	-	34.6	105.2	VI	4.5	Vaughn
3-Aug-1955	6	39	42	37	107.3	VI	4.5	Dulce
23-Jul-1960	14	16	-	34.4	106.9	VI	4.5	Bernardo
3-Jul-1961	7	6	-	34.2	106.9	VI	4.5	Socorro
23-Jan-1966	1	56	39	37.02	107	VI	4.8	Dulce
5-Jan-1976	6	23	29	35.9	108.5	VI	4.7	Gallup
29-Nov-1989	6	54	39	34.5	106.9	VI	4.7	Bernardo
29-Jan-1990	13	16	11	34.5	106.9	VI	4.6	Bernardo
2-Jan-1992	11	45	35	32.3	103.2	VI	5	Eunice
10-Aug-2005	4	8	17	36.96	104.8	IV	5	Raton
29-June-2014	4	59	35	32.58	109.2	VI	5.2	Lordsburg

Figure 4-54 below identifies the number of 4.5 or greater magnitude earthquakes for each Preparedness Area.

Figure 4-54 Strongest Earthquakes 4.5 and Greater by Preparedness Area (1869 to 2017) [40]

Preparedness Area	Number of 4.5+ magnitude earthquakes 1869 to present
1	2
2	1
3	3
4	1
5	18
6	7
Total	**32**

Figure 4-55 outlines earthquakes where additional information was available regarding damage reports or unique conditions. Source information is from the NCDC and data provided by local authorities.

Figure 4-55 Significant Past Occurrences - Earthquakes 1918 – 2017

Date	Location	Significant Event

[40] Source: http://earthquake.usgs.gov/earthquakes/search/

Date	Location	Significant Event
June 29, 2014	50 km west-northwest of Lordsburg, NM	An earthquake that was felt across southwestern New Mexico as far as Roswell. Shaking reported in the cities of Lordsburg, Deming, Las Cruces, and Albuquerque. The greatest intensities (Intensity IV) occurred in Lordsburg, but there was no reported damage. However, across the border in Arizona in the towns of Duncan and Safford, cracks locally occurred on ceilings and floors, picture frames were knocked off walls, and ceiling tiles fell.
September 1, 2009	Socorro, NM (Socorro County) (Preparedness Area 5)	A felt earthquake of local magnitude (ML) 2.3 occurred approximately 3 km NE of Socorro near Escondida. Small events continued to occur during this time with activity beginning near the Lemitar area on August 24, 2009. These events have been numerous with fairly shallow depths of 5.5-6 km. The largest event was ML=2.5 on August 29, 2009 at 18:31:01 MDT (August 30, 2009 at 01:31:01 UTC) and was felt by many residents of Lemitar and Socorro. We have preliminary locations on the largest 53 events (ML range of 0.5 to 2.5); however, over 400 smaller events have also occurred since August 19, 2009. The locations of 53 of the largest earthquakes are very similar, suggesting that this is an earthquake swarm. Earthquake swarms are usually caused in response to tectonic or hydrological pressure changes in the crust. Minor felt earthquakes in this region are not uncommon, and have been documented by Dr. Allan Sanford in the past. However, this was a swarm with unusually frequent, large earthquakes (14 earthquakes with ML > 1.4). For a size comparison, felt reports were noted for 4 events with ML 1.9 and greater.
September 12, 2007	Reserve, NM (Catron, County) (Preparedness Area 6)	A minor felt earthquake (3.5 USGS) occurred on September 8, 2007 at 1:15:40 am MDT (07:15:40 UTC). The event was located approximately 6 miles (10 km) west-southwest of Reserve, the Catron County seat. The Sheriff's Department in Reserve logged felt reports as far away as Luna (20 miles N) and Apache Creek (15 miles east), as well as reports from the Catron County jail. The event was part of a small swarm that lasted several hours. This is an unusual location, historically, for a felt earthquake, although a swarm of felt earthquakes estimated to be as large as 4.5 occurred in the Glenwood Springs, NM region in 1938-1939.

Date	Location	Significant Event
January 4, 1971	City of Albuquerque (Bernalillo County) (Preparedness Area 5)	Maximum Intensity VI earthquake felt within 600 square miles of the City of Albuquerque. Minor damage in the west and northwest of the City with reports of cracked walls/ plaster, broken windows and damage to fallen objects. Most damage reported at University of Albuquerque (now the location of St. Pius X High School) and West Mesa High School, both located on the west side of the City.
January 23, 1966	Dulce, NM (Rio Arriba County) (Preparedness Area 3)	A magnitude 5.5 earthquake centered near Dulce (Rio Arriba County) affected about 39,000 square kilometers of northwestern New Mexico and southwestern Colorado. Nearly every building in Dulce was damaged to some degree; many buildings had exterior and interior damage and considerable chimney damage was noted. The principal property damage was sustained at the Bureau of Indian Affairs School and Dormitory Complex and at the Dulce Independent Schools. Rock falls and landslides occurred along Highway 17, about 15 to 25 km west of Dulce; in addition, some minor cracks appeared in the highway. Minor damage was also reported at Lumberton, New Mexico, and Edith, Colorado. More than $200,000 damage was inflicted on Indian school facilities in Dulce, NM.
November 3, 1954	Albuquerque, NM (Bernalillo County) (Preparedness Area 5)	Plaster cracks, broken windows, and cracked fireplaces have been reported from past earthquakes. Minor structural damage occurred to a bank in Albuquerque from an intensity V earthquake. Barns have collapsed and rooftop air-conditioners shaken loose.
May 28, 1918	Village of Cerrillos (Santa Fe, County) (Preparedness Area 3)	An earthquake with strong local effects in Santa Fe County, where people in the village of Cerrillos were thrown off their feet and fallen plaster was reported (intensity VII - VIII).

Date	Location	Significant Event
November 15, 1906	Socorro, NM (Socorro County) (Preparedness Area 5) Santa Fe, NM (Santa Fe, County) (Preparedness Area 3)	The largest historic earthquake in New Mexico: **(**Mercalli Intensity: VII): This earthquake, which was the culmination of a sustained earthquake swarm between 1904 through 1907, increased the property damage already sustained at Socorro from previous earthquakes. Four rebuilt chimneys were shaken off the Socorro County Courthouse, and two others were cracked severely. Plaster fell at the courthouse, and a cornice on the northwest corner of the two-story adobe Masonic Temple was thrown onto its first floor. Several bricks fell from the front gable on one house. Plaster was shaken from walls in Santa Fe about 200 kilometers from the epicenter. Felt over most of New Mexico and in parts of Arizona and Texas.[41]

4.5.3.4 *Frequency*

Based on State-wide data related to past seismic events, the frequency of magnitude 4.5 or larger earthquakes in the State of New Mexico has been determined as low to medium. Historically, based on available data related to previous earthquake events in New Mexico, every year there is a 0.22 chance of a 4.5+ earthquake occurring in New Mexico.

4.5.3.5 *Probability of Occurrence*

Significant earthquakes (larger than 6.5 magnitude with more than $1 million in damage) with epicenters in the State of New Mexico have not been felt since 1970, but the area has numerous geologically young faults with the potential for a large magnitude earthquake. The potential for such a disaster is low. The greatest threat is along the Rio Grande rift.

4.5.3.6 *Risk Assessment*

According to Arup Maji (Professor Civil and Structural Engineering, University of New Mexico) the likely consequence of earthquakes in New Mexico is partial collapse of unreinforced masonry and old adobe buildings. Roads and bridges are unlikely to suffer damage that would render them unusable.

According to Rick Aster (former Chair of the Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology; current Chair of the Department of Geosciences, Colorado State University), if a major Basin and Range earthquake similar to the 1887 Sonoran Earthquake were to occur in New Mexico, the State would suffer high levels of damage, with general losses ranging from 10s to 100s of millions of dollars depending on the location of the event. Furthermore, the area most subject to seismic activity, based on historic occurrence, is the Socorro-to- Albuquerque segment of the Rio Grande valley. This area is densely populated and rapidly developing. Present building codes require construction of certain occupancies (schools, hospitals, public buildings) to high earthquake resistance standards, although seismic mitigating construction is not required for residential buildings.

DHSEM was able to work with the New Mexico Bureau of Geology and Mineral Resources to conduct Hazus modeling in each of the six Preparedness Areas. Hazus runs were done for each Preparedness

[41] Source: http://earthquake.usgs.gov/regional/States/events/1906_11_15.php;Reid, 1911

Area based on the highest magnitude most probable earthquake (listed in Figure 4-56). Based on input from Subject Matter Experts Dan Koning, Senior Field Geologist, the following maximum probable magnitude earthquakes were modeled for each Preparedness Area.

Figure 4-56 Hazus Model Maximum Probable Magnitude for each Preparedness Area

Preparedness Area	Location	Maximum Probable Magnitude
1	Carlsbad	5.5
2	Las Vegas	5.5
3	Los Alamos	7.3
4	Farmington	5.5
5	Albuquerque	7.5
6	Las Cruces	7.3

Figure 4-57 identifies potential impacts from an earthquake for the purposes of EMAP compliance.

Figure 4-57 Potential Impacts from Earthquakes

Subject	Potential Impacts
Agriculture	In an earthquake, agriculture and food processing facilities may be damaged along with critical infrastructure that supports those operations. Damage to production agriculture is limited; possibly due to blocked roads.
Health and Safety of the Public	The public may be injured or killed by falling materials. Broken glass can cause injuries.
Health and Safety of Responders	Responders face the same impacts as the public.
Continuity of Operations	Those operations that are in or near the impact area may be shut down or even destroyed.
Delivery of Services	Service delays are anticipated to operations within or near the damaged areas.
Property, Facilities, Infrastructure	Earthquakes can cause widespread damages to buildings and infrastructure. Some buildings or bridges can be condemned. Water and gas lines as well as dams may rupture. Earthquake building codes have not been implemented consistently throughout the State, and this could be a serious problem.
Environment	Earthquake related phenomena, such as landslides or fires, may locally degrade the environment.
Economic Condition	A strong earthquake may cause severe damages within a community.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

4.5.3.7 *Data Limitations*

Present seismic monitoring in New Mexico is conducted by the New Mexico Institute of Mining and Technology and the U.S. Geological Survey National Earthquake Information Center in Golden, CO. Levels of instrumentation and staffing are presently sufficient to generally characterize events anywhere within the State to magnitude levels of approximately 3.0 (and significantly smaller in better-instrumented areas, such as the vicinity of the WIPP/Carlsbad area and the Socorro region. Unusual sequences of exceptional societal or scientific interest can be additionally studied with temporary deployments of portable seismographs through the IRIS PASSCAL Instrument Center at the New Mexico Institute of Mining and Technology and/or using USGS national resources. Los Alamos National Laboratory also operates a regional seismographic network focused on the Pajarito fault zone and Valles Caldera region.

DHSEM and FEMA Region 6 completed the *New Mexico Rio Grande Rift: Catastrophic Earthquake Response Plan* in December 2015. The project began in 2014 and the final deliverable is a plan that will address the State's capability to respond to a catastrophic incident and provide an executable plan that designates clear roles and responsibilities and informs all-hazard plans in addition to the update to the 2018 State Plan.

4.5.3.8 *What Can Be Mitigated?*

Damage from earthquakes can be mitigated for existing buildings by structural retrofits and by improved securing of vulnerable contents/furnishings/installations within structures. Structures erected before standard building codes, such as un-reinforced masonry buildings, are typically vulnerable to earthquake damage. Present building codes require construction of certain occupancies (schools, hospitals, public buildings) to high earthquake resistance standards, although seismic mitigating construction is not required for residential buildings. A prudent homeowner, business owner, or developer would be well advised to consider earthquake mitigation when designing subdivisions, apartment buildings, shopping centers, and individual residences in certain parts of the State. More detailed information on other structures in each Preparedness Area is required to identify those that are highly vulnerable. New buildings can be built stronger, according to the most recent seismic design specifications found in contemporary building codes, to minimize their vulnerability to earthquake damage.

Earthquake insurance in New Mexico has not generally been an option for residents. However, experts agree that there are cost benefits to seismic retrofits. One mitigation action is to research if earthquake insurance would be a benefit to New Mexico communities.

4.5.3.9 *Changing Weather Patterns*

At the time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of earthquake activity in the State of New Mexico.

4.5.4 ***Extreme Heat***

4.5.4.1 *Hazard Characteristics*

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. In an average year, extreme heat kills 175 people.[42] Young children, the elderly, outdoor laborers, and sick people are the most likely to suffer the

[42] Source: FEMA Extreme Heat Backgrounder

effects of extreme heat. The heat index measures the severity of hot weather by estimating the apparent temperature: how hot it feels (Figure 4-59). Skin resistance to heat and moisture transfer is directly related to skin temperature, therefore the ambient temperature can be quantified by examining the relation between relative humidity versus skin temperature. If the relative humidity is higher/lower than the base value, the apparent temperature is higher/lower than the ambient temperature.

Figure 4-58 also outlines the heat disorders during extreme temperatures. In New Mexico at elevations below 5,000 feet, individual day-time temperatures often exceed 100°F during the summer months. However, during July, the warmest month, temperatures range from slightly above 90°F in the lower elevations, to 70°F in the higher elevations.[43]

Figure 4-58 Heat Index/Heat Disorders[44]

Heat Index/Heat Disorders		
Danger Category	**Heat Disorders**	**Apparent Temperature (^{0}F)**
I Caution	Fatigue possible with prolonged exposure and physical activity.	80-90
II Extreme Caution	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and physical activity.	90-105
III Danger	Sunstroke, heat cramps and heat exhaustion likely; heatstroke possible with prolonged exposure and physical activity.	105-130
IV Extreme Danger	Heatstroke or sunstroke imminent.	>130

Extreme heat, or heat wave, is defined by the NWS as a temperature of 10 degrees or more above the average high temperature for the region, lasting for several weeks. This condition is a public health concern. During extended periods of very high temperatures or high temperatures with high humidity, individuals can suffer a variety of ailments, including heatstroke, heat exhaustion, heat syncope, and heat cramps:

Heatstroke is a life-threatening condition that requires immediate medical attention. It exists when the body's core temperature rises above 105° F as a result of environmental temperatures. Patients may be delirious, in a stupor or comatose. The death-to-care ratio in reported cases in the U.S. averages about 15%.

Heat exhaustion is much less severe than heatstroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness, or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.

Heat syncope is typically associated with exercise by people who are not acclimated to physical activity. The symptoms include a sudden loss of consciousness. Consciousness returns promptly when

[43] Source: *Western Region Climate Center* - *www.wrcc.dri.edu/narratives/NEWMEXICO.htm*
[44] Source: NOAA - http://www.nws.noaa.gov/os/heat/index.shtml#heatindex

the person lies down. The cause is primarily associated with circulatory instability because of heat. The condition typically causes little or no harm to the individual.

Heat cramps are typically a problem for individuals who exercise outdoors but are unaccustomed to heat. Similar to heat exhaustion, it is thought to be a result of a mild imbalance of fluids and electrolytes.

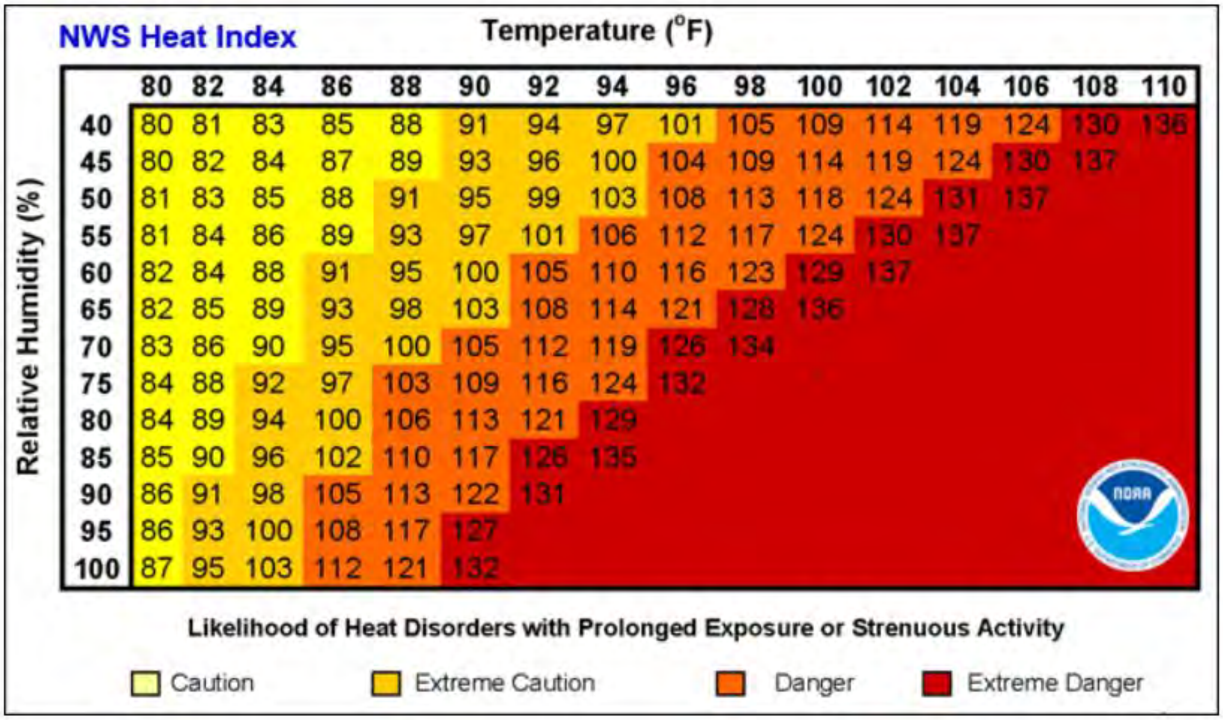
The elderly, disabled, and debilitated are especially susceptible to heat stroke. Large and highly urbanized cities can create an island of heat that can raise the area’s temperature by 3 to 5^{o} F. Therefore, urban communities with substantial populations of elderly, disabled, and debilitated people could face a significant medical emergency during an extended period of excessive heat. The highest temperature recorded in New Mexico is 122°F on June 27, 1994 at the Waste Isolation Pilot Plant (WIPP) site in Eddy County (Preparedness Area 1).

New Mexico is partially an arid desert State, and summer temperatures often exceed the 100-degree mark under normal conditions. Nighttime temperatures are typically cool due to low humidity, and even though daytime temperatures may be high, people experience relief at night. Heat waves in which daily high temperatures exceed 110^{o} F for many days in a row are rare. Such a heat wave in the higher altitudes would probably have a more damaging effect because people would not be expecting such hot conditions. However, anywhere in the State that experienced the humidity/temperature combination could suffer ill effects from the event. A heat wave would also have a drying effect on vegetation, facilitating the ignition of wildfires. If a heat wave were coupled with a power failure, the effect on the population would be much more severe due to a lack of air conditioning. In general, it is safe to say that there is no area of the State that is immune from the hazard of heat wave.

A unique aspect to extreme heat in New Mexico is the fact that UVB radiation also increases with increasing altitude, or distance above the surface of the earth. For every 1,000 feet of altitude, the UV radiation increases by about four percent. This means that approximately 20% more UV radiation reaches the Earth's surface in Santa Fe than in a city that is at similar latitude but at sea level. This can exacerbate heat effects at high altitude.

In 1979, meteorologist R.G. Steadman developed a heat index (Figure 4-59) to illustrate the risks associated with extreme summer heat. NOAA's heat alert procedures are based mainly on Heat Index Values. The Heat Index, sometimes referred to as the “apparent temperature” is given in degrees Fahrenheit. The Heat Index is a measure of how hot it really feels when relative humidity is factored with the actual air temperature.

Figure 4-59 Heat Index[45]



RH (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

According to the Office of the Medical Investigator, there are two recorded events of extreme heat causing death or injury within the State of New Mexico. Those deaths were due to negligence of parents leaving children in the car for a long period of time. Periods of excessive heat usually result in high electrical consumption for air conditioning, which can cause power outages and brownouts.

While PNM reports no wide spread power failures due to overuse, the large numbers of new homes and conversion to air conditioning from evaporative coolers, could put a strain on the electrical grid.

4.5.4.2 *Previous Occurrences*

The State of New Mexico experiences extreme heat events annually. Figure 4-60 highlights past occurrences recorded by the Department of Homeland Security and Emergency Management. On June 10, 2013 an event resulted in injury. Events from August 6, 2012 and July 14, 2010 identified deaths.

Figure 4-60 Significant Past Occurrences - Extreme Heat (June 1980 – December 2017)

Date	Location	Significant Event
June 10, 2013	Albuquerque, NM (Preparedness Area 5)	An infant left inside a hot car for over 2 hours during the afternoon was left in critical condition due to the heat. Temperatures around the city were in the upper 90's to low 100's Fahrenheit.

[45] Source: http://www.nws.noaa.gov/os/heat/index.shtml#heatindex

Date	Location	Significant Event
August 6, 2012	Albuquerque, NM (Preparedness Area 5)	A toddler died after being left inside a parked vehicle for over eight hours. Ambient air temperatures were in the lower to mid-90s Fahrenheit. High temperature recorded at the Albuquerque International Sunport was 93° Fahrenheit.
July 14, 2010	Albuquerque, NM (Preparedness Area 5)	A 2-year-old died after being left in a hot car for almost four hours at Southwestern Indian Polytechnic Institute. By noon MST, the outside air temperature was 93° Fahrenheit which may have resulted in temperatures exceeding 135° Fahrenheit in the vehicle.
July 2003	State of New Mexico (All Preparedness Areas)	Hottest month ever recorded in New Mexico. There were 14 days of highs of 100° Fahrenheit or more, and no cooling at night. A new all- time high low temperature of 78° Fahrenheit is set. 21 days do not go below 70° Fahrenheit. Average temperature of 84.6° Fahrenheit for the entire month shatters 1980 record of 82.7° Fahrenheit.
May 24, 2000	State of New Mexico (All Preparedness Areas)	New daily high temperature records were set across the State as temperatures soared into the high 90s and 100s all across the east and south. Record highs in the mid and upper 80s were also set in the higher elevation communities of both the south central, central and northern mountains.
June 1998	State of New Mexico (All Preparedness Areas)	Conditions had been unusually warm and dry throughout the month, but the heat intensified beginning on the 20th with daily high temperatures climbing well above 100° Fahrenheit, except in mountain communities at elevations above 7500 feet. Readings in the southeast section of the State peaked at 108° to 113° Fahrenheit as these locations exceeded 10 consecutive days with daily highs above 100° Fahrenheit. New records for duration of 100+° Fahrenheit were set from Carlsbad north to Clovis and Tucumcari. The heat broke records that had lasted 60 to 70 years. By the end of the month a number of locations in the east had observed 16 to 20 days with a daily high over 100° Fahrenheit.
June 27, 1994	Albuquerque, NM (Bernalillo County) (Preparedness Area 5)	Albuquerque area hits 107° Fahrenheit, the highest temperature ever recorded in Albuquerque (the 104° Fahrenheit on June 26 tied the previous record).

Date	Location	Significant Event
Summer (June through August) 1980	Albuquerque, NM (Bernalillo County) (Preparedness Area 5)	Record heat with 25 days of 100 or more in the Albuquerque metro area (prior record was 12 days). July average daytime high is 99.1° Fahrenheit.

Figure 4-61 outlines previously recorded extreme heat events within each Preparedness Area. Note the information in the table below only includes data presented by county, and does not include data presented by National Weather Service Forecast Zones.

Figure 4-61 Preparedness Areas 1 - 6 Extreme Heat History (June 1980 – December 2017) [46]

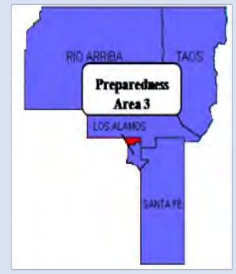
Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln, Quay and Roosevelt							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	$0	$0	
Total	**3**	**0**	**0**	**0**	**$0**	**$0**	

Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	$0	$0	
Total	**3**	**0**	**0**	**0**	**$0**	**$0**	

[46] Source: http://www.ncdc.noaa.gov

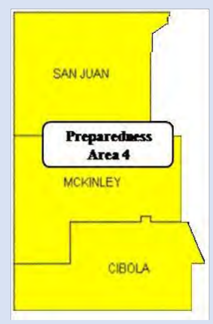
Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Heat	3	0	0	0	$0	$0
Total	**3**	**0**	**0**	**0**	**$0**	**$0**



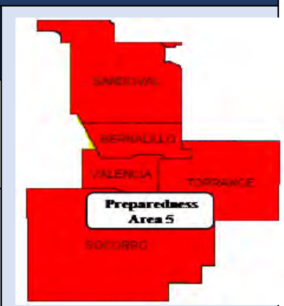
Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Heat	3	0	0	0	$0	$0
Total	**3**	**0**	**0**	**0**	**$0**	**$0**



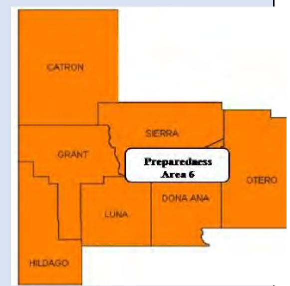
Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Heat	8	0	2	1	$0	$0
Total	**8**	**0**	**2**	**1**	**$0**	**$0**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

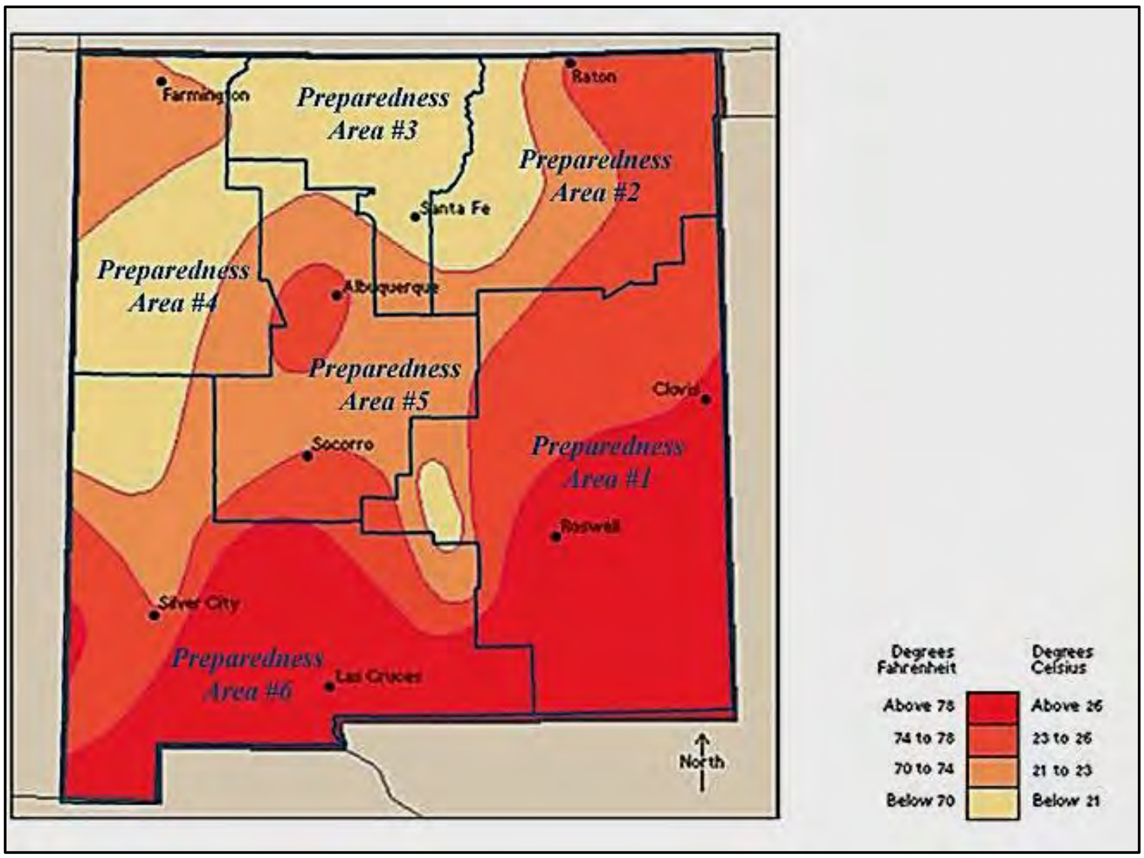
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Heat	3	0	0	0	$0	$0
Total	**3**	**0**	**0**	**0**	**$0**	**$0**



4.5.4.3 *Frequency*

Patterns, frequency, and degree of severity of extreme heat events are difficult to predict. Referencing the map in Figure 4-62, the State can experience average summer temperatures from 70 to well over 78 degrees with temperatures in the summer reaching up to 100 degrees plus. In temperatures exceeding 90°F, young children, the elderly, outdoor laborers, and sick people are the most likely to suffer from sunstroke, heat cramps, heat exhaustion, and possibly heatstroke.

Figure 4-62 2012 Average Temperature and Preparedness Area Map of New Mexico[47]



The National Weather Service Albuquerque reported above average monthly temperatures in New Mexico for 2012, which is one of the warmest years on record. Meteorologists stated that 2012 was

[47] Source: 2010 NM State Hazard Mitigation Plan

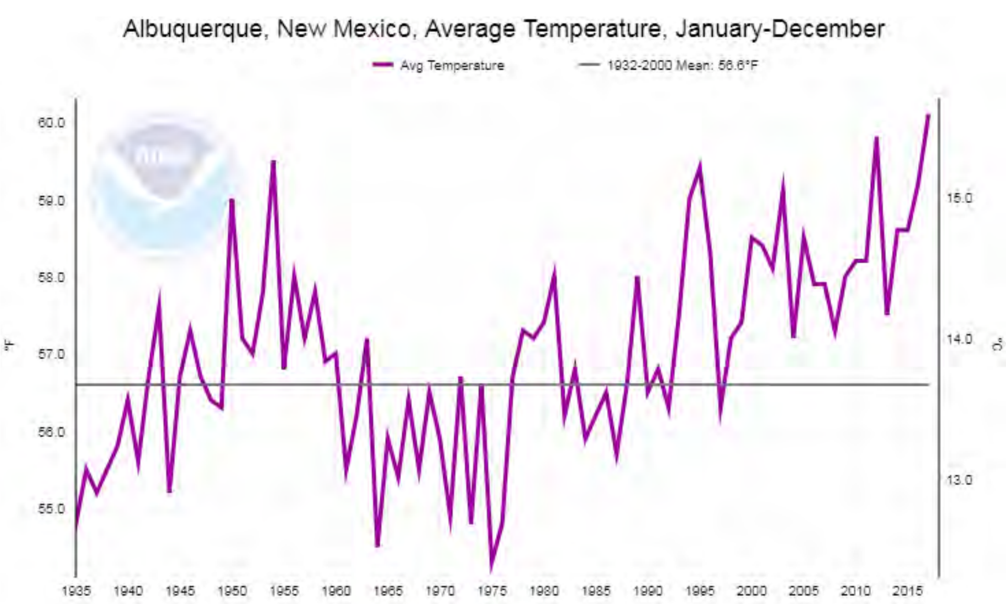
yet another year that supported the upward trend in temperature. At each of their three climate stations, the average temperature through December 25, 2012 was the warmest on record, as shown in Figure 4-63 and

Figure 4-64. Locations included Albuquerque (Preparedness Area 5), Clayton (Preparedness Area 2) and Roswell (Preparedness Area 1).

Figure 4-63 Average Temperatures for December 2012[48]

Location	Long-term Average Temperature through 12/25	Average 2012 Temperature through 12/25
Albuquerque	57.4	60.4
Clayton	53.8	58.3
Roswell	61.0	64.4

Figure 4-64 Annual Temperatures for Albuquerque and Roswell 2015[49]



[48] Source: https://www.ncdc.noaa.gov/cag/
[49] Source: http://www.srh.weather.gov/abq/?n=clifeature_2012sigevents

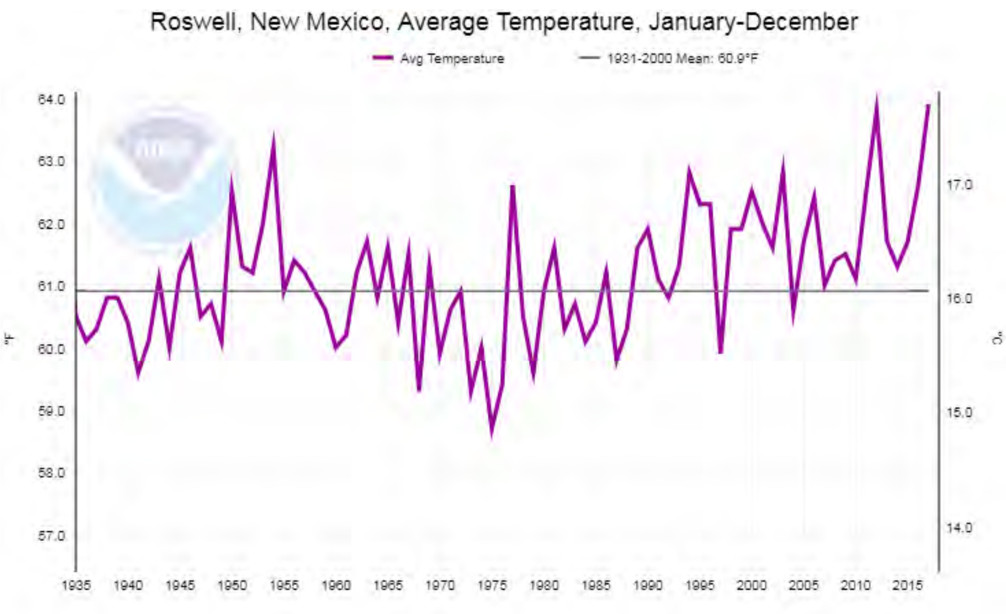
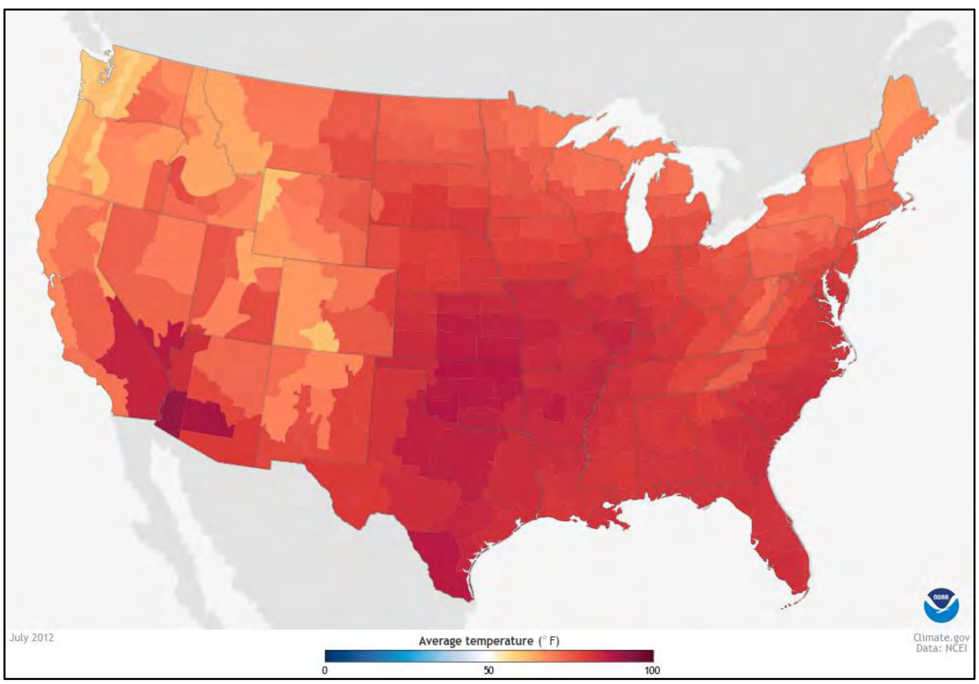


Figure 4-65 to Figure 4-70 display the average monthly temperature for July from 2012 to 2017, which shows more intense heat for 2012.[50]

Figure 4-65 Average Monthly Temperature for July 2012



[50] Source: https://www.climate.gov/maps-data/data-snapshots/averagetemp-monthly-cmb-2017-06-00?theme=Temperature

Figure 4-66 Average Monthly Temperature for July 2013

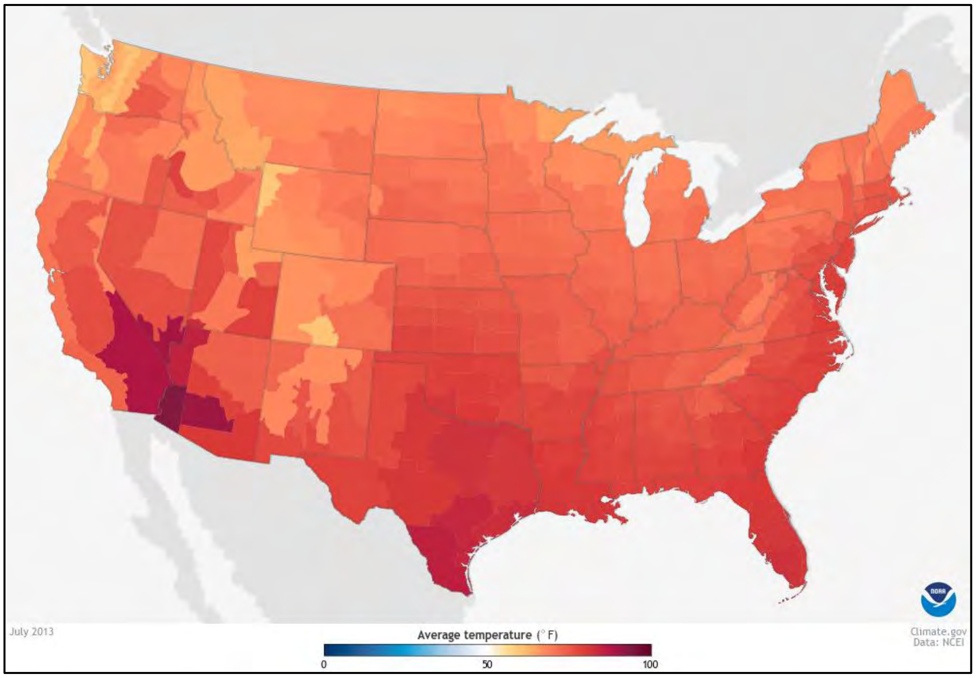


Figure 4-67 Average Monthly Temperature for July 2014

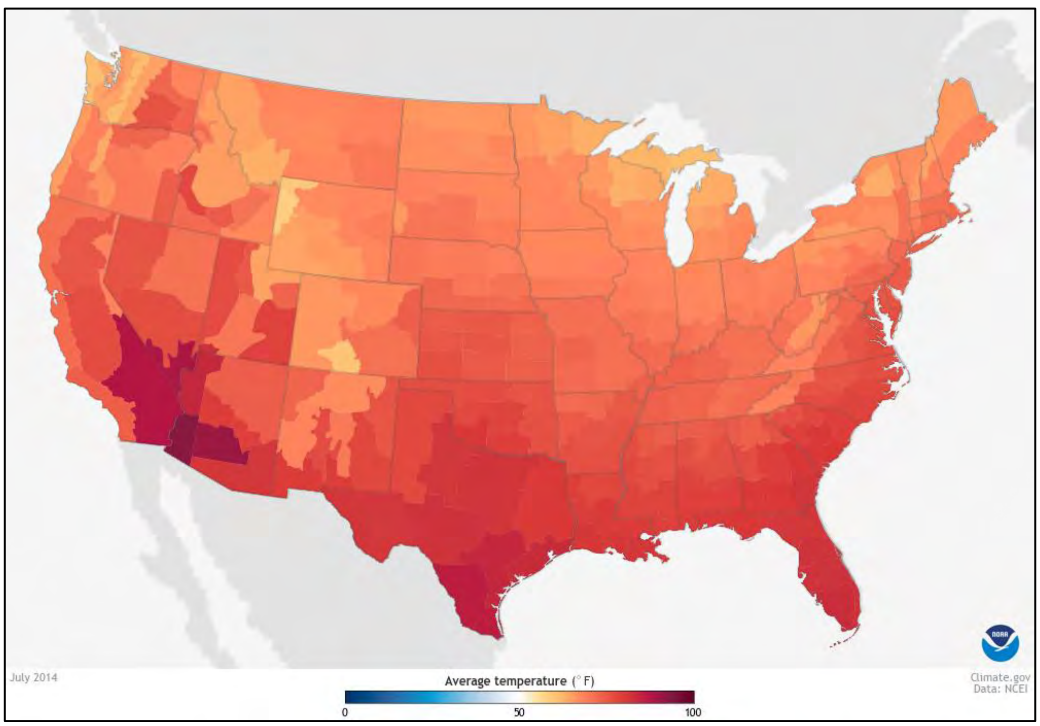


Figure 4-68 Average Monthly Temperature for July 2015

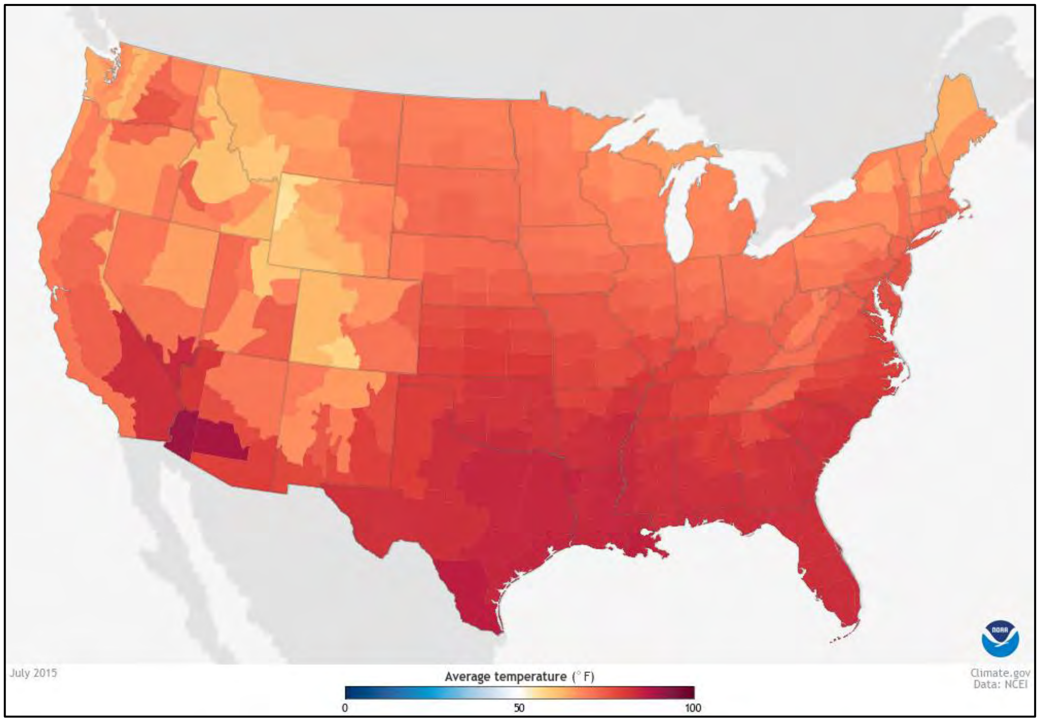


Figure 4-69 Average Monthly Temperature for July 2016

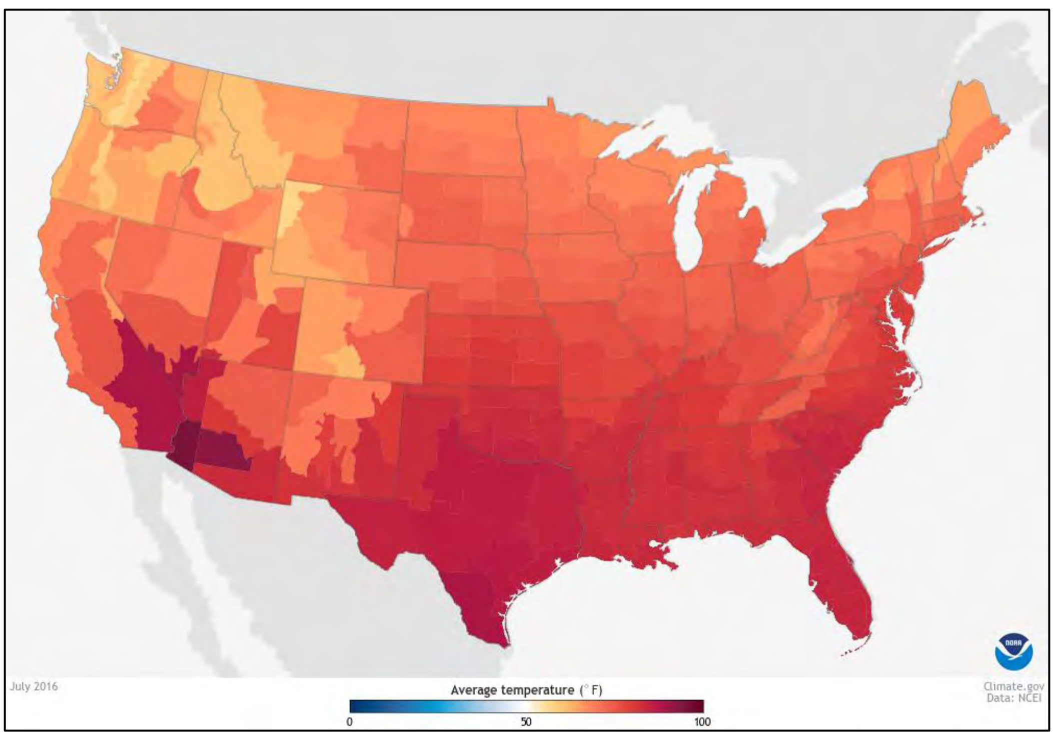
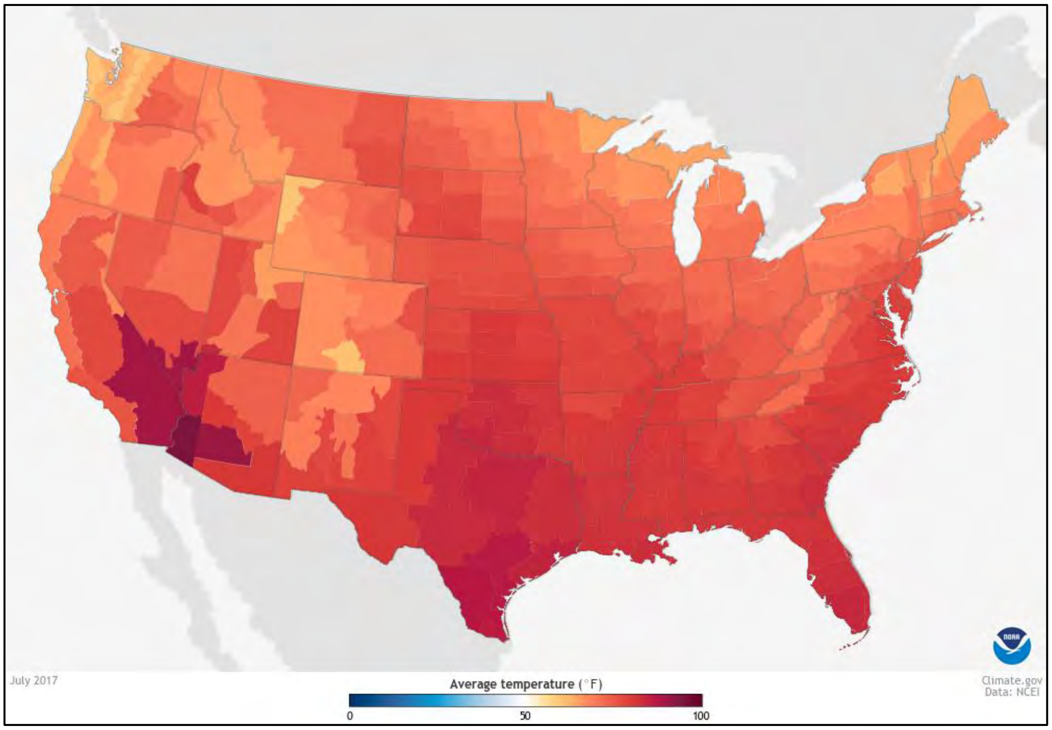


Figure 4-70 Average Monthly Temperature for July 2017



4.5.4.4 *Probability of Occurrence*

To determine the probability of each Preparedness Area experiencing future extreme heat occurrences, the probability or chance of occurrence was calculated based on historical data identified in Figure 4-61. Figure 4-71 identifies the probability of each Preparedness Area experiencing some type of extreme heat event annually. Probability was determined by dividing the number of events observed by the number of years (37 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. It should be noted that general inconsistencies in local event reporting to the NCDC would make this probability seem low as extreme heat events are an annual occurrence.

Figure 4-71 Probability of Occurrence - Extreme Heat

Probability of Occurrence	
Preparedness Area	**Extreme Heat**
Preparedness Area 1	8%
Preparedness Area 2	8%
Preparedness Area 3	8%
Preparedness Area 4	8%
Preparedness Area 5	22%

Probability of Occurrence	
Preparedness Area	**Extreme Heat**
Preparedness Area 6	8%

4.5.4.5 *Risk Assessment*

New Mexico experiences some form of extreme heat activity annually, based on seasonal meteorological patterns and local topographical conditions. All Preparedness Areas are susceptible to extreme heat conditions, although local topography, such as elevation and land contours, plays a significant part in how this extreme heat affects a particular area. The effects of extreme temperatures generally affect at risk sectors of the population: the elderly, the young, the sick/infirmed, those living below the poverty level, and outdoor laborers. Figure 4-72 outlines impacts from extreme heat events for each Preparedness Area to consider when planning for these types of events.

Figure 4-72 Extreme Heat Impacts

Subject	Impacts
Agriculture	Extreme heat can affect crops, livestock and those working in and around agriculture production areas. The heat can also affect agriculture transportation from the aspect that some commodities are perishable and movement of those products must occur more expeditiously in extreme heat.
Health and Safety of The Public	Injuries and death have resulted from extreme heat events. Individuals caught out doors can suffer dehydration and death from high temperatures; Increased wildfire risk
Health And Safety of Responders	Responders face the same impacts as the public.
Continuity of Operations	Airport closures and local/regional power failures
Delivery of Services	Airport closures and local/regional power failures
Property, Facilities, Infrastructure	No impacts anticipated
Environment	Increased drought conditions (see Drought section for a list of associated environmental impacts)
Economic Condition	Increased utility costs due to the extreme temperatures are anticipated; Loss of tourism; Decreased agricultural yields

Subject	Impacts
Public Confidence	No impacts anticipated

4.5.4.6 *Data Limitations*

The SHMPT could not quantify vulnerability of individual structures to damage from extreme heat hazards. Subsequent versions of this Plan Update will need to incorporate and respond to these data deficiencies. The NCDC is limited in the amount of extreme heat incidents have occurred in New Mexico.

4.5.4.7 *What Can Be Mitigated?*

One important part of mitigating extreme heat hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to extreme heat by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending extreme heat events.

4.5.4.8 *Changing Weather Patterns*

The frequency, duration and intensity of heat waves in New Mexico would likely increase in the presence of warmer mean annual temperatures due to long-term, changing weather patterns.

4.5.5 Expansive Soils

4.5.5.1 *Hazard Characteristics*

Expansive soils, also locally called adobe or clay, are fine-grained soils generally found in areas that historically were a floodplain or lake areas. Expansive soils swell when wet and shrink when dry. They contain abundant expandable clay that generally accumulates in low-energy areas. Expansive soil is subject to swelling and shrinkage, varying in proportion to the amount of moisture present in the soil. As water is absorbed into the soil (by rainfall or watering), expansion takes place. If dried out, the soil contracts, often leaving small fissures or cracks. Excessive drying and wetting of the soil can progressively deteriorate “slab on grade” foundations over the years and can rupture pipes, leading to further problems.

Expansive soil is found in all States, although the highest concentrations are found in Texas, Colorado, Virginia, North Dakota, Oklahoma, and Montana. One of the most expansive soils, known locally as adobe[51], is found in New Mexico, Texas and Colorado. The expansion and contraction of soil beneath a structure tends to exert tremendous pressure and stress, causing severe structural damage. In some cases, entire sidewalks and streets have been lifted, resulting in severe cracking and distortion.

According to the New Mexico Bureau of Geology and Mineral Resources, the landscape of New Mexico has six distinct physiographic providences. The northwest corner of the State is within the Colorado

[51] Not all adobe in New Mexico is expandable; adobe bricks have only a small proportion of clay.

Plateau. South of this area is the Mogollon-Datil Volcanic Field, with the southwestern corner of the State being within the Basin and Range province. The far north central portion of the State is within the Southern Rocky Mountains. The central part of the State is within the Rio Grande Rift, and the eastern third of the State is classified as the Great Plains.[52]

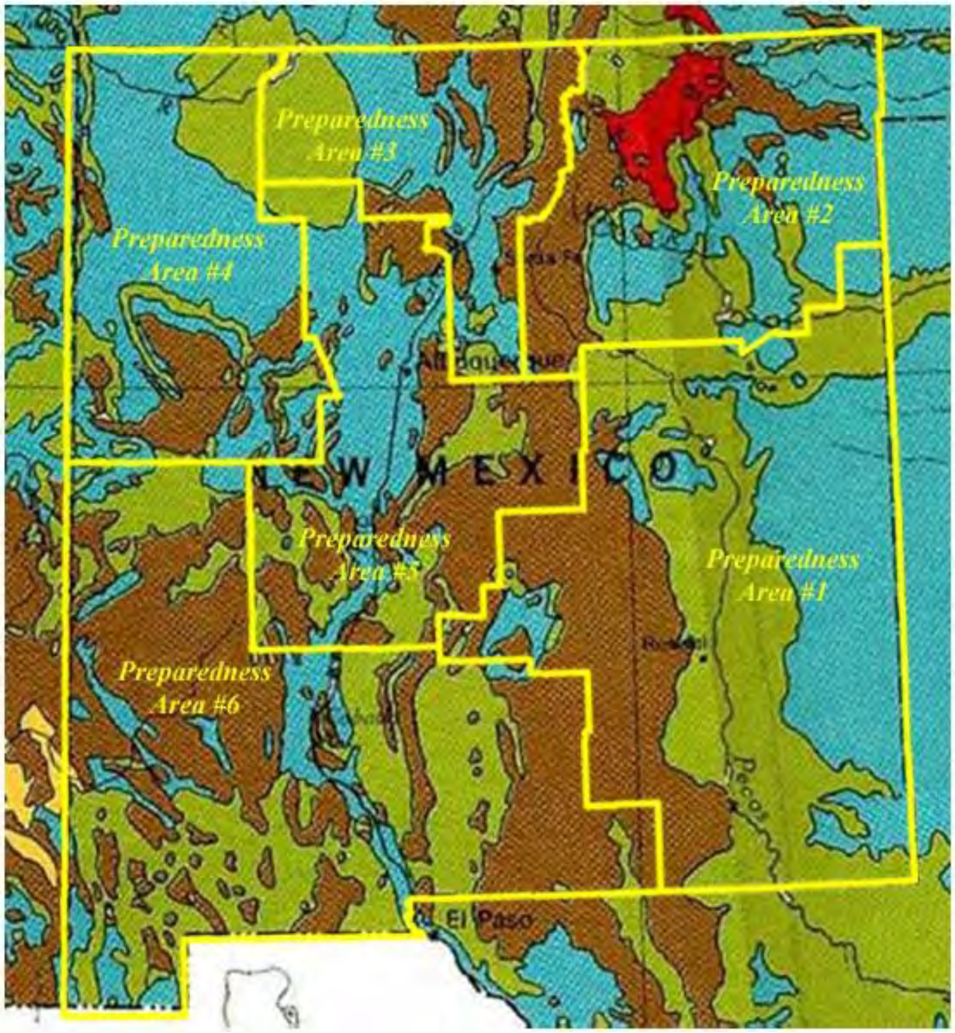
Figure 4-73[53] shows the areas of expansive soils in New Mexico. The red areas in the northeast portion of the State around Taos and Colfax counties are areas that contain abundant clay with high swelling potential. The blue areas generally have less than 50% clay and also have high swelling potential. The orange area, of which there is only a very small portion on the Arizona border, indicates areas with abundant clay having slight to moderate swelling potential. The green areas generally have less than 50% clay with slight to moderate swelling potential and the brown areas have little or no swelling clay.

One Subject Matter Expert, Dr. Dave Love from the New Mexico Institute of Mining and Technology, commented that it is surprising that only the Raton area is shown as having abundant clay that has high swelling potential. Although there is not current documentation available, areas in Santa Fe and Socorro are reported to have expandable soils, too.

[52] Source: http://geoinfo.nmt.edu/tour/provinces/home.html

[53] Source: Fidelity Inspection and Consulting Services at http://www.inspection1.com/types/soils/newmex.htm (December 2012)

Figure 4-73 New Mexico Expansive Soils and Preparedness Areas



(red)	Unit contains abundant clay having high swelling potential
(blue)	Part of unit (generally less than 50%) consists of clay having high swelling potential
(orange)	Unit contains abundant clay having slight to moderate swelling potential
(light green)	Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
(dark brown)	Unit contains little or no swelling clay
(yellow)	Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westernmost of State only)

4.5.5.2 *Previous Occurrences*

In conducting research for this hazard there were no previous occurrences identified at this time. While damages due to expansive soils are occurring in New Mexico, the fact that the onset takes a very long time leads to damages that are cumulative rather than instantaneous. In the opinion of Dr. Dave Love, the damage is fairly frequent, but under-reported.

4.5.5.3 *Frequency*

Based on input from the New Mexico Bureau of Geology and Mineral Resources, the risks associated with expansive soils are not subject to frequency; they are a static feature with damage occurring due to wetting and drying cycles. The wetting-drying cycle may be human-caused or from natural precipitation. Therefore this hazard is in a constant cycle and changes on a daily basis. Due to no previous occurrence data being available at this time, the SHMPT will not profile Expansive Soils any further. If future conditions or events warrant, upcoming editions of the plan will further elaborate on this hazard.

4.5.5.4 *Risk Assessment*

Expansive Soils can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. Due to the low frequency of this hazard, the SHMPT will not profile Expansive Soils any further. If future conditions or events warrant, upcoming editions of the plan will further elaborate on this hazard.

Figure 4-74 provides impacts for consideration when reviewing expansive soil issues for the purposes of EMAP compliance.

Figure 4-74 Impacts from Expansive Soil

Subject	Potential Impacts
Agriculture	In agriculture production, expansive soils would typically be in pastures that support livestock range grazing. No significant impact would be anticipated.
Health and Safety of the Public	None anticipated.
Health and Safety of Responders	None anticipated.
Continuity of Operations	None anticipated.
Delivery of Services	None anticipated.
Property, Facilities, Infrastructure	The slow nature of this type of event causes the impacts to be almost imperceptible, however, costly damages to the built environment may occur - primarily highways and roads.
Environment	Pipeline ruptures could have significant impact.
Economic Condition	High infrastructure and building repair costs.
Public Confidence	Very little impact anticipated.

4.5.5.5 *Data Limitations*

Until expansive soil occurrence and damage information becomes available, it cannot be integrated into the Plan Update. It may be possible to combine expansive, corrosive and hydrocompactive soils into one heading called Hazardous Soils. Again, until data becomes available on any of these soil types, they cannot be integrated into the Plan Update. According to the Subject Matter Experts, there are no hazardous soils mapping or damage occurrence data being collected.

Expansive soils occurrence and damage data collection will be included as one of the mitigation actions in the Plan Update. Further analysis of existing data for corrosive and hydrocompactive soils will also be added as a mitigation action.

4.5.5.6 *What Can Be Mitigated?*

With regards to current day construction, mitigation of expansive soils is relatively simple in New Mexico. For small structures, the expansive clay can be excavated and removed. Then, compacted sandy soil is put beneath the foundations before construction starts. For larger structures with deeper foundations in thick expansive soils or rock, more extensive procedures are required.

It is possible that human activities in the area of expansive, hydrocompactive, and corrosive soils could be more closely regulated. Land management agencies, construction and inspection agencies, along with local government permit review could be more proactive in requiring testing of soils before construction.

4.5.5.7 *Changing Weather Patterns*

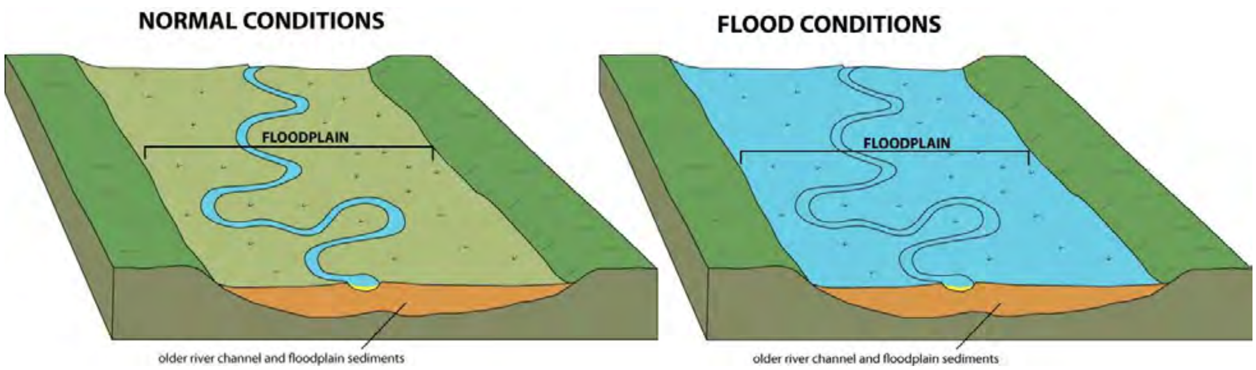
Based on input from the New Mexico Bureau of Geology and Mineral Resources, at this time there has not been a definitive link between an increase or decrease in the frequency or severity of expansive soils damage due to long-term, changing weather patterns. Additional study may show that more frequent high-magnitude or high intensity precipitations would cause more frequent expansive soil incidents. However, there is significant uncertainty about if there are thresholds in precipitation magnitude and intensity needed to cause significant swelling of soils. Periods of extended drought may also lead to desiccation cracks that are larger than previously observed, also leading to expansive soil-induced damage. This question requires further study.

4.5.6 Flood/Flash Floods

4.5.6.1 *Hazard Characteristics – Floods/Flash Flooding*

Nationwide, hundreds of floods occur each year, making flooding one of the most common hazards in all 50 States and U.S. territories. Most injuries and deaths from flooding happen when people are swept away by flood currents, and most property damage results from inundation by sediment-filled water. The majority of flood events in the United States involve inundation of floodplains. Figure 4-75 shows inundation of floodplains during a large-scale weather system with prolonged rainfall from storms or snowmelt.

Figure 4-75 Flood Definition[54]



For the purposes of this report, this type of flooding is referred to as *riverine flooding* and is characterized by a gradual and predictable rise in a river or stream due to persistent precipitation. After the stream or river overflows its banks the surrounding area often remains under water for an extended period of time.

Riverine floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence, shown in Figure 4-76, is expressed as the percentage chance that a flood of a specific extent will occur in any given year. Flash floods are usually the result of excessive precipitation, rapid snowmelt, increased impervious surface, or burn scar run-off and can occur suddenly. Although the State of New Mexico experiences riverine flooding, *flash flooding* is a more common and a more damaging type of flooding.

Figure 4-76 Flood Probability Terms[55]

Flood Recurrence Intervals	Chance of exceedance in any given year
10-year	10%
50-year	2%
100-year	1%
500-year	0.2%

Flash floods are aptly named: they occur suddenly after a brief but intense downpour; they move quickly and end abruptly. Although the duration of these events is usually brief, the damages can be quite severe. People are often surprised at how quickly a normally dry arroyo can become a raging torrent. Flash floods are the primary weather-related killer with around 140 deaths recorded in the United States each year. Flash floods are common and frequent in New Mexico, and as a result, New Mexico has the 10th highest flash flood fatality rate in the nation. Flash floods cannot be predicted; however, some

[54] Source: https://www.wired.com/2011/05/flooding-creates-floodplains/

[55] Source: USGS Water Science School: https://water.usgs.gov/edu/

conditions are known to make certain areas more vulnerable to flash floods. For example, the presence of hydrophobic soils following high-severity wildfire increases flood hazard in and downstream of the affected watershed. Alluvial fans and alluvial fan flood hazards exist in the State. Alluvial fan flood hazard characteristics include heavy sediment/debris loads and high velocity flows.

Flash flooding is the second greatest weather hazard in New Mexico. New Mexico ranks 10th in the Nation in flash flood deaths per capita, using statistics based on storm data from 2006 - 2012.[56] The flash flooding problem stems from a number of factors. During the summer (June through August period), thunderstorm frequency in certain parts of New Mexico is among the highest in the Nation. Excessive moisture during the summer can lead to large volume runoffs enhanced by the terrain. Figure 4-77 lists the major contributing factors of riverine flooding vs. flash flooding.

Figure 4-77 Flooding vs. Flash Floods – Contributing Factors[57]

Riverine Floods	Flash Floods
Low lying, relatively undisturbed topography	Hilly/mountainous areas
High season water tables	High velocity flows
Poor drainage	Short warning times
Excess paved surfaces	Steep slopes
Constrictions – filling	Narrow stream valleys
Obstructions – bridges	Parking lots and other impervious surfaces
Soil characteristics	Improper drainage

According to FEMA, "an alluvial fan is a sedimentary deposit located at a topographic break such as the base of a mountain front, escarpment, or valley side, that is composed of stream flow and/or debris flow/sediments and has the shape of a fan, either fully or partially extended."[58] "Over 15-25% of the arid west is covered by alluvial fans," reports FEMA.[59] New Mexico has more alluvial plains than alluvial fans due to the natural apex, according to Paul Dugie, NM Floodplain Managers Association. Though the intense rainstorms which produce fan floods occur randomly, they nevertheless can develop very rapidly at any time and can recur with frequency.[60] The California Alluvial Fan Task Force States, "When alluvial fan flooding occurs, it is flashy and unpredictable and variable in magnitude. This type of flooding does not necessarily occur as the result of large amounts of rain. Often, it is triggered by intense rainfall over short periods of time. The natural flooding process that drives alluvial fan sedimentation tends to produce thick deposits of sand and gravel, particularly near the apex of the fan, with relatively minor proportions of fine-grained particles." According to Dr. David Love, New Mexico Bureau of Geology and

[56] Source: 2013 State of New Mexico Hazard Mitigation Plan (http://www.nws.noaa.gov/om/hazstats.shtml)
[57] Source: http://www.weatherexplained.com/Vol-1/Floods-Flash-Floods.html
[58] Source: FEMA, MT-2 Procedures Manual, May 2009, p.30
[59] FEMA, Alluvial Fans: Hazards and Management, 1989, p. 3
[60] FEMA, Alluvial Fans: Hazards and Management, 1989, p. 3

Mining Resources, in the State of New Mexico, there have been no confirmed studies specific to alluvial fan flooding risk.

According to multiple studies, alluvial fan flood risk can cause high velocity flow (as high as 15-30 feet per second) producing significant hydrodynamic forces, erosion/scour to depths of several feet, deposition of sediment and debris (to depths of several feet), deposition of sediment and debris (depths of 15 – 20 feet have been observed), debris flows/impact forces, mudflows, inundation, producing hydrostatic/buoyant forces (pressure against buildings caused by standing water), flash flooding with little, if any, warning times.

Alluvial fans are often overlooked as hazards and there is a tendency to underestimate both the potential and severity of alluvial fan flood events. The infrequent rainfall, gently sloping terrain, and often long-time spans between successive floods contribute to a sense of complacency regarding the existence of possible flood hazards.[61]

4.5.6.2 *National Flood Insurance Program*

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The Federal Insurance and Mitigation Administration (FIMA) manages the NFIP and implements a variety of programs authorized by Congress to reduce losses that may result from natural disasters. In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

The Community Rating System (CRS) is a voluntary program for NFIP participating communities implemented in 1990 as a program to recognize and encourage community floodplain management activities that exceed minimum NFIP standards. The goals of the CRS are to (1) reduce flood damages to insurable property, (2) strengthen and support the insurance aspects of the NFIP, and (3) encourage a comprehensive approach to floodplain management. The CRS has been developed to provide incentives in the form of premium discounts for communities to go beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding. A study of the 450 communities nationwide that participate in the CRS program found that these activities, freeboard requirements, open space protection, and flood protection, significantly reduce flood damage. The State NFIP Coordinator can assist local communities with aspects of the CRS program that provide the greatest benefit by training and supporting local floodplain administrators and assisting local communities in developing ordinances and regulations to guide drainage infrastructure projects and development to provide New Mexico Communities with increased flood protection and resilience.

[61] Source: FEMA, MT-2 Procedures Manual, May 2009

Participation in the CRS program is voluntary and participating communities have their flood insurance premium rates adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS. Figure 4-78 shows the participating CRS communities in New Mexico. There are 11 New Mexico communities that participate in the CRS. There is one community (Las Cruces) that has a Class 6 rating; this rating allows for a 20% insurance premium discount for structures located in the SFHA and 10% discount for structures outside the SFHA. There are seven communities that have a Class 8 rating; this rating allows for a 10% insurance premium discount for structures located in the SFHA and 5% discount for structures outside the SFHA. There are three communities that have a Class 9 rating; this rating allows for a 5% insurance premium discount for structures located in the SFHA and 5% discount for structures outside the SFHA. Since the 2013 Plan update, Farmington was re-classified from 9 to 8. All other classifications remained the same.

Figure 4-78 New Mexico Eligible Communities in CRS as of December 31, 2017[62]

Community Number	Community Name	NFIP Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
350045	Alamogordo	10/01/91	10/01/91	9	5	5	C
350002	Albuquerque	10/01/93	11/04/16	8	10	5	C
350001	Bernalillo County	10/01/93	11/04/16	8	10	5	C
350010	Clovis	10/01/91	05/16/13	8	10	5	C
350012	Dona Ana County	10/01/03	7/06/16	8	10	5	C
350067	Farmington	10/01/91	8/5/10	8	10	5	C
350029	Hobbs	10/01/92	12/16/08	8	10	5	C
355332	Las Cruces	10/01/91	07/06/16	6	20	10	C
350054	Portales	10/01/95	10/06/10	9	5	5	C
350006	Roswell	10/01/92	09/25/09	9	5	5	C

[62] Source: FEMA CRS document https://www.fema.gov/media-library-data/1503240360683-30b35cc754f462fe2c15d857519a71ec/20_crs_508_oct2017.pdf

Community Number	Community Name	NFIP Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
350064	San Juan County	05/01/08	08/05/10	8	10	5	C

The National Flood Insurance Program aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of general risk insurance, but also of flood insurance, specifically.

The NFIP is self-supporting for the average historical loss year, which means that operating expenses and flood insurance claims are not paid for by the taxpayer, but through premiums collected for flood insurance policies. To obtain secured financing to buy, build, or improve structures in Special Flood Hazard Areas (SFHAs), flood insurance must be purchased. Lending institutions that are Federally regulated or Federally insured must determine if the structure is located in a SFHA and must provide written notice requiring flood insurance. Flood insurance is available to any property owner located in a community participating in the NFIP. All areas are susceptible to flooding, although to varying degrees.

The most widely adopted design and regulatory standard for floods in the United States is the 1% annual chance exceedance (ACE) flood and this is the standard formally adopted by FEMA. The 1% annual flood, also known as the base flood elevation, has a 1% chance of occurring in any particular year. It is also often referred to as the "100-year flood" since its probability of occurrence suggests it should only reoccur once every 100 years (although this is not the case in practice). Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather it reflects the probability that over a long period of time, a flood of that magnitude should only occur in 1% of all years.

The State of New Mexico reported the following NFIP participation statistics as of December 31, 2017, based on information provided by FEMA Region VI. The statistics are summarized for each Preparedness Area in Figure 4-79 below.

- Number of NFIP Policies was 12,803 (a decrease of 4,096 from the 16,899 reported in the 2013 Plan)
- Amount of Insured Assets Covered was $2,772,592,200 (a decrease of $316,453,700 from the $3,088,045,900 reported in the 2013 Plan)
- Amount of Total Premiums was $10,536,830
- Claims made since 1978 were 1,317 (an increase of 260 from the 1,057 reported in the 2013 Plan)
- Total Value of Claims Paid since 1978 ~~is~~ was $14,946,317 (an increase of $3,800,486 from the $11,145,831 reported in the 2013 Plan)

Figure 4-79 NFIP Participation Statistics as of December 31, 2017

Location	Number of Policies	Total Coverage	Total Premiums	Claims since 1978	Total Paid Since 1978
Preparedness Area 1	2699	$486,260,500	$2,059,267	445	$4,208,753
Preparedness Area 2	145	$28,998,200	$169,403	27	$108,938
Preparedness Area 3	831	$229,899,400	$741,461	107	$807,400
Preparedness Area 4	414	$101,482,900	$372,953	85	$965,519
Preparedness Area 5	5,526	$1,146,678,800	$4,923,348	301	$2,123,425
Preparedness Area 6	3,188	$677,373,000	$2,270,398	352	$6,732,282
Totals State-wide	**12,803**	**$2,772,592,200**	**$10,536,830**	**1,317**	**$14,946,317**

Currently there are 104 communities participating in the NFIP: 29 counties, 35 cities, 26 villages, 13 towns and one Tribal jurisdiction. The four counties that do not participate in the NFIP are De Baca and Guadalupe in Preparedness Area 1, and Harding and Union in Preparedness Area 2).

In the State of New Mexico, as in the whole United States, the number of NFIP policies has been decreasing. Between December 2012 and December 2017, the number of NFIP policies has dropped by 4,096 which is a 24.3% drop in the number of policies over a period of five years.

4.5.6.3 *Repetitive Loss Properties*

As of December 31, 2017, two severe repetitive loss structures were identified in the State (Figure 4-80) with seven losses totaling $34,955.77 in damages. Both structures are residential and were insured at the time of the losses.

As of December 31, 2017, 36 repetitive loss structures were identified in the State (Figure 4-81) with 115 losses totaling $2,038,266.84 in damages. One of the properties suffered damages five times. Three of the properties suffered damages four times. Note that the 2013 Plan incorrectly identified that there were 48 repetitive loss structures.

Figure 4-80 Severe Repetitive Loss Properties (as of 12/31/17)

Community Name Severe Rep Loss	Zip Code	Losses per Structure	Total Claim Amount Paid Out	County Name
HOBBS, CITY OF	882404748	2	$5,517.86	LEA COUNTY
LAS CRUCES, CITY OF	880052910	5	$29,437.91	DONA ANA COUNTY
TOTAL	**2 structures**	**7**	**$34,955.77**	

Figure 4-81 Repetitive Loss Properties (as of 12/31/17)

Community Name Repetitive Loss	Zip Code	Losses per Structure	Total Claim Amount Paid Out	County Name
ALBUQUERQUE, CITY OF	871051728	2	$42,604.50	BERNALILLO COUNTY
ALBUQUERQUE, CITY OF	871055943	2	$23,188.96	BERNALILLO COUNTY
ALBUQUERQUE, CITY OF	871122119	2	$4,900.18	BERNALILLO COUNTY
AZTEC, CITY OF	874104514	2	$97,969.07	SAN JUAN COUNTY
AZTEC, CITY OF	874102098	2	$65,449.13	SAN JUAN COUNTY
AZTEC, CITY OF	874102044	2	$105,534.85	SAN JUAN COUNTY
CARLSBAD, CITY OF	882203332	2	$38,218.28	EDDY COUNTY
CARLSBAD, CITY OF	882203332	2	$35,781.76	EDDY COUNTY
CARLSBAD, CITY OF	882203080	2	$9,266.86	EDDY COUNTY
CARLSBAD, CITY OF	882204256	2	$12,971.87	EDDY COUNTY
CLOVIS, CITY OF	881017829	5	$234,322.49	CURRY COUNTY
CLOVIS, CITY OF	881018375	2	$175,614.10	CURRY COUNTY
DEMING, CITY OF	88030	2	$88,420.82	LUNA COUNTY
DONA ANA COUNTY	880076305	2	$41,113.78	DONA ANA COUNTY
DONA ANA COUNTY	88007	2	$26,109.24	DONA ANA COUNTY
DONA ANA COUNTY	880817394	2	$83,238.63	DONA ANA COUNTY
DONA ANA COUNTY	880058606	3	$47,690.80	DONA ANA COUNTY
GALLUP, CITY OF	873015308	2	$12,090.08	MCKINLEY COUNTY
GRANTS, CITY OF	870202740	2	$44,538.28	CIBOLA COUNTY
HOBBS, CITY OF	882400000	4	$87,193.60	LEA COUNTY
HOBBS, CITY OF	882404542	4	$21,957.15	LEA COUNTY
HOBBS, CITY OF	882400000	4	$25,323.38	LEA COUNTY
HOBBS, CITY OF	882404749	2	$9,023.07	LEA COUNTY
HOBBS, CITY OF	882404748	3	$13,064.88	LEA COUNTY
HOBBS, CITY OF	882404733	2	$12,986.76	LEA COUNTY
HOBBS, CITY OF	882404745	2	$40,488.16	LEA COUNTY
HOBBS, CITY OF	882400000	2	$13,128.48	LEA COUNTY
HOBBS, CITY OF	882404747	2	$13,005.58	LEA COUNTY
LEA COUNTY	882409671	2	$30,843.88	LEA COUNTY
PORTALES, CITY OF	881307334	3	$7,362.40	ROOSEVELT COUNTY
PORTALES, CITY OF	881306102	2	$6,658.21	ROOSEVELT COUNTY
ROSWELL, CITY OF	882016246	2	$9,890.56	CHAVES COUNTY
ROSWELL, CITY OF	882012047	2	$8,255.34	CHAVES COUNTY
RUIDOSO, VILLAGE OF	883457509	2	$22,154.83	LINCOLN COUNTY
SAN JUAN COUNTY	874120000	2	$6,374.92	SAN JUAN COUNTY
SAN MIGUEL COUNTY	877019747	2	$50,003.52	SAN MIGUEL COUNTY
TOTAL:	**36 structures**	**108**	**$2,038,226.84**	

4.5.6.4 *NFIP Changes*

In 2014, FEMA established the Technical Mapping Advisory Council (TMAC), as mandated by the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12), to review the National Flood Mapping Program (Program), recommend improvements to the Program, and assess projected future conditions as they relate to flooding. Since 2014, the TMAC has issued annual recommendations that have the potential to impact the NFIP program. These new recommendations highlight the importance of accurate flood hazard maps to provide relevant information for determining flood risk-rated insurance premiums (FRIPs) and communicating the cost of those premiums over time to residents in areas subject to inundation and water damage. The TMAC recommendations have the potential to significantly change flood insurance and risk mapping in New Mexico. [63]

Future flood studies in New Mexico in areas which have levees will be subject to FEMA's updated Levee Analysis and Mapping Procedures. If the levees are found to be non-accredited according to the requirements set forth in 44 CFR 65.10 then FEMA will contact community officials and collect local input prior to determining the procedure(s) that will be used to identify the areas of potential flood hazard on the landward side of non-accredited levee systems. [64]

4.5.6.5 *Floodplain Mapping and Current Status of DFIRMs Maps*

Through FEMA's flood hazard mapping program, Risk Mapping, Assessment and Planning (Risk MAP), FEMA identifies flood hazards, assesses flood risks and partners with states and communities to provide accurate flood hazard and risk data to guide them to mitigation actions. Flood hazard mapping is an important part of the National Flood Insurance Program (NFIP), as it is the basis of the NFIP regulations and flood insurance requirements. FEMA maintains and updates data through Flood Insurance Rate Maps (FIRMs) and risk assessments. FIRMs include statistical information such as data for river flow, storm tides, hydrologic/hydraulic analyses and rainfall and topographic surveys. During FEMA's Map Modernization program, Digital Flood Insurance Rate Maps (DFIRMs) for 23 of New Mexico's 33 counties were developed. Ten counties were not digitized and six; Catron, De Baca, Guadalupe, Harding, Hidalgo, and Union Counties, have had no floodplain mapping conducted. Mora and Torrance counties' FIRM effective dates are 1977 and 1978, respectively, and were converted by letter from HUD Flood Hazard Boundary Maps. Sierra County's effective FIRM date was 1986 and Quay County's is 2003. Though county wide mapping is not available for Catron, De Baca, Guadalupe, Hidalgo, and Union Counties, some extent of these counties has some form of floodplain delineation. No mapping for Harding County has ever been conducted. Figure 4-82 shows the status of each County DFIRM as of June 2017.

Flood hazard areas depicted on the Flood Insurance Rate Map are identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is also referred to as the base flood or 100-year flood. SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30. Moderate flood hazard areas, labeled Zone B or Zone X (shaded) are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year)

[63] TMAC, Technical Mapping Advisory Council Annual Report December 2016. https://www.fema.gov/media-library-data/1492803841077-57e4653a1b2de856e14672e56d6f0e64/TMAC_2016_Annual_Report_(508).pdf
[64] Analysis and Mapping Procedures for Non-Accredited Levees https://www.fema.gov/final-levee-analysis-and-mapping-approach

flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled Zone C or Zone X (unshaded).[65] Zone D Areas with possible but undetermined flood hazards, no flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk. Approximately 34% of mapped areas in New Mexico are designated as Zone D, including nine counties and 18 Tribal Reservations. This Zone D designation adversely impacts residents and local communities economically, communities are unable to determine the actual risk to their residents and businesses and economic opportunities have been lost due to this zone designation. The large area of New Mexico designated as Zone D significantly impacts local communities and a strategy to lessen the impacts of unknown flood risk needs to be developed.

A State-wide floodplain map based on existing FEMA floodplain mapping, Figure 4-83, delineates Special Flood Hazard Areas (SFHA), or land areas that are identified by FEMA maps as subject to inundation by a flood. On this map, the SFHAs are shaded with different colors and divided into distinct flood hazard zones depicted on the map legend. Floodplain maps are useful tools for identifying the location of flood-prone areas. This information contributes to the development of strategies that may mitigate the potential impacts from a flooding event. The major population centers have zoning and regulatory authority that is adequate to control development and offer some regulatory protections to the population, limiting or restricting development in high hazard areas. In more remote locations, communities may be eager to encourage development and less prepared to educate the public about the risks from natural hazards ahead of an event. Resources in remote locations for assisting communities after a hazard event are also limited. Remote locations present challenges to providing adequate floodplain mapping to programs such as FEMA's Risk Mapping, Assessment, and Planning (Risk MAP), which can lead to inadequate information on existing maps or a lack of flood maps.

[65] Source: https://www.fema.gov/flood-zones

Figure 4-82 DFIRMs Status in New Mexico as of June 2017

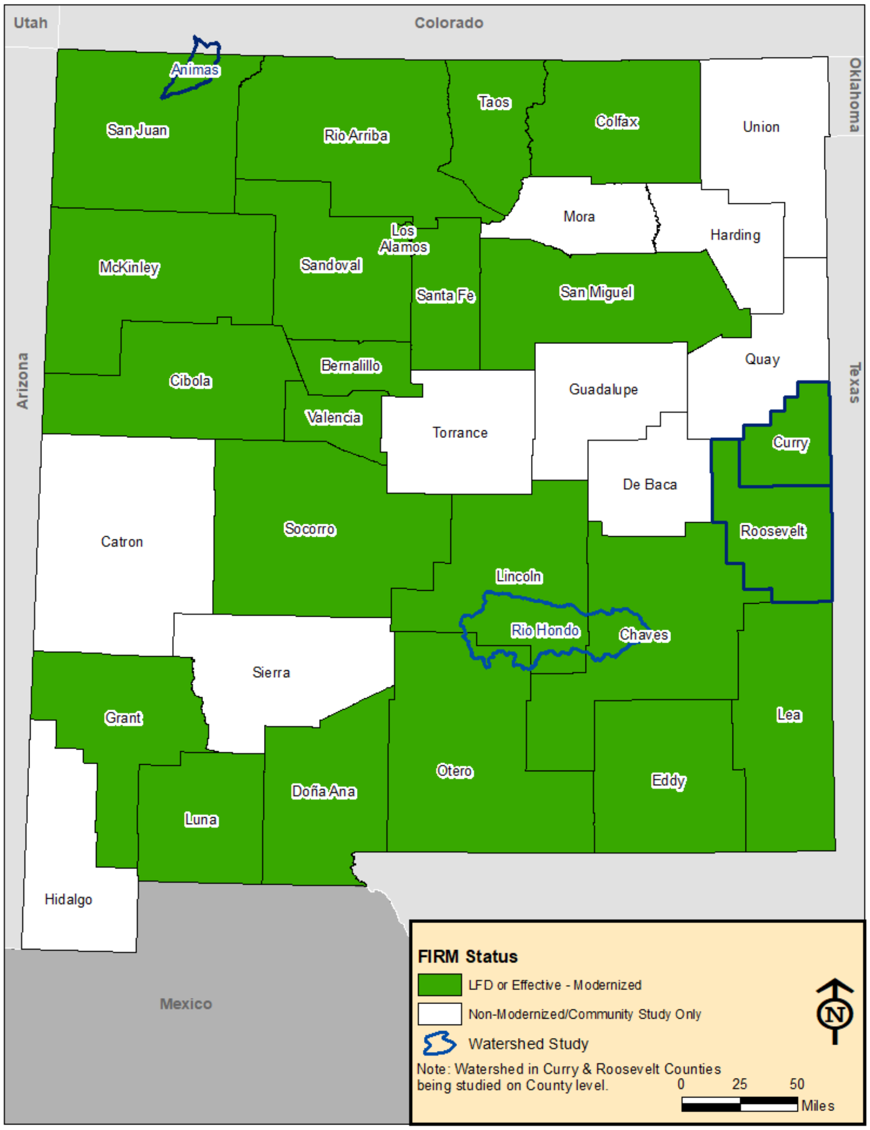
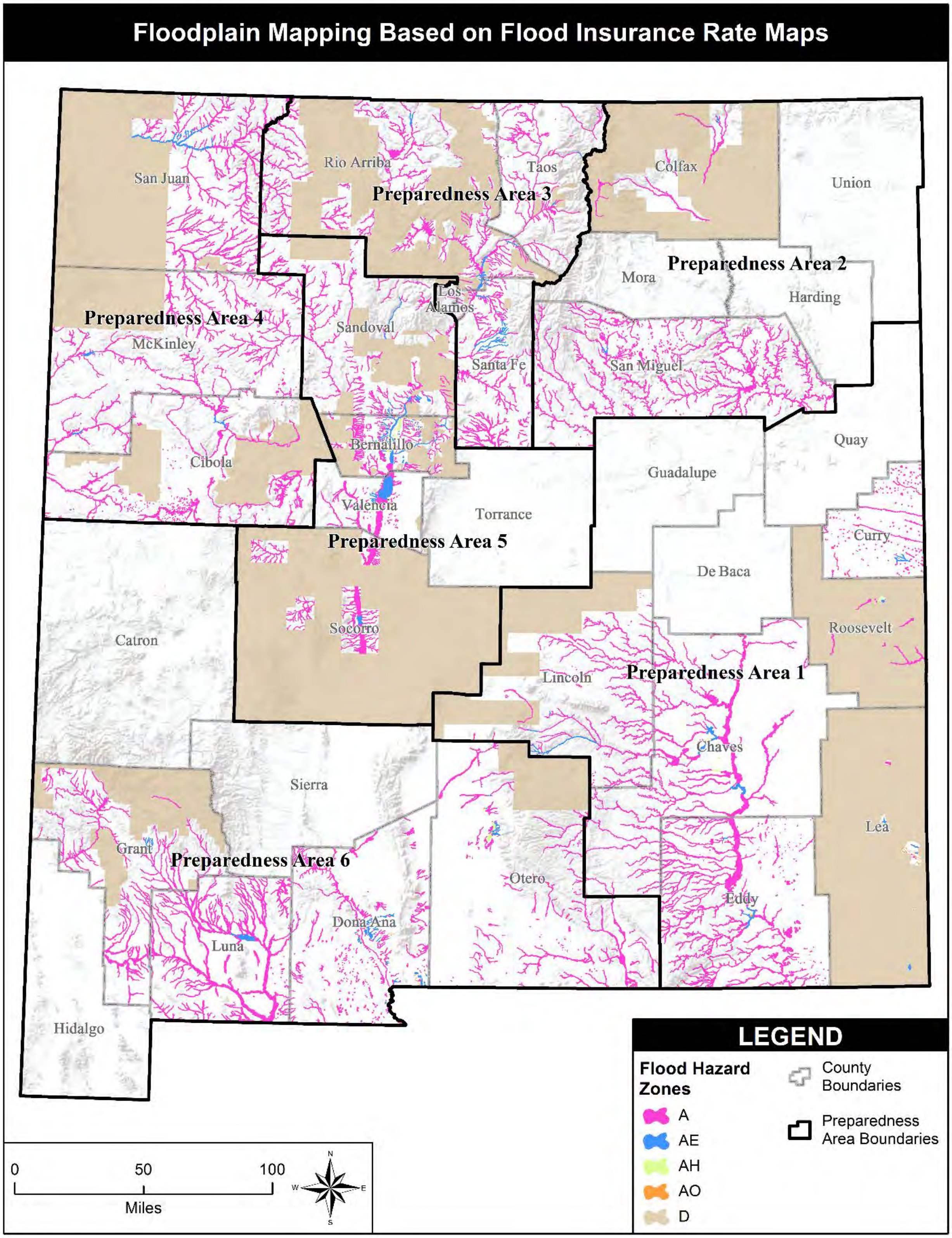


Figure 4-83 New Mexico State Floodplain Maps



Almost all of New Mexico's recent disaster declarations have been flood related, and all of the flood declarations since 2008 have been for public assistance (infrastructure) and Hazard Mitigation Grant Program (HMGP) only. This means that vital infrastructure such as roads and bridges are being affected by flooding. While approximate flood mapping allows for flood insurance rates to be determined, it does not provide information about whether bridges and roads may be overtopped or the true depth of flooding. Therefore, the heights that structures and infrastructure need to be elevated to are unknown.

Outdated maps pose similar problems in some jurisdictions. Flood events can alter the floodplain over time or, in some cases, during a single event. The City of Corrales saw up to three feet of silt and sand deposited in areas and extreme erosion in areas during the July 2013 floods. The silt and erosion caused significant changes in elevations in some areas, decreasing or eliminating the usefulness of effective FIRM maps for the area. There are several potential mitigation techniques that can be applied here. The first would be to update FIRMs which would allow communication of updated risk. Another would be to account for debris in drainage infrastructure since it is a known problem. One other option would be to apply bank stability and erosion protection in the areas where the silt and debris originates.[66]

The New Mexico CTP, the Earth Data Analysis Center, annually updates the New Mexico Risk Map Five Year Business Plan which outlines projects that the CTP will undertake to help New Mexico communities reduce flood risk. These projects are developed in conjunction with the New Mexico State Floodplain Coordinator and FEMA Region VI and are guided by the New Mexico Hazard Mitigation Plan. The projects are prioritized according to Risk Map guidelines in its Multi-Year Plan. The strategies and products address the need for better flood hazard identification and mapping. These strategies include utilizing a watershed study approach which allows for a better understanding of flooding and includes elevation data improvement in the form of LIDAR acquisition. Along with the acquisition of accurate elevation data FEMA has instituted a new approach to FIRM in the unmodernized and underserved areas that are currently lacking flood risk information. The Base Level Engineering (BLE) approach creates data that may be used to assess stream inventory, prioritize watersheds or stream segments for further study, provides a sounding board and initiates a discussion with communities that revolves around risk information, risk identification and indication of flood risk abatement and mitigation strategies that may reduce current or future flood risk. [67] BLE datasets are produced to meet the current technical mapping standards outlined in FIMA Policy 204-078-1 Standards for Flood Risk Analysis and Mapping. This allows FEMA Region VI to move efficiently from Discovery to the update of the FIRMs, preparing Zone A maps for communities that are currently underserved by the National Flood Insurance Program. The BLE approach also produces a range of flood risk datasets to include Floodplains (10%, 1% and 0.2% annual chance events), Water Surface Elevation Grids (1% and 0.2% annual chance events), Flood Depth Grids (1% and 0.2% annual chance events), and Hazus Flood Risk Assessment. This wealth of information is intended to elevate the delivery of Zone A FIRMs. BLE datasets can be used in support of local floodplain management activities, hazard mitigation planning efforts, grant applications and disaster response. The BLE information is released through an interactive data portal after review with State and Local officials. This portal allows users to produce a site-specific report for any location within the 1% annual chance floodplain and it produces a site-specific report that can be used for local discussions about individual risk. The site is available for use at: https://apps.femadata.com/estbfe

[66] New Mexico Flood Disaster Information and Risk Analysis Report. March 2015. http://www.riskmap6.com/documents/resource/2013_NMFloodDisasterInfoRiskAnalysisReport_FINAL.pdf

[67] Base Level Engineering FEMA Region 6 http://www.riskmap6.com/documents/resource/FEMA_R6_BLE_FACTSHEET_V2.pdf

The Rio Hondo Watershed in southeastern New Mexico was the first HUC-8 watershed to undergo a BLE study, additional watersheds are scheduled for study in the upcoming years.

4.5.6.6 *Previous Occurrences*

New Mexico has experienced numerous flood/flash flooding events in each Preparedness Area. The current online NCDC database is limited in past events and contains data starting from May 1996 to December 2017, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total of 1,292 flood/flash flood events with 32 deaths, 15 injuries, over $115 million in property damage, and over $5 million in crop damage.[68]

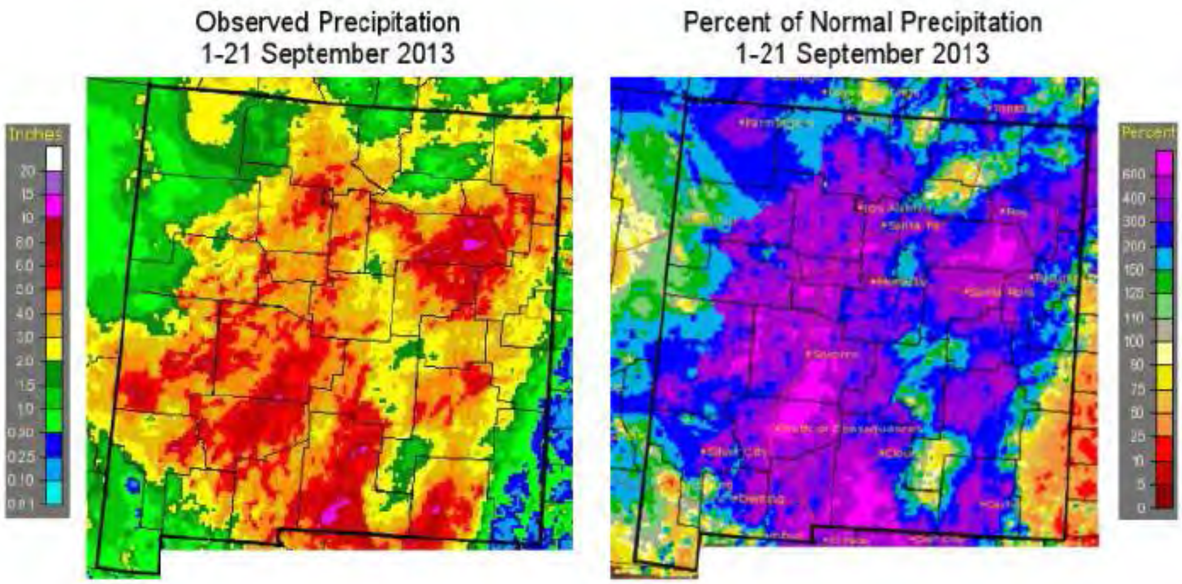
The years 2013 and 2014 saw very heavy flooding throughout the State of New Mexico. The flooding during this time resulted in over $20 million in property damage and six Presidential Disaster Declarations. This figure represents Federal dollars obligated to date and is expected to increase as repair work continues. Overall, the State has had eight flood disaster declarations since 2010 and 12 since 2004. For comparison's sake, from 1973 to 2003, a 30-year period, there were 11 flood declarations. There is a potential that this level of damage could continue as a result of extreme weather, climate change, floods after fires, and increased development.

From September 9th-18th, 2013, New Mexico experienced a major precipitation event that resulted in extensive flooding in some drainages, and record and near-record flows in many streams. The interaction between monsoonal circulation from the south that tracked in moisture sourced from tropical storms over Mexico, and a trough over Arizona and Nevada that helped steer this moisture into New Mexico and Colorado and, eventually, Texas, resulting in widespread flooding and approximately $18.5 million in damages. Portions of the State experienced 1,000-year rainfall events. Figure 4-84 shows the observed precipitation and the percent of normal precipitation for the first three weeks of September 2013. Note portions of the State received 600% of their normal precipitation during this time frame.[69]

[68] Source: http://www.ncdc.noaa.gov/stormevents/

[69] Source: Post Flood Report: Record Rainfall and Flooding Events During September 2013 in New Mexico, Southeastern Colorado and Far West Texas, US Army Corps of Engineers, 2014

Figure 4-84 Observed and Percent of Normal Precipitation in New Mexico from the September 2013 Floods



The US Army Corps of Engineers completed a post flood report after the September 2013 floods (DR 4151 and DR 4152)[70]. The report summarizes the meteorological and hydrological characteristics of the flood event, and its impacts to infrastructure and communities in each major basin throughout the State. The analysis includes performance of flood control structures and in each major basin within the USACE, Albuquerque District and includes a preliminary overview of damages caused by these events as well as losses avoided. Figure 4-85 shows losses avoided by flood control measures in each basin.

Figure 4-85 Losses Avoided by Flood Control Measures by Basin for the September 2013 Floods

Basin	Project	Flood Control Benefits ($)
Rio Grande	Cochiti	$113,088,400
	Jemez Canyon	$37,696,200
	Galisteo	$45,326,800
	Total	$196,111,400
Pecos	Brantley	$1,948,900
	Santa Rosa	$4,060,800
	Sumner	$8,244,700
	Two Rivers	$185,554,000
	Total	$199,808,400
Upper Canadian River	None	None
Upper Arkansas River	None	None
Upper San Juan River	None	None
Lower Colorado River Tributary Headwaters	None	None
Total		**$395,919,800**

[70] Source: Post Flood Report: Record Rainfall and Flooding Events During September 2013 in New Mexico, Southeastern Colorado and Far West Texas, US Army Corps of Engineers, 2014

The New Mexico Cooperating Technical Partner (CTP), the Earth Data Analysis Center, is conducting a multi-year project to assess hazard risk at the watershed level.[71] The first year of the Multi-Hazard Risk Portfolio (MHRP) was focused on flood. New Mexico is comprised of part or all of 85 different HUC-8 watersheds. The criteria used to prioritize watersheds within New Mexico were designed to be as objective and repeatable as possible while including factors that meet the needs of communities within the State. These criteria include: Population at Risk, Area of Non-Federal Land, Essential Facilities At Risk, Dam Hazard Potential and Subject Matter Expertise. Additionally, a detailed analysis of each watershed including topography, land ownership, flood map status, NFIP statistics, and a general description of the watershed characteristics is provided in the MHRP. An important component of the process was a survey of local community and county officials with jurisdictional authority in New Mexico.

Figure 1-2 in Appendix A describes those significant events that have occurred in New Mexico within specific Preparedness Areas. Information provided by NCDC and local Emergency Managers.

Declared Disasters from Flood/Flash Flooding

DHSEM reports 40 State Declared Disasters for flooding between 2003 and 2017 (Figure 1-3 Appendix A). This number is based on how many Executive Orders were signed by the Governor for flooding or flood threat. According to DHSEM records, the total cost for State declared flood events from 2008 through 2017 was $533,850,251.

The chart below (Figure 4-86) summarizes the amount of funding that has been provided to eligible applicants for Federally declared disasters from 2008 to present. Additional detail is available in the Capability Appendix (Figure 2-1 and 2-3 Appendix B). This data is as of August 8, 2017. Note that Santa Clara Pueblo received two direct disaster declarations in 2013 (DR-4147 and 4151); dollar figures for these two disasters are not include in the figures below.

Figure 4-86 Federally Declared Flooding Disasters, 2008-2017

Disaster Number	Total Project Amount	Amount Included for 406 Mitigation	Number of 406 Project Worksheets	% of C-G Project Worksheets
1936	$9,988,263	$3,449,063	290	43.87%
1783	$51,010,550	$616,767	43	34.40%
4047	$35,759,446	$46,898,731	15	41.03%
4079	$246,515,566	$34,004	9	15.79%
4148	$7,485,874	$169,832	22	13.66%
4152	$54,870,776	$4,361,806	98	14.89%
4197	$12,165,573	$1,704,087	15	40.54%
4199	$116,054,204	$46,898,731	15	48.39%
Totals	$533,850,251	$104,133,022	507	19.51%
19.5% is the 406 funding as a percent of the total PA project amount				

[71] Source: New Mexico Multi-Hazard Risk Portfolio, Earth Data Analysis Center, Cooperating Technical Partner Program, FEMA Risk MAP, September 2015, http://nmflood.org/content/new-mexico-risk-map-projects

Another source of flood damage information is from the NCDC. Below is a tally of flood damage as reported by NCDC broken out by Preparedness Area (Figure 4-87). According to NCDC, State-wide property damage from flood damage was over $115 million and crop damage was over $5 million from May 1996 through December 2017.

Figure 1-2 in Appendix A outlines significant past events that have occurred in New Mexico Preparedness Areas. Data was taken from NCDC, which records flood events from May 1996 to December 2017.

Figure 4-87 Preparedness Areas 1 - 6 Flood/Flash Flood History (May 1996 - December 2017) [72]

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln, Quay and Roosevelt						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Flood	33	0	1	0	$27,256,500	$1,000
Flash Flooding	424	0	6	3	$10,977,200	$110,500
Total	**457**	**0**	**7**	**3**	**$38,233,700**	**$111,500**

Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Flood	8	0	0	0	$2,100,000	$0
Flash Flooding	69	0	1	6	$1,623,000	$0
Total	**77**	**0**	**1**	**6**	**$3,723,000**	**$0**

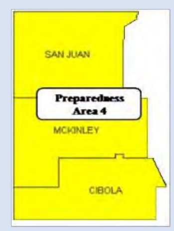
[72] Source: http://www.ncdc.noaa.gov.

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	7	0	0	0	$110,000	$0
Flash Flooding	120	0	4	4	$16,952,500	$10,600
Total	**127**	**0**	**4**	**4**	**$17,062,500**	**$10,600**

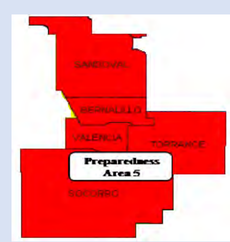
Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	4	0	0	0	$850,000	$0
Flash Flooding	109	0	12	1	$7,283,500	$11,500
Total	**113**	**0**	**12**	**1**	**$8,133,500**	**$11,500**

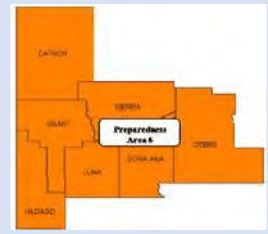


Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	12	0	0	0	$2,105,000	$0
Flash Flooding	204	0	3	0	$25,447,000	$4,356,200
Total	**216**	**0**	**3**	**0**	**$27,552,000**	**$4,356,200**



Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Flood	26	0	0	0	$475,000	$0
Flash Flooding	270	0	4	1	$19,963,000	$860,500
Total	**296**	**0**	**4**	**1**	**$20,438,000**	**$860,500**



4.5.6.7 *Frequency*

Most of the flash floods in New Mexico are associated with the summer monsoon season. Approximately 60% of all flash floods in the State occur in July and August. The monsoon season generally dissipates in the northern part of the State (Preparedness Area 4) in early September. In mid to late summer, the pacific winds bring humid subtropical air into the State. Solar heating triggers afternoon thunderstorms that can be devastating. July and August 2012 brought intense flooding with burn scar areas producing up to 400% greater flows than the calculated 1% chance storm event. Figure 4-88 and Figure 4-89 show the monsoon burst periods that caused numerous flood events in 2017 and 2018. This information is provided by the National Weather Service in Albuquerque, 2018, Monsoon Season Summary.

Figure 4-88 2017 Monsoon Burst Periods

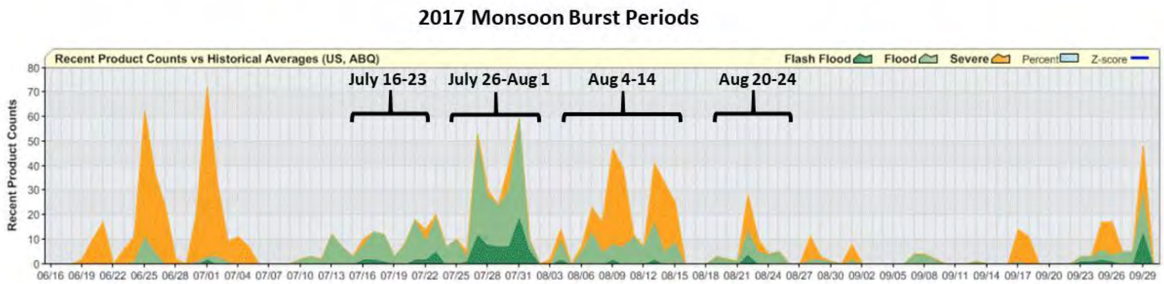


Figure 4-89 2018 Monsoon Burst Periods

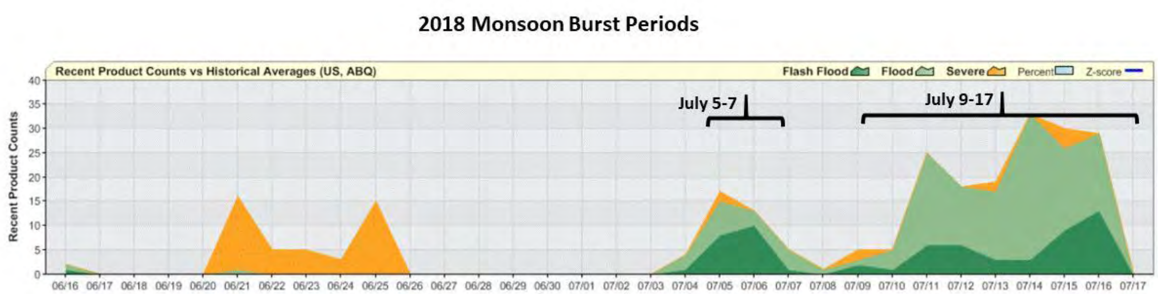


Figure 4-90 shows the number of flood/flash flood events per county from 1996 to December 2017. These events are based on NCEI data. Six events have been excluded from the chart due to being reported by NWS zone rather than county, as described below:

- NORTHWEST PLATEAU (ZONE) – 1 flood event on 6/1/2005
- NORTHWEST PLATEAU / SAN JUAN EXCEPT X SW AND SE / NC MCKINLEY (ZONE) – 1 flood event on 5/25/2005
- SANGRE DE CRISTO MOUNTAINS (ZONE) – 1 flood event on 5/23/2005
- SOUTHWEST DESERT/BOOTHILL (ZONE) – 1 flood event on 9/22/1997
- SOUTHWEST MOUNTAINS/LOWER GILA REGION (ZONE) – 1 flood event on 9/22/1997
- SOUTHWEST MOUNTAINS/LOWER GILA REGION / X N HILDAGO / GRANT EXCEPT S / W SIERRA (ZONE) – 1 flood event on 2/11/2005

Eddy County (Preparedness Area 1) has experienced the most floods/flash floods during this time period, with 188 total events.

Figure 4-90 Flood/Flash Flood Events by County, 1996-2017

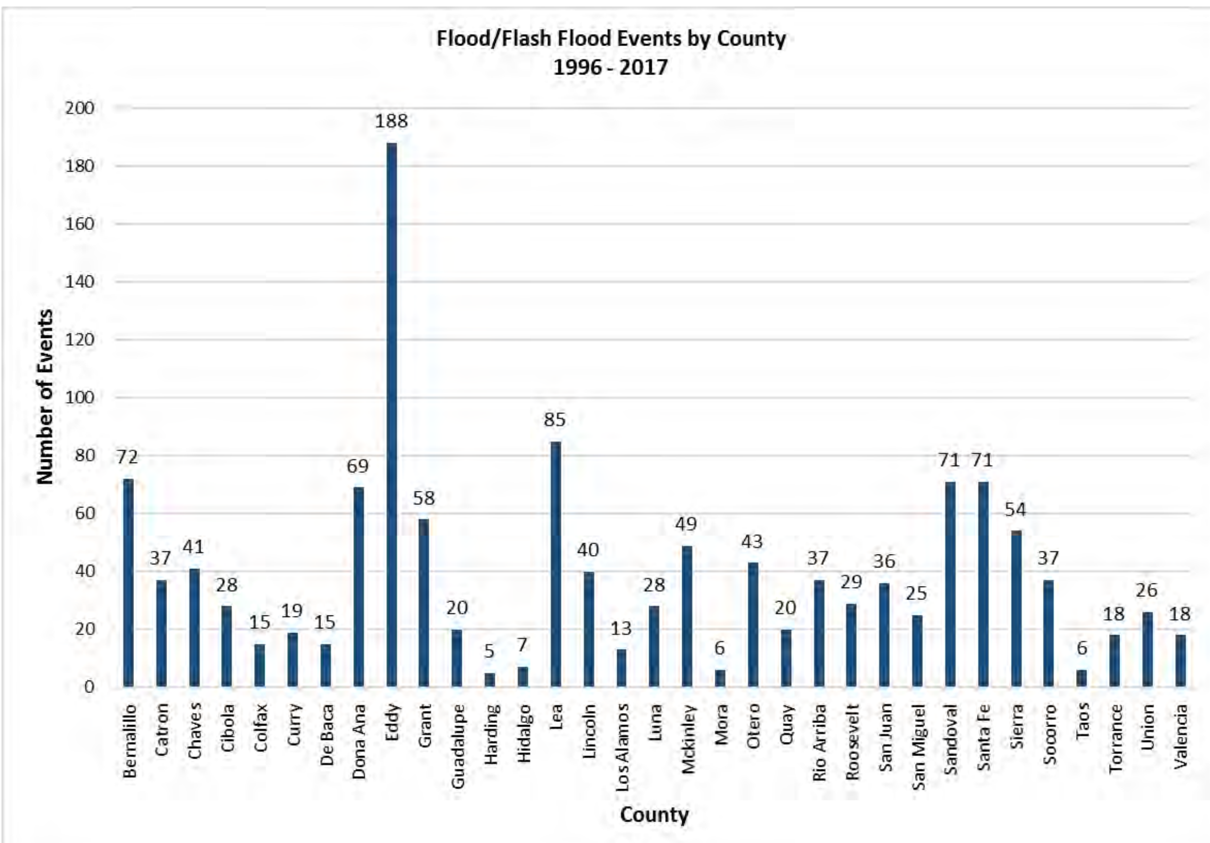
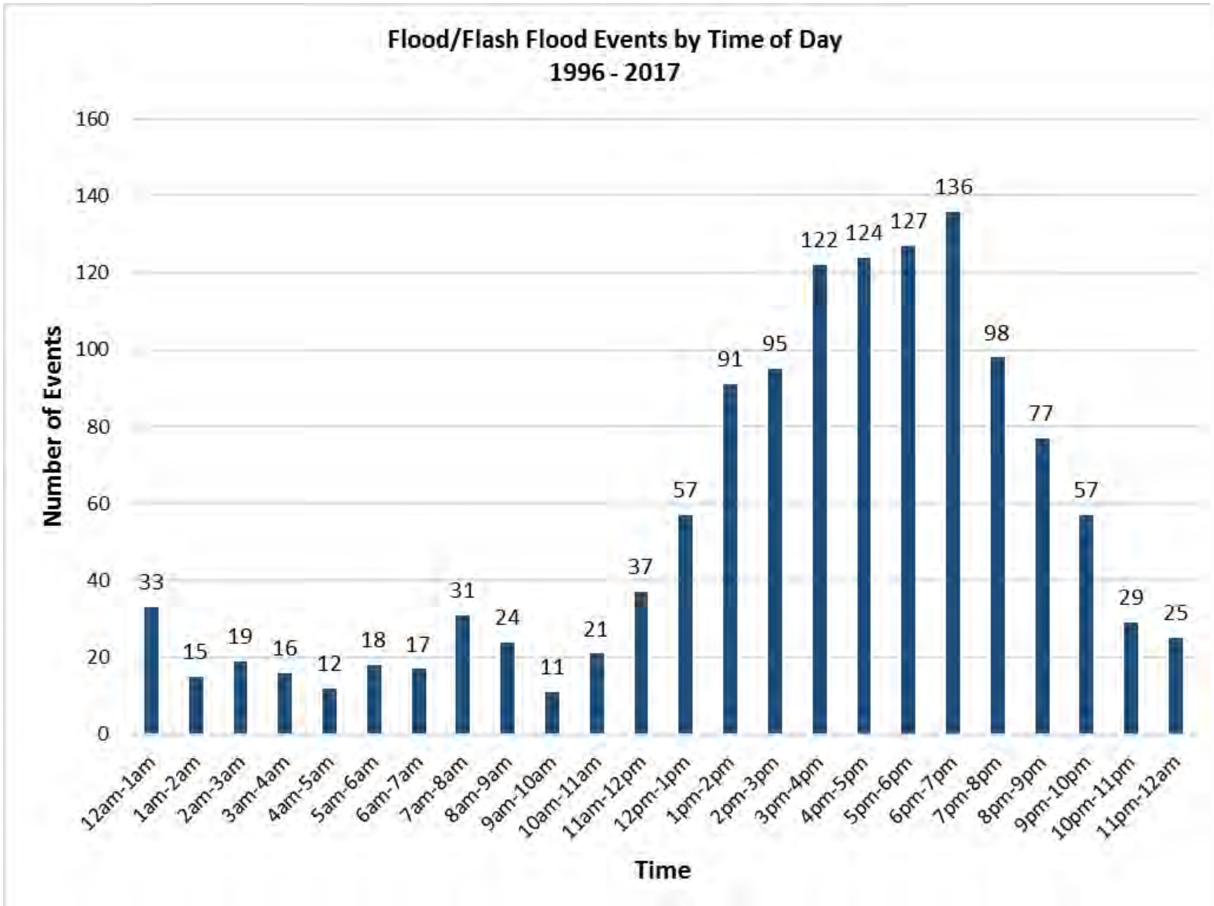


Figure 4-91 shows the number of flood/flash flood events by time of day from 1996 through December 2017, based on NCEI data. Flooding associated with afternoon thunderstorms is evident. The majority of flooding events occur between 3:00pm and 7:00pm, with 6:00pm to 7:00pm experiencing the most flooding events.

Figure 4-91 Flood/Flash Flood Events by Time of Day, 1996 - 2017



Because of too much rain, in too small an area, in too short a time, flash flooding may result. These flash floods generally travel down arroyos (normally dry streambed) and can involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the uprooting of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding. Urban areas are increasingly subject to flash flooding due to the removal of vegetation, replacement of ground cover with impermeable surfaces, and construction of drainage systems. Local drainage floods may occur outside of recognized drainage channels or delineated floodplains due to a combination of locally heavy precipitation, a lack of infiltration, inadequate facilities for drainage and storm water conveyance, and increased surface runoff.

Winter flash flood events usually result from unseasonably high-level rain on top of a snow pack. Excessive runoff allows the combined release of the water in the snow pack along with the rain. These can be flash flood events lasting less than a day, or they can evolve into longer-term flooding events lasting from one day to a couple of weeks. Winter flooding occurs between November and February and usually affects the southwest portion of the State.

Most spring events occur between April and June. They vary between winter type events where the rain falls over the remaining winter snow pack in or near the mountains to events in the eastern plains, which are often associated with cold fronts, abundant moisture from the Gulf of Mexico, and upslope conditions. Although all of the eastern plains are subject to this type of event, the greatest frequencies have been in the far southeast, in Eddy and Lea Counties (Preparedness Area 1).

Late summer floods can occur due to hurricane remnants and tropical storms that move over the State from both the Gulf of Mexico and the Pacific Ocean. By the time these remnants reach New Mexico, however, usually the only feature remaining is an abundance of moisture. Hurricane-force winds have long since dissipated. Flash floods frequently occur on alluvial fans with devastating results. The combination of rapidly rising floodwater, high velocities and heavy sediment/debris loads contributed to the damage in Alamogordo and Hatch (Preparedness Area 6) in 2006 (Figure 4-92). Figure 4-93 shows post-fire flooding in Preparedness Area 2 (Ute Park and downstream of Midnight Mesa) after the Ute Park Fire, July 2018.

Figure 4-92 Flooding in Preparedness Area 6 (Alamogordo and Hatch, NM) 2006

Figure 4-93 Post-Fire Flooding in Preparedness Area 2, July 2018

The series of photos show the devastation from floods in Preparedness Area 6 (Alamogordo and Hatch, NM). Photos provided by NMDHSEM.

Figure 4-94 Flooding in Preparedness Areas 4, 5, and 6 (DR-4197) 2013

4.5.6.8 *Probability of Occurrence*

Each Preparedness Area has several conditions that may contribute to flash floods and exacerbate the associated impacts:

Steep Slopes: Moderate to steep sloping terrain that can contribute to flash flooding, since runoff reaches the receiving arroyos and rivers more rapidly over steeper terrain.

Obstructions: During floods, obstructions can block flood flow and trap debris, damming floodwaters and potentially causing increased flooding uphill from the obstructions.

Soils: Soils throughout much of the State are derived from underlying parent materials rich in carbonate as well as mixed clays. As a result, soils are typically fine grained, and have low infiltration rates and high runoff potential. Vegetative cover is either mixed shrubs or mixed grasses.

Sparse vegetative cover combines with high runoff soil potential to result in significant flooding hazards in ephemeral washes and adjacent areas. Wildfires result in extreme soil damage. Soil damage usually occurs where burn intensities are severe to moderate. The loss of the organic components in the soil greatly decreases the ability of rain to infiltrate. Large floods can occur in these burned areas from average monsoonal rainstorms.

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific magnitude will occur in any given year.

To determine the probability of New Mexico experiencing flood/flash flood event, the probability or chance of occurrence was calculated based on historical data identified in the NCDC database from a period of May 1996 to December 2017 (259 months/21 years). Probability was determined by dividing the number of events observed by the number of years (21 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. In applying this formula, Preparedness Areas probabilities to the following hazards are identified in Figure 4-95

Figure 4-95 Probability of Occurrence - Flood/Flash Flood

Probability of Occurrence		
Preparedness Area	**Flood**	**Flash Flooding**
Preparedness Area 1	100%	100%
Preparedness Area 2	38%	100%
Preparedness Area 3	33%	100%
Preparedness Area 4	19%	100%
Preparedness Area 5	57%	100%
Preparedness Area 6	100%	100%

4.5.6.9 *Risk Assessment*

New Mexico and other areas across the Southwest U.S. are affected by the North American Monsoon System (NAMS) every summer, and the "Monsoon Season" is designated as the period lasting from June 15th through September 30th. With the onset of the Monsoon, New Mexico is typically impacted by a variety of weather hazards that can often put the population at risk for serious injury or death. Thunderstorm frequency increases during this period, while exceptionally hot days are common as well. These pages were prepared to help promote awareness of the life-threatening weather hazards that affect New Mexico during the Summer Monsoon. Impacts from Floods/Flash Flooding to New Mexico are identified in Figure 4-96 for the purposes of EMAP compliance.

Figure 4-96 Potential Impacts from Flood/Flash Flood Events

Subject	Potential Impacts
Agriculture	Flooding and flash flooding events can be devastating to the agriculture industry. Crops, livestock and agriculture infrastructure can be destroyed. Long term a water supply for irrigation and livestock water can be eliminated by the flood waters, changing existing water channels. The potential also exists that an approved irrigation water supply in compliance with the Food Safety and Modernization Act can be contaminated from floodwaters causing the crops to not be certified for market or consumption.
Health and Safety of the Public	Flooding in the State has been known to sweep people away and cause drowning.
Health and Safety of Responders	Same impact as the public.
Continuity of Operations	While the flooding in New Mexico is generally short-lived, the long-term impacts such as in the Village of Hatch can shut down an entire community for weeks.
Delivery of Services	Delivery of services may be impossible for weeks.
Property, Facilities, Infrastructure	Facilities in the flooded areas will sustain damages, up to and including total loss. Utilities such as water and sewage may be completely unusable.
Environment	Long term severe impacts are possible due to the severe contamination often found in flood waters. Fortunately, flash flooding passes quickly and doses not linger. However, the strong forces of the water can cause massive amounts of erosion and can divert natural waterways.
Economic Condition	As we saw in 2006, communities can have severe economic losses in the form of damages, and business shutdowns.
Public Confidence	If a community is impacted by flooding, the public may very well be angry for allowing development to occur in hazardous areas, or for allowing adverse impacts downstream from development.

Below are six Preparedness Area scale floodplain maps based on existing flood insurance rate maps. Figure 4-97 – Figure 4-102 delineate Special Flood Hazard Areas (SFHA), or land areas that are identified by FEMA maps as subject to inundation by a flood. Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. On this map, the SFHAs are shaded with different colors and divided into distinct flood hazard zones depicted on the map legend. Each zone reflects the severity or type of flooding in the area. The following flood zone maps have been included to allow for a finer level of analysis by depicting flood risks by Preparedness Area.

Figure 4-97 Preparedness Area 1 Floodplain Map

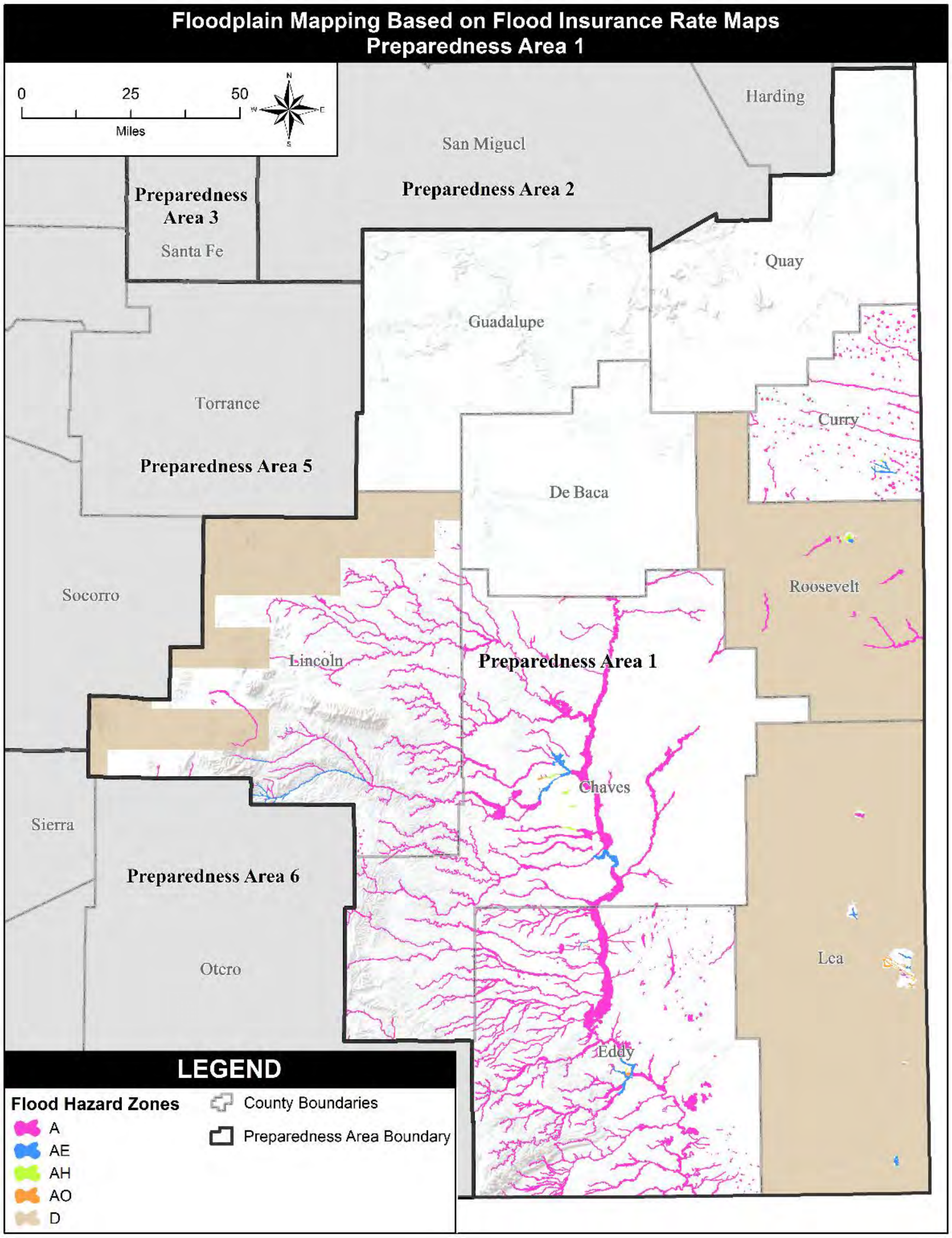


Figure 4-98 Preparedness Area 2 Floodplain Map

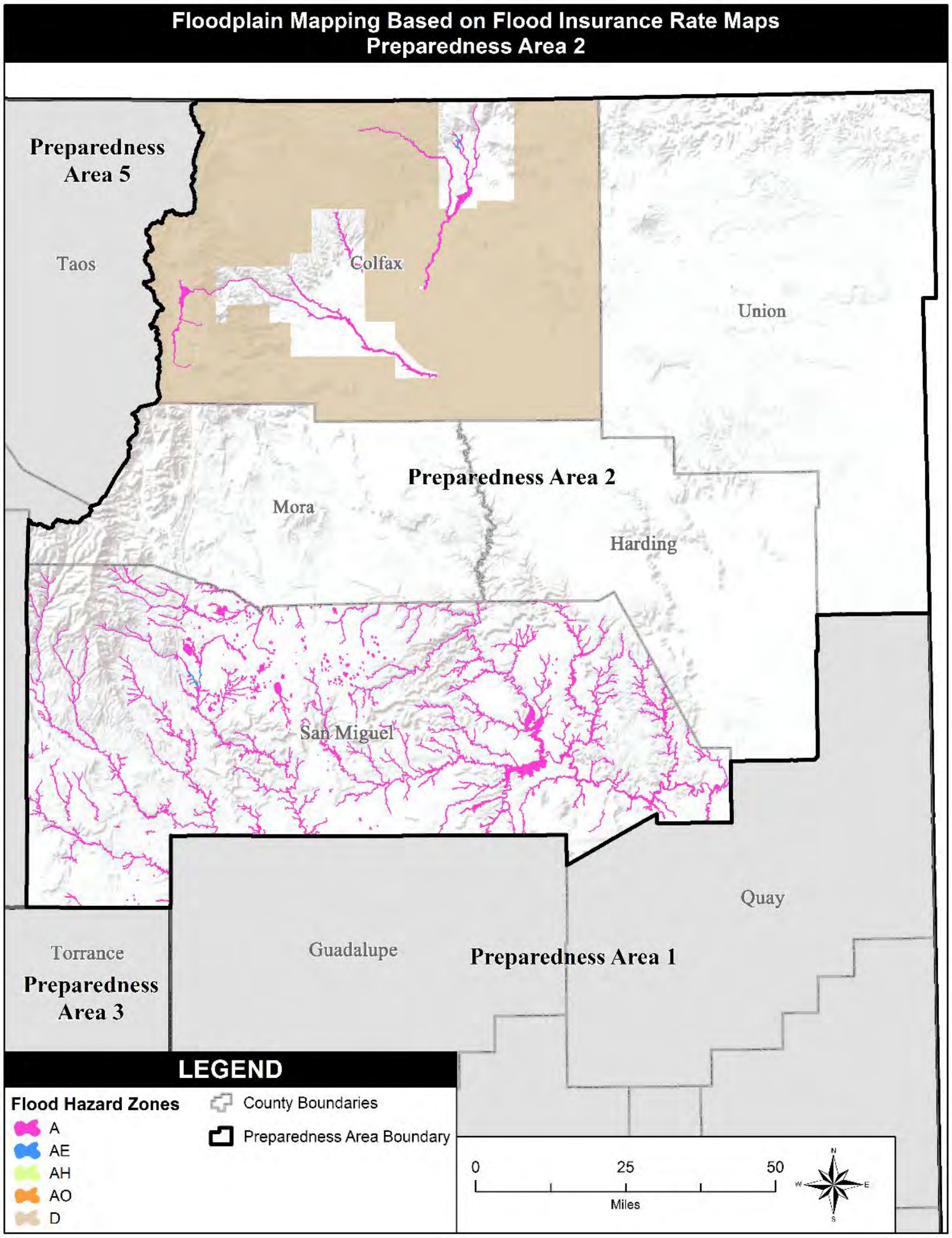


Figure 4-99 Preparedness Area 3 Floodplain Map

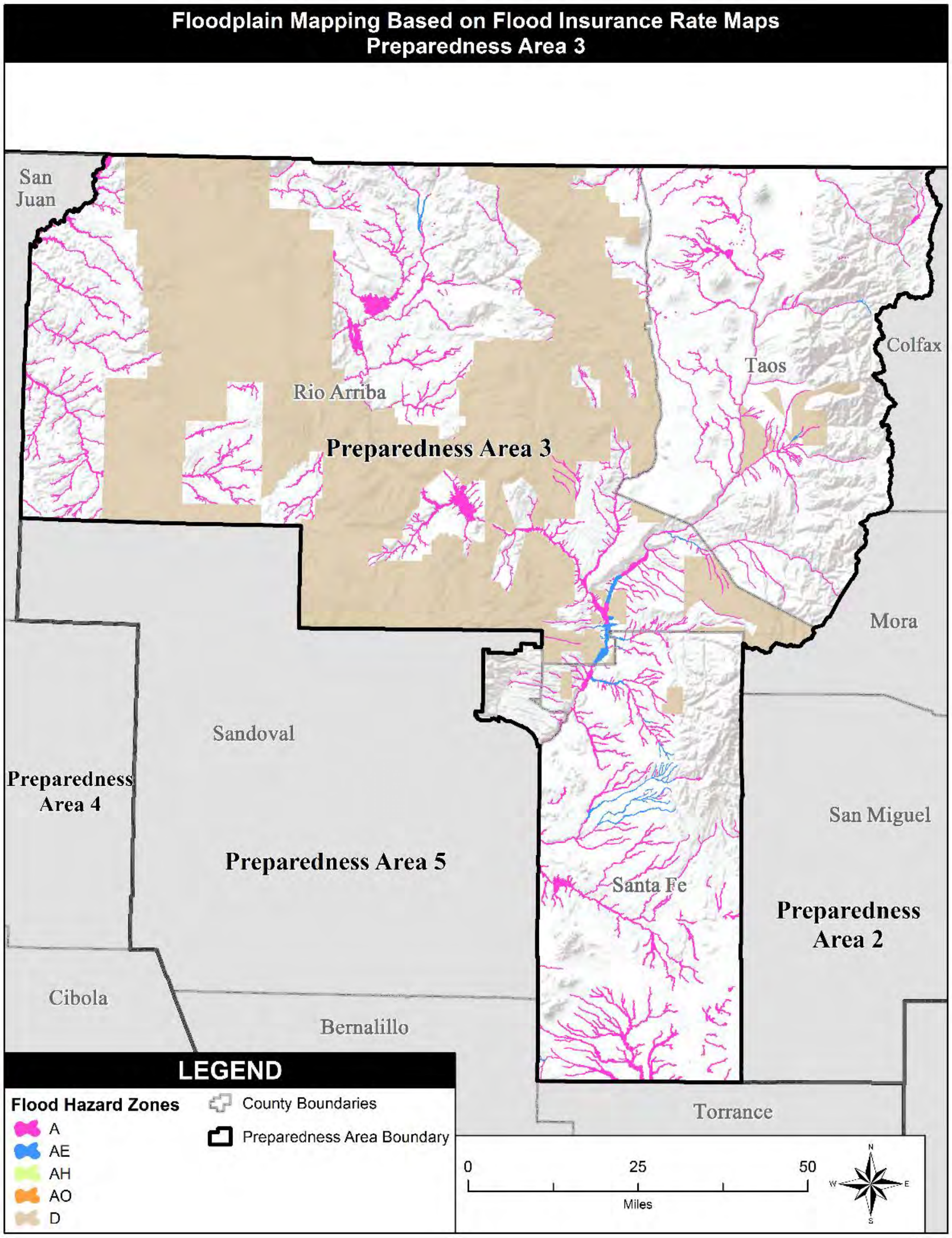


Figure 4-100 Preparedness Area 4 Floodplain Map

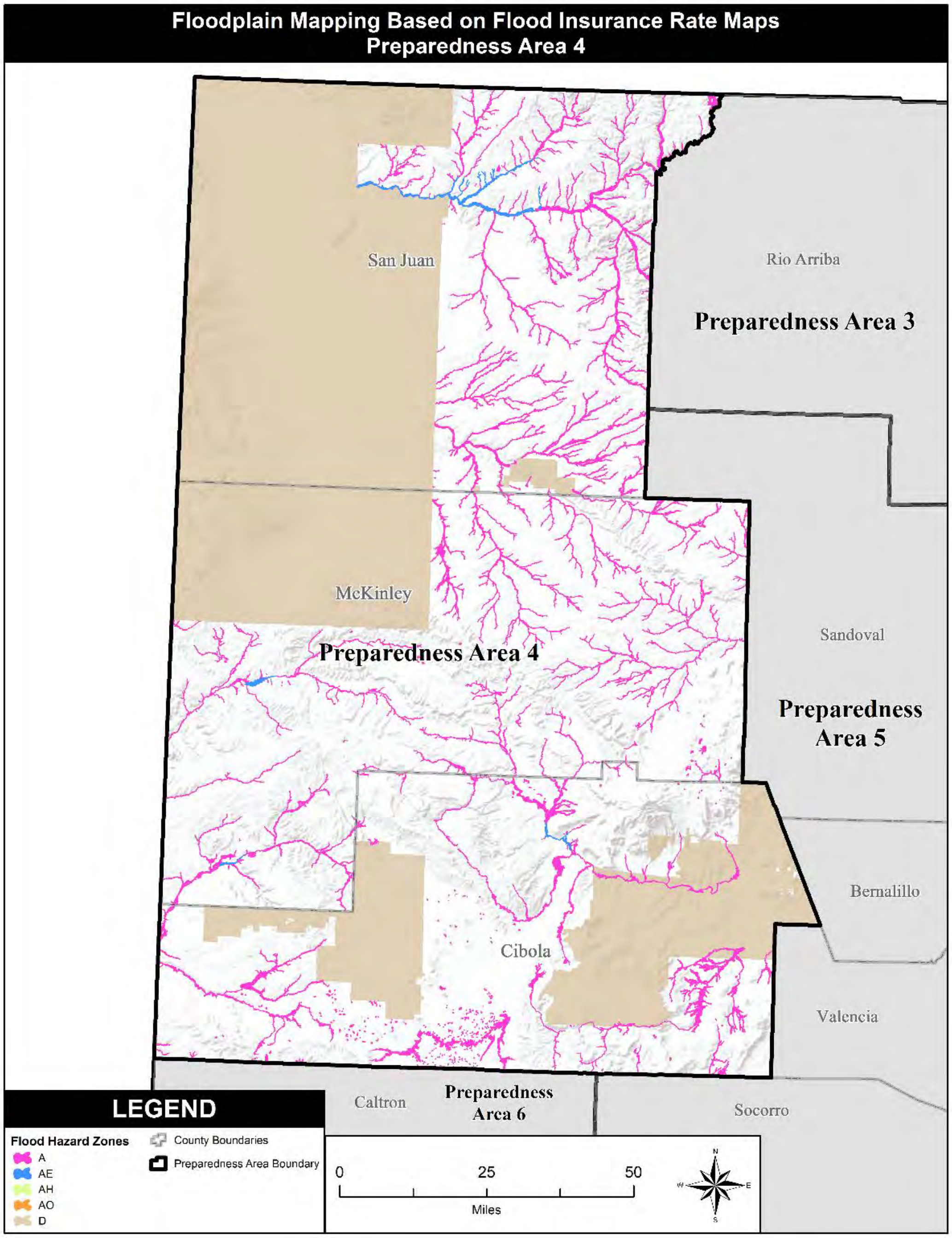


Figure 4-101 Preparedness Area 5 Floodplain Map

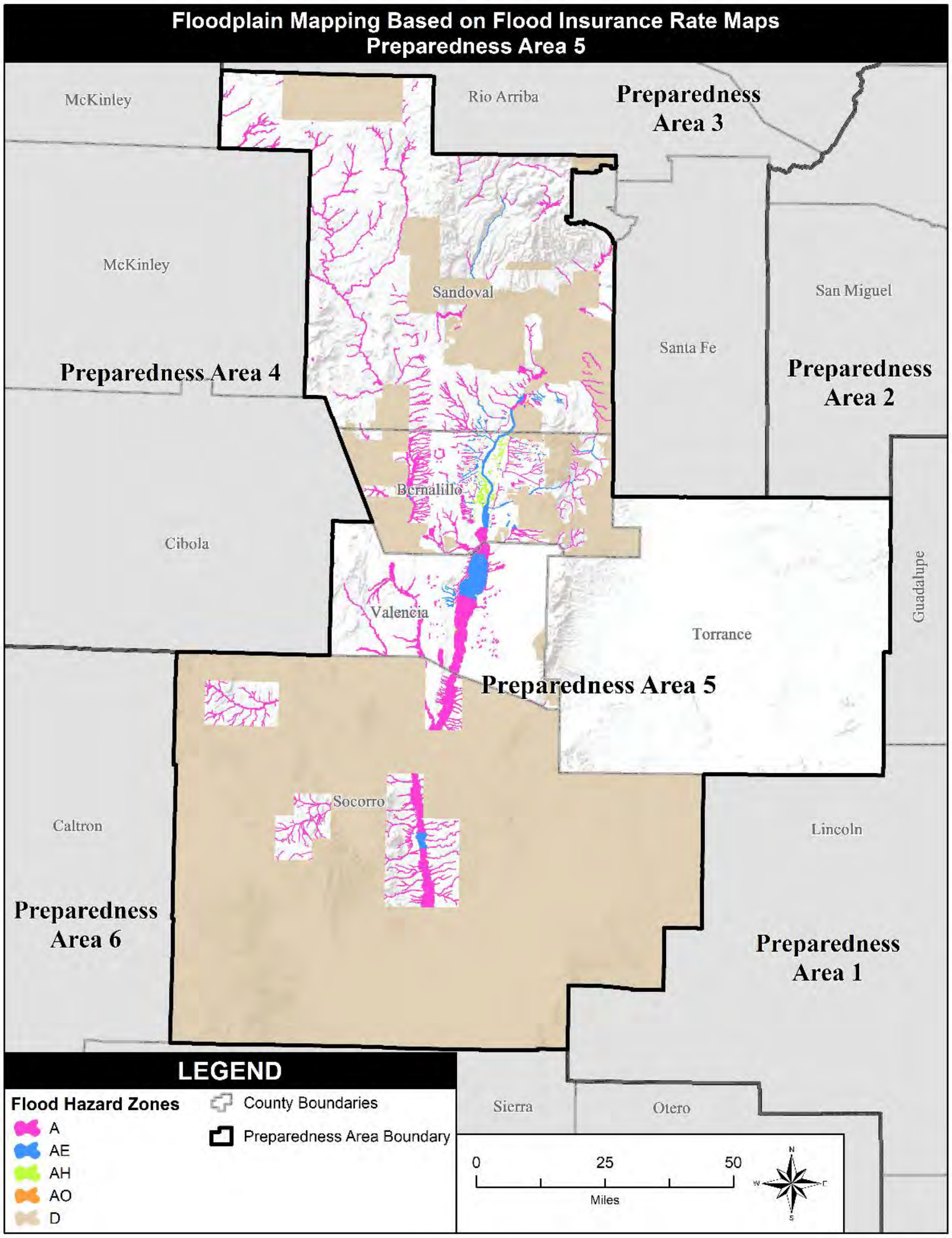
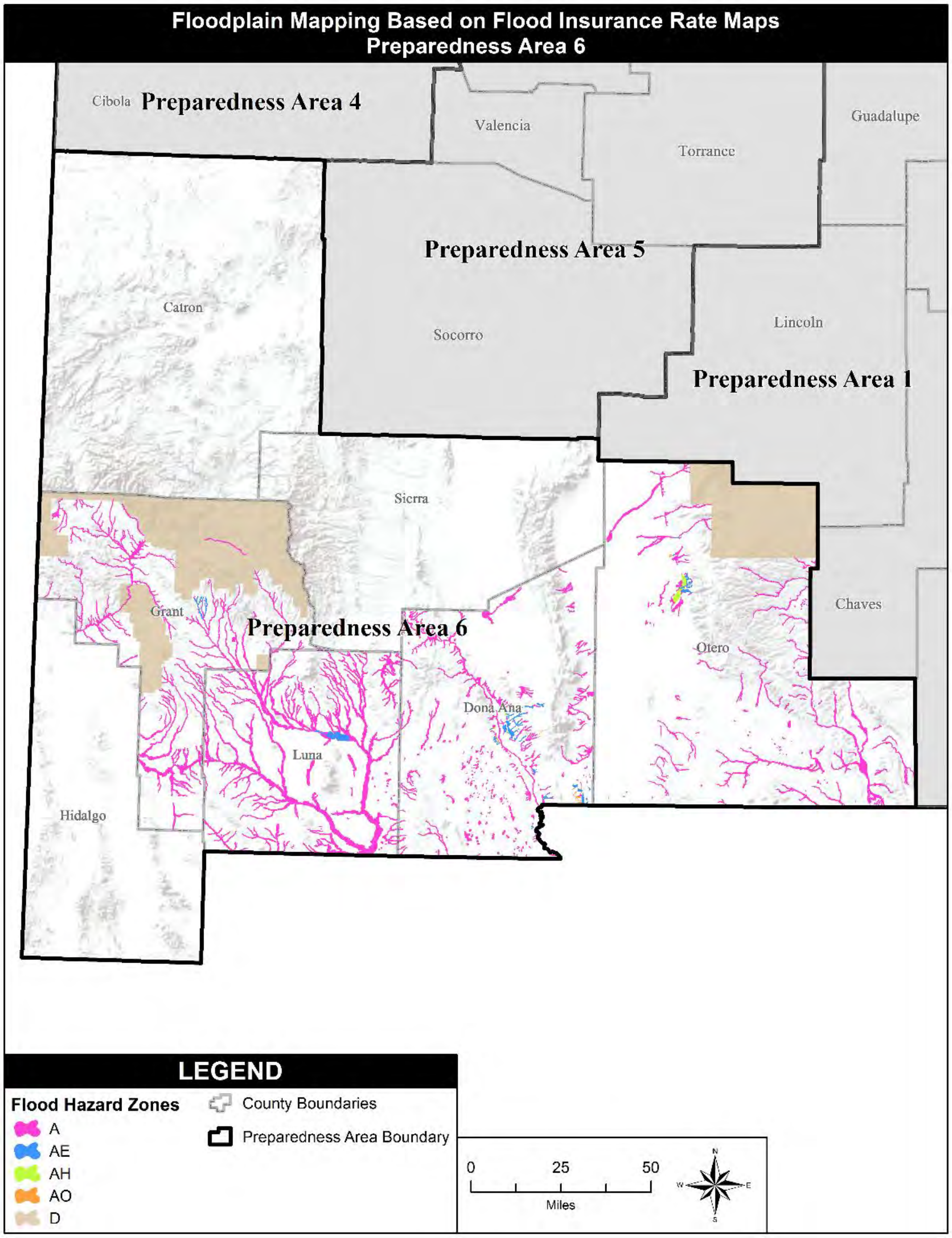


Figure 4-102 Preparedness Area 6 Floodplain Map



Flash floods have been and will continue to be a significant threat to the economic and social well-being in the State of New Mexico. Based on previous occurrences, Preparedness Areas 1 and 6 may be more prone to the effects of a flash flood occurring. Moving forward, Figure 4-97– Figure 4-102 (above) are tools that each Preparedness Area can use to develop strategies that may decrease or eliminate the potential impacts from such an event.

4.5.6.10 *Flooding and Debris Flow Post-fire*

Section 4.3 of this Plan describes the drought-wildfire-flood cycle experienced in the State.

Freshly burned landscapes are at risk of damage from post-wildfire erosion hazards such as those caused by flash flooding and debris flows. Burn scar areas have a tremendous impact on flood and debris flow following short duration high intensity rainfall. These high volume low frequency floods result from typical monsoon summer rains and occur in and downstream of the burn scar areas. Dramatic changes in runoff, erosion, and deposition have been documented in watersheds affected by wildfire. These post-fire changes have led to loss of life, damage to property, and significant impacts on infrastructure.

Extreme soil damage occurs within watersheds that experience a wildfire. Soil damage usually occurs where burn intensities are severe to moderate. The loss of the organic components in the soil greatly decreases the ability of rain to infiltrate. Within these burned areas, large floods result from average monsoonal rainstorms. In combination with the damaged soil, the destruction of vegetation by wildfires and in particular the forest canopy has created high potential for floods. In general, coniferous trees intercept more rainfall than deciduous trees in full leaf. New Mexico forests are predominantly coniferous and the risk for flooding is increased when these forest types and others are drastically reduced and destroyed by wildfires.

Increased long term risk of flooding will continue for years after a watershed has experienced a burn. Ongoing concerns are the increased potential for flooding and debris flow plus large amounts of sediment being transported from the burn scar areas. Additionally, debris flows could create temporary dams or sediment plugs along drainage courses that could fill and breach, sending flood waves downstream creating life safety issues. Life safety concerns are higher in those communities located downstream of burned watersheds.

A recent example of the destructive power and repetitive nature of flood damage in burn scar areas is the Santa Clara Pueblo, which has received four flood disaster declarations since the highly destructive Las Conchas Fire in 2011 (also a disaster declaration). The USACE Albuquerque District studied the altered hydrology post-fire in Santa Clara Pueblo after the Las Conchas Fire. The hydrologic discharge increased from 25% to 400% for the 100-year flood (1% annual chance exceedance flood) after the fire. These changes are for the two to three months after the fire when the soils were extremely hydrophobic. While the vegetation will eventually grow back and the ash soil will wash away, an increase in hydrologic discharge will continue for several years until pre-fire conditions have returned. The post-fire watershed effects in the Pueblo were also ripe for massive landslides and debris flow. Retention basins designed to catch upstream flows could quickly fill with sediment and overtop and even breach. Another issue related to flood risk after fire is that with mountainsides denuded of protective vegetation, rainfall events cause severe erosion resulting in debris flows and damage to water control facilities that quickly become full of sediment. The drought/wildfire/flood cycle in the western United States from 2000 to the present has wreaked heavy damage in many parts of New Mexico. Developed areas downstream from forested areas with steep terrain are especially vulnerable.

Debris flows are destructive, fast-moving slurries of water and sediment that can originate from rainfall on recently burned, rugged areas and can have an enormous destructive power. The location, extent, and severity of wildfire and the subsequent rainfall intensity and duration cannot be known in advance; however, it is possible to determine likely locations and sizes of post-wildfire debris flows using available geospatial data and mathematical models. Debris flow hazards can also be assessed for areas that have not burned but are at high risk of wildfire.

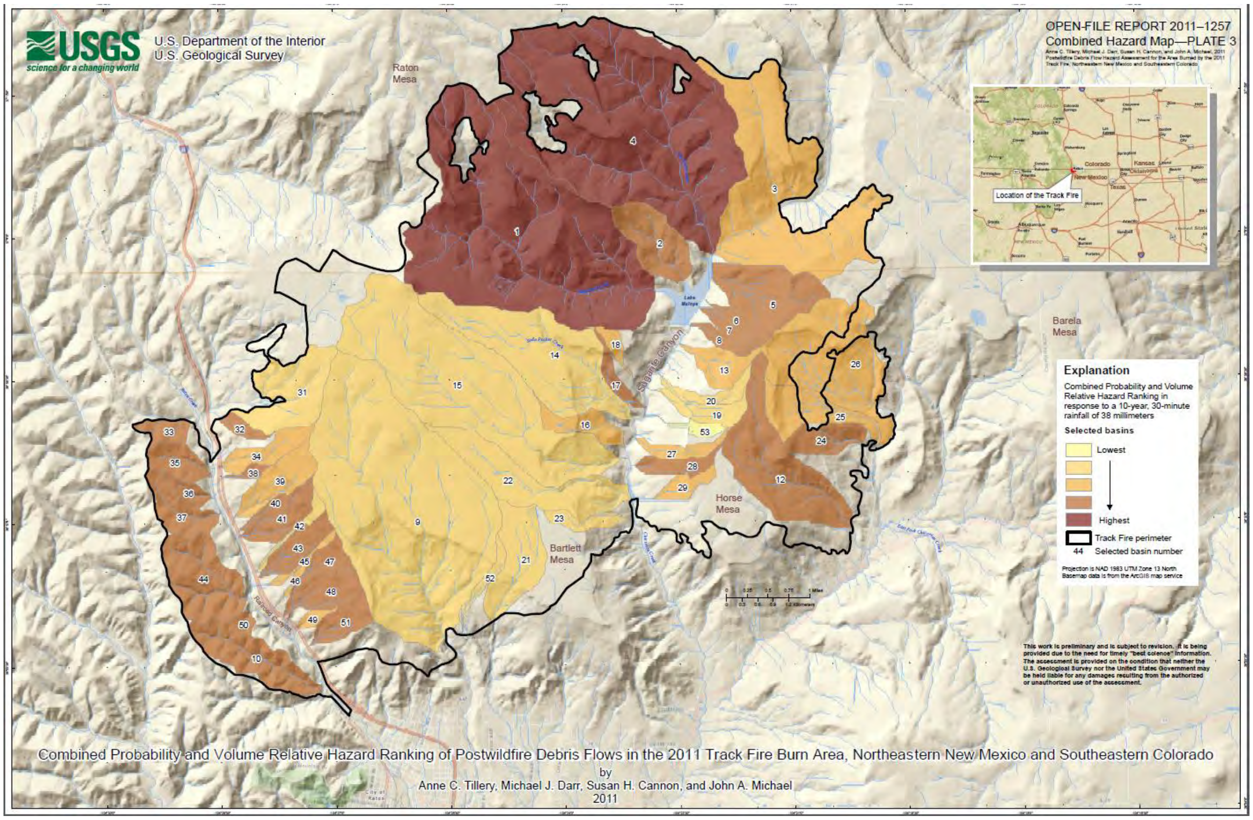
The USGS has developed a model to estimate post-wildfire debris-flow probability and volume for watersheds originating in basins of concern, or areas most at risk for loss of life and property. The models incorporate measures of burn severity, topography, soils, and storm rainfall to estimate the probability and volume of post-wildfire debris flows following the fire. Combined Relative Debris-Flow Hazard Rankings are produced by summing the estimated probability and volume rankings to illustrate those areas with the highest potential occurrence of debris flows of the largest volumes resulting from modeled storm events. These post wildfire debris-flow hazard models have been applied after four fires in New Mexico since the model was developed: the 2011 Track and Las Conchas Fires and the 2012 Little Bear and Whitewater-Baldy Fires. The full USGS reports include results for several modeled storm events, as well as three maps that show the probability of a flood, volume estimates, and a combined hazard map.

Track Fire[73]

Combined relative debris-flow hazard rankings for a 30-minute duration, 10-year recurrence storm producing 38 millimeters of rain, indicated the highest post-wildfire debris flow susceptibilities are associated with Segerstrom Creek and Swachheim Creek. These rankings reflect extremely hazardous conditions within and immediately downstream from these basins, where debris flows may impact Lake Maloya and pose significant hazards to life and property. The second highest possible combined relative debris-flow hazard rankings were estimated for most of the tributary basins to Railroad Canyon, which empties into the northwest shore of Lake Maloya, which empty into the east shore of Lake Maloya, in Sugarite Canyon, on the southeast edge of the fire. Figure 4-103 shows the combined debris-flow hazard from the Track Fire.

[73] Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire debris flows hazard assessment for the area burned by the 2011 Track Fire, northeastern New Mexico and southeastern Colorado: U.S. Geological Survey Open-File Report 2011–1257, 9 p.

Figure 4-103 Combined Debris-Flow Hazard from the Track Fire

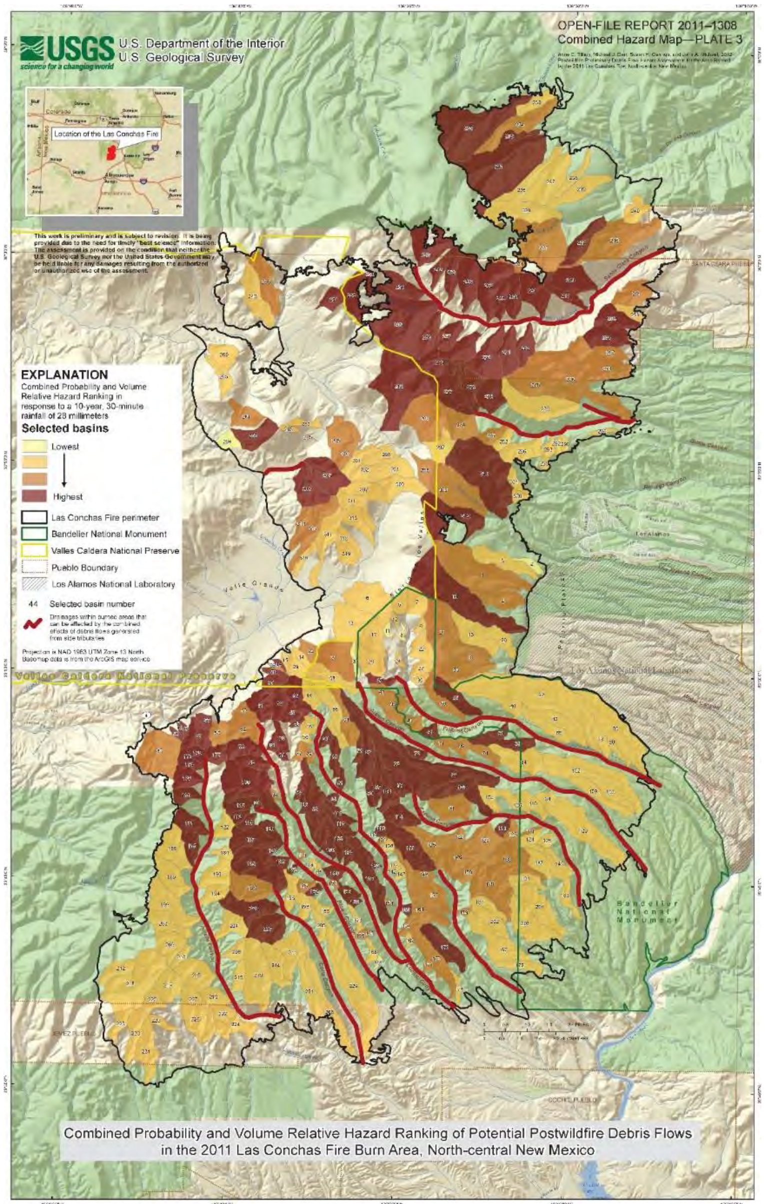


Las Conchas[74]

The models showed that for a 30-minute-duration, 10-year-recurrence rainstorm of 28.0 millimeters, the highest combined hazard rankings in the northern section of the burned area are predicted for basins tributary to Santa Clara Canyon, the Rio del Oso, and Vallecitos Creek. The watersheds of Peralta, Colle, Bland, Cochiti, Capulin, Alamo, and Frijoles Canyons in the southern section of the burned area also showed high Combined Relative Debris-Flow Hazard Ranking, as well as basins in Water Canyon, Guaje Canyon, and Los Alamos Canyon. Figure 4-104 shows the combined debris-flow hazard from the Las Conchas fire.

[74] Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire preliminary debris flow hazard assessment for the area burned by the 2011 Las Conchas Fire in north-central New Mexico: U.S. Geological Survey Open-File Report 2011–1308, 11 p.

Figure 4-104 Combined Debris-Flow Hazard from the Las Conchas Fire



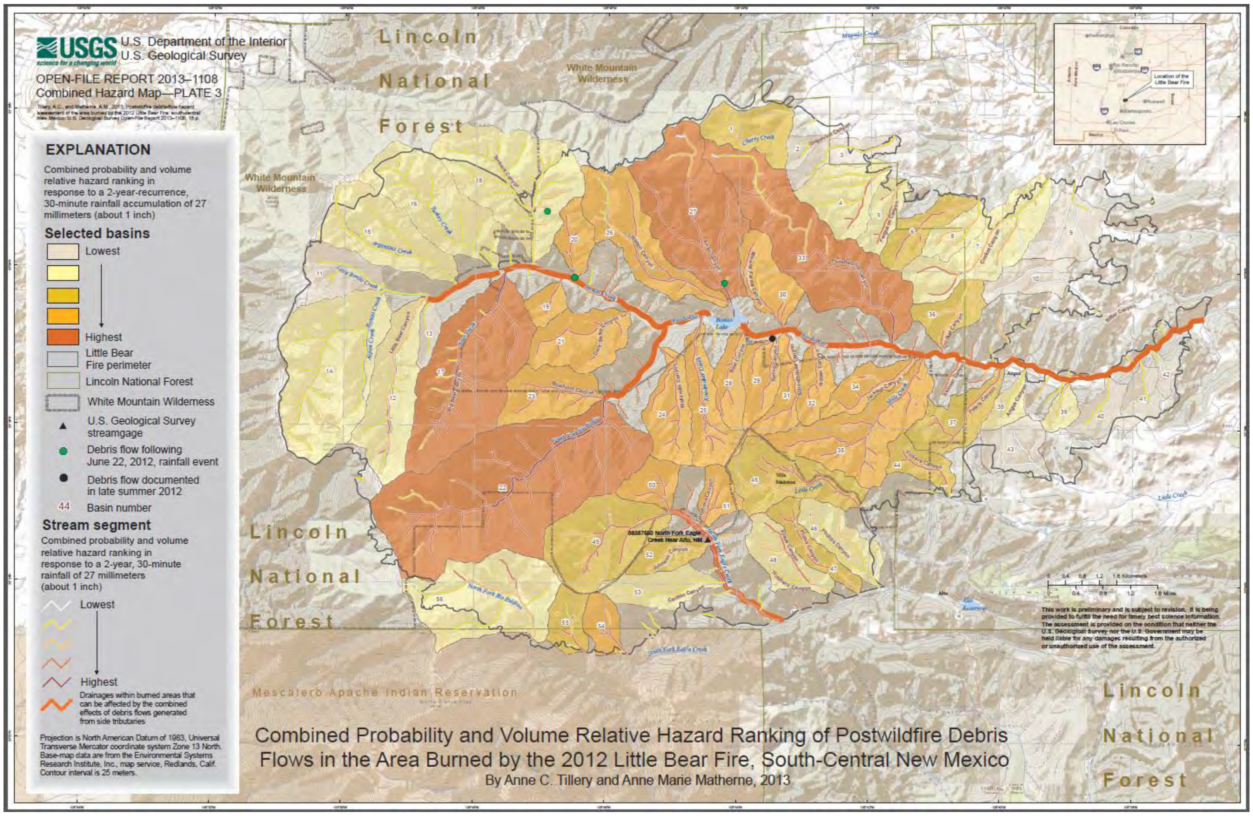
Little Bear[75]

For a 2-year-recurrence, 30-minute-duration rainfall of 27 millimeters (a 50% chance of occurrence in any given year), the highest combined hazard ranking is predicted for four drainage basins, Bear Creek, South Fork Rio Bonito, Anan Canyon, and Philadelphia Canyon. For a 10-year-recurrence rainfall, those same four drainage basins plus Mills Canyon were modeled with the highest combined hazard ranking. For the 25-year-recurrence rainfall, an additional 10 drainage basins were modeled with the two highest combined hazard rankings. Stream segment analysis indicated a relative hazard ranking at the two highest categories over most of the central Rio Bonito drainage basin. North Fork Eagle Creek from Telegraph Canyon to below Carlton Canyon is the only stream segment in the southern burn area

[75] Tillery, A.C., and Matherne, A.M., 2013, Postwildfire debris-flow hazard assessment of the area burned by the 2012 Little Bear Fire, south-central New Mexico: U.S. Geological Survey Open-File Report 2013–1108, 15 p., 3 pls., http://pubs.usgs.gov/of/2013/1108/.

modeled with the highest relative hazard ranking. Figure 4-105 shows the combined debris-flow hazard from the Little Bear fire for a 2-year recurrence, 30-minute rainfall accumulation of 27 millimeters.

Figure 4-105 Combined Debris-Flow Hazard from the Little Bear Fire

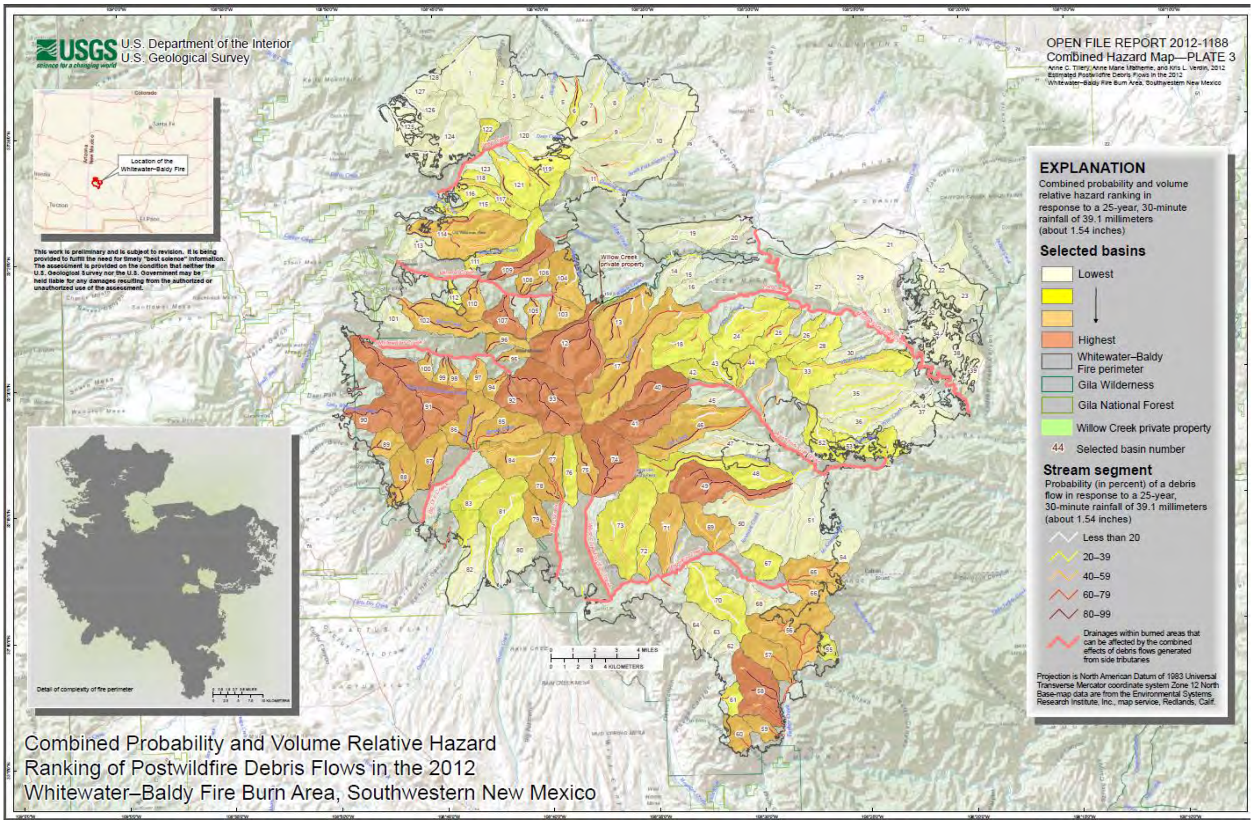


Whitewater-Baldy[76]

For a 25-year-recurrence, 30-minute-duration rainfall, basins with the highest combined probability and volume relative hazard ranking include tributaries to Whitewater Creek, Mineral Creek, Willow Creek, West Fork Gila River, West Fork Mogollon Creek, and Turkey Creek. Debris flows from Whitewater, Mineral, and Willow Creeks could affect the communities of Glenwood, Alma, and Willow Creek. Figure 4-106 shows the combined debris-flow hazard for a 25-year, 30-minute rainfall of 39 millimeters from the Whitewater-Baldy fire.

[76] Tillery, A.C., Matherne, A.M., and Verdin K.L., 2012, Estimated probability of postwildfire debris flows in the 2012 Whitewater–Baldy Fire burn area, southwestern New Mexico: U.S. Geological Survey Open-File Report 2012–1188, 11 p., 3 pls.

Figure 4-106 Combined Debris-Flow Hazard from the Whitewater-Baldy Fire



Additionally, in 2013, the USGS developed a new method for estimating post-fire erosion hazards before a wildfire actually burns with a study in the Sandia and Manzano Mountains, and an additional pre-wildfire evaluation for the Jemez Mountains in 2016. For these studies, an Integrated Relative Debris-Flow Hazard Index was modeled, based on a combination of debris-flow probability, estimated volume of debris flow, and average burn probability for each basin. For example, the most hazardous subbasins will have the highest probabilities of experiencing a fire in some part of the subbasin, the highest probabilities of debris-flow occurrence, and the largest estimated volumes of debris-flow material.

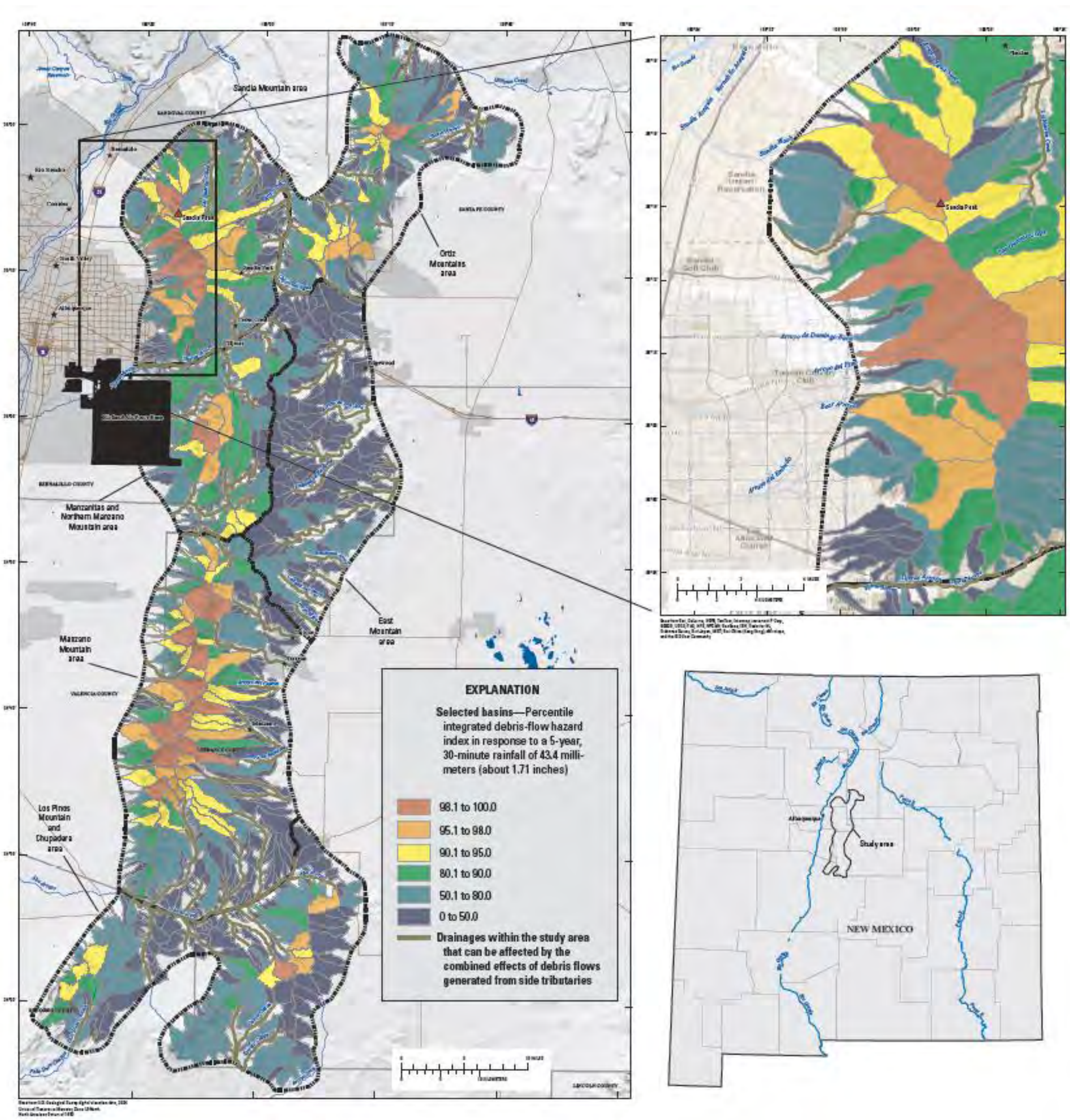
Sandia and Manzano Mountains – Pre-wildfire Evaluation[77]

Most of the subbasins with the highest integrated debris-flow hazard index rankings are in the steepest parts of the Sandias and Manzanos and contain substantial areas of high simulated burn severity and therefore high basin-average, annual burn probability indices. Nineteen subbasins are contained in the upper 2% of integrated debris-flow hazard indices rankings. These subbasins include five subbasins on the west-facing slopes of the Sandias, four of which have downstream reaches that lead into the outskirts of the City of Albuquerque. Of the remaining 14 subbasins in the upper 2% of integrated debris-flow hazard indices rankings, 12 are located along the highest and steepest slopes of the Manzano Mountains, largely on the western slope; however, one of these subbasins is approximately five miles upstream from the community of Tajique and another is several miles upstream from the

[77] Tillery, A.C., Haas, J.R., Miller, L.W., Scott, J.H., and Thompson, M.P., 2014, Potential postwildfire debris-flow hazards—A prewildfire evaluation for the Sandia and Manzano Mountains and surrounding areas, Central New Mexico: U.S. Geological Survey Scientific Investigations Report 2014–5161, 24 p. with appendix, http://dx.doi.org/10.3133/sir20145161.

community of Manzano, both on the eastern slopes of the Manzanos. Figure 4-107 shows the potential integrated debris-flow hazard that could result from a 5-year, 30-minute rainfall of 43 millimeters post wildfire in the Sandia and Manzano Mountains.

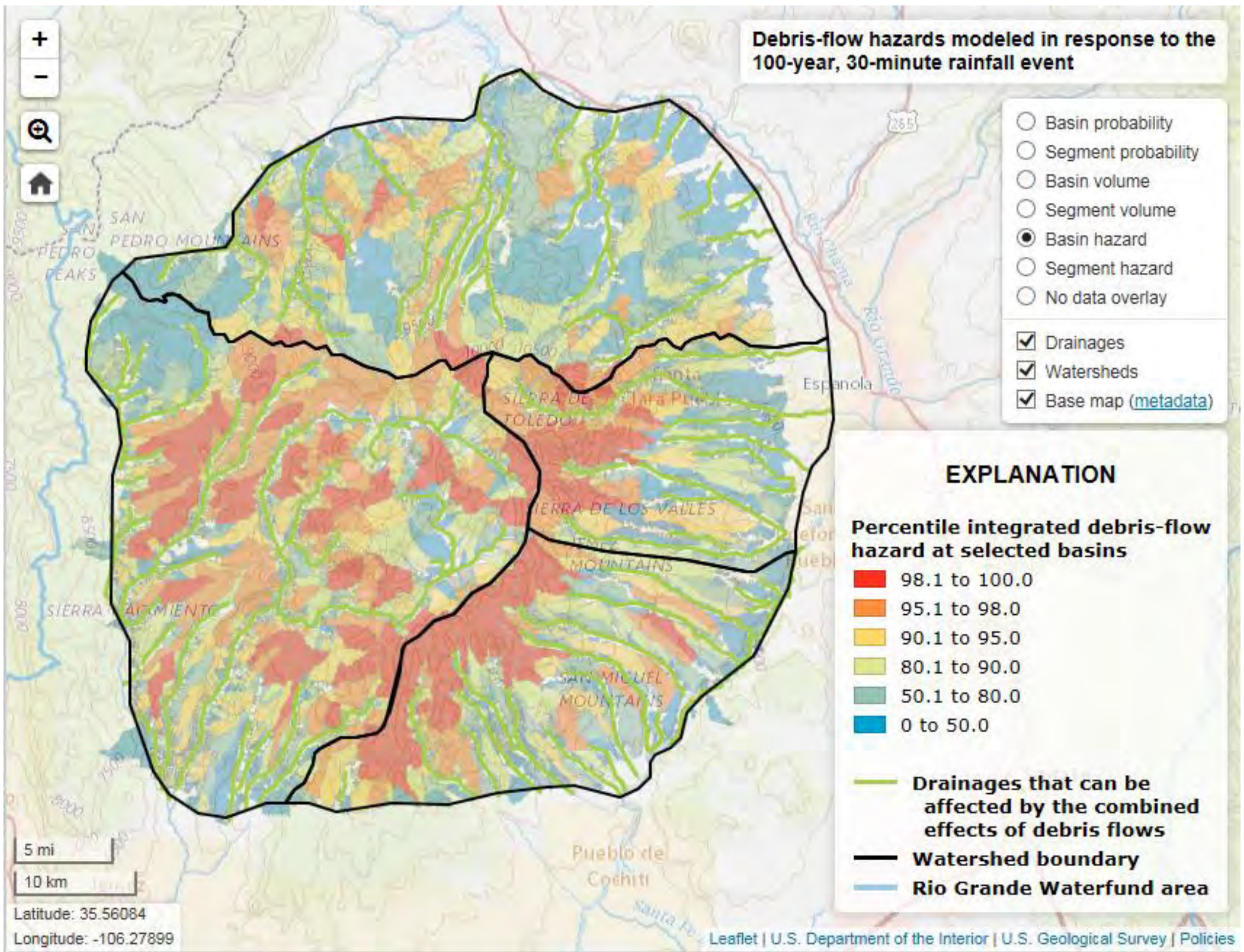
Figure 4-107 Potential Integrated Debris-Flow Hazard from a Wildfire in the Sandia and Manzano Mountains



Jemez Mountains Pre-wildfire Evaluation[78]

For a 100-year recurrence interval, 30-minute duration rainfall event (referred to as the 100-year design storm), the subbasins with integrated hazard index values in the top 2% typically are large, upland tributaries to canyons and channels primarily in the Upper Rio Grande and Rio Grande-Santa Fe watershed areas. Other subbasins with integrated hazard-index values in the top 2% are scattered throughout the Jemez River watershed area, including some subbasins in the interior of the caldera. Only a few subbasins in the top integrated hazard index group are in the Rio Chama watershed area. Figure 4-108 shows the potential integrated debris-flow hazard that could result from a 100-year, 30-minute rainfall post wildfire in the Jemez Mountains.

Figure 4-108 Potential Integrated Debris-Flow Hazard from a Wildfire in the Jemez Mountains



The main driver of post-fire watershed response is rainfall intensity. Short rain events can lead to significant flooding in wildfire damaged landscapes. To help communities decrease response time to potential flooding in burn scar areas, the USGS can install real-time rain gages in wildfire burn scars areas. Figure 4-109 is an example of a real-time precipitation gage at Cochiti Mesa installed by a cooperative project of the USGS, US Forest Service and DHSEM. During the banner wildfire years of 2011

[78] Tillery, A.C., and Haas, J.R., 2016, Potential postwildfire debris-flow hazards—A prewildfire evaluation for the Jemez Mountains, north-central New Mexico: U.S. Geological Survey Scientific-Investigations Report 2016-5101, 27 p., http://dx.doi.org/10.3133/sir20165101.

and 2012 in New Mexico, the USGS, in cooperation with the U.S. Forest Service, the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, the NM Department of Homeland Security, and the U.S. National Park Service, installed real-time rain gages in the Las Conchas (6 gages), Whitewater Baldy (4 gages), and Little Bear (6 gages) burn scar areas. Figure 4-109 shows an example of a real-time rain gage installed by the USGS in the Los Conchas burn scar area on Cochiti Mesa. The data from the rain gages installed high in the watershed can be accessed online at any time by citizens and managers and provide reliable information for use in reducing losses to life associated with post wildfire flooding.

Figure 4-109 USGS real time precipitation gage at Cochiti Mesa (Las Conchas Fire)

The following figure (Figure 4-110) shows pre-burn and post-burn peak flows using a 25-year, 1-hour design storm for the area impacted by the Little Bear Fire (mostly in Lincoln County). A 25-year, 1-hour storm event would be a storm with 4% chance of occurrence in any given year and lasts one hour in duration. The average change is a 158% increase in runoff. The highest increase was found in the Upper Big Bear Canyon with a 459% increase (from 573 to 3,202 cubic-feet per second (CFS)).

Figure 4-110 Little Bear Fire Data[79]

Watershed subHuc6	Acres	Peak CFS		
		Pre-Burn	Post-Burn	Increase
Eagle Lk_1	1086	851	1534	80%
Eagle Lk_2	586	565	960	70.0%
Kraut Creek	1027	1099	2871	161.0%
Little Creek	966	582	1744	200.0%
Philadelphia side drain	172	263	769	192.0%
SkiArea532drain	203	145	739	410.0%
Upper Big Bear Cyn	1050	573	3202	459.0%
FS_upper Eagle Crk Hm	2033	1794	4099	128.0%
Ski Area Outlet	1036	806	1515	88.0%
Upper Big Bear Cyn treated	1050	3202	2158	-32.6%
532midSkiDrain	117	36	93	160.0%
532NskiDrain	203	179	236	31.8%
Apache Bowl	278	60	123	105.0%
Moonshine Gulch	230	433	780	80.1%
Upper Reservoir Trib.	51	14	20	42.9%
Average % change				**158%**

Case Study: Post-Wildfire Debris Flow Mitigation in the Rio Nambe Watershed

In June of 2011, the Pacheco fire burned 10,250 acres in the Rio Nambe watershed, which drains to the Nambe Falls Dam and Reservoir on the Pueblo of Nambe tribal lands. The fire created 5,771 acres of hydrophobic soil which caused post-fire debris flows and floods in the Rio Nambe watershed. These debris flows and sedimentation caused box culvert bridge damages, floodplain aggradation, destruction of access road and picnic structures, recreational fisheries losses, and a reduction in the reservoir capacity by greater than 40 acre-feet.

This prompted the Rio Nambe Watershed Hazard and Risk Assessment, a USACE Technical Assistance Report for flood/debris and sediment mitigation using PL 84-99 Category 250 “advance measures” authority for emergency flood assistance. This included a risk assessment for Nambe Falls Dam and Reservoir and downstream communities, hydrologic modeling for pre- and post-fire peak flows, sediment yield model, recommendations for mitigation measures/conceptual designs, and a benefit/cost analysis. Figure 4-111 shows the results of the pre- and post-fire peak flows for the watershed. According to the USACE and USBOR, “The hydrologic model results show that the magnitude of the floods discharged from a precipitation event are five to 30 times larger under post-fire conditions in the Rio Nambe watershed.”

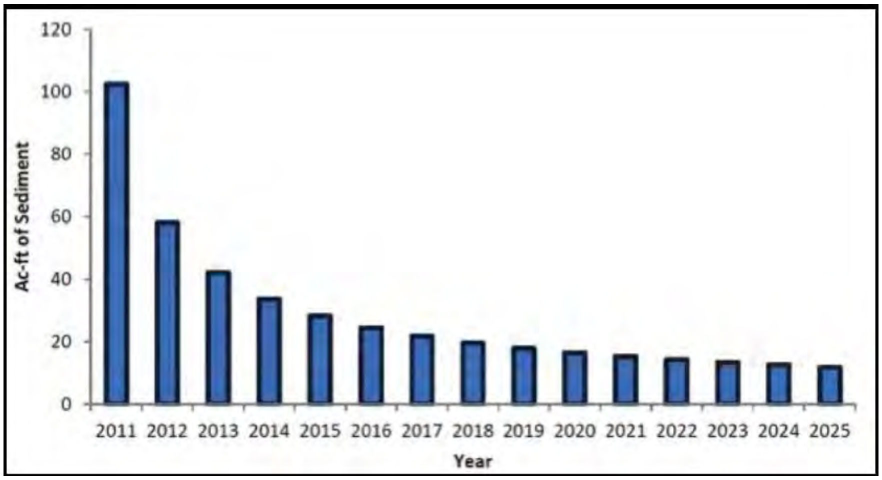
[79] Source: The Little Bear Fire Burn Area Emergency Response (BAER) Report (NOAA 14)

Figure 4-111 Pre/Post Wildfire Peak Discharge Estimates

Recurrence Interval	Pre-fire Peak Discharge Estimate	Post-fire Peak Discharge Estimate
2 yr. / 50%	131 cfs	1,155 cfs
10 yr. / 10%	237 cfs	7,315 cfs
25 yr. / 4%	1,239 cfs	10,905 cfs
100 yr. / 1%	3,509 cfs	16,683 cfs

Figure 4-112 shows the post fire Rio Nambe watershed sediment yield through 2025. The pre-fire average annual sediment yield was 3.8 acre-feet/year.

Figure 4-112 Post Wildfire Rio Nambe Watershed Sediment Yield through 2025



Source: USACE-USBOR, 2014

Based on the study, the feasibility of a debris flow barrier was conducted and a cost-estimate derived for grant funding. The debris flow barrier designed was a multi-level debris flow barrier system of three flexible ring-net barriers (Figure 4-113). Along with other ongoing efforts, such as early flood warning system implementation, trails and recreation area rehabilitation, fisheries re-stocking, water quality sampling, and long term, post-project monitoring, the risk of the Rio Nambe watershed to post-fire flooding and debris flows was reduced.

Figure 4-113 Debris Flow Barrier System

Source: Kane, 2016

4.5.6.11 *Data Limitations*

In order to address the data deficiency, a team of subject matter experts (NM FPMA, local research scientists in geomorphology or geology) would study the probability, extent, vulnerability and impact of post-fire flooding and alluvial fan flood hazards.

4.5.6.12 *What Can Be Mitigated?*

For counties (Preparedness Areas) with extremely limited resources, mitigation actions have to be very specific and cost effective. As a result, mitigation actions should focus on property protection, localized corrective measures for drainage and erosion in developed areas, and ensuring that future development is sited out of the floodplain as identified by the study. One priority is to protect critical infrastructure such as utilities, access routes and water supply wellheads.

In order to address the data deficiency, a team of subject matter experts (NM FPMA, local research scientists in geomorphology or geology) would study the probability, extent, vulnerability and impact of post-fire flooding and alluvial fan flood hazards.

4.5.6.13 *Changing Weather Patterns*

Flash floods associated with short duration, high intensity rainfall events affect New Mexico every year. A vast majority of flash floods accompany slow-moving thunderstorms during the monsoon season. While there has not been a definitive link between long-term, changing weather patterns and the frequency of flash flood events associated with thunderstorms in the State of New Mexico, a greater number of significant wildfires owing to an increase in the frequency, duration and intensity of drought would contribute to a higher likelihood of potentially devastating burn scar flash flooding in parts of the State. Additionally, flooding impacts from snowmelt runoff along tributaries of main stem rivers could shift to earlier in the runoff season.

4.5.7 High Wind

4.5.7.1 Hazard Characteristics

Wind is defined as the motion of air relative to the earth's surface, and the hazard of high wind is commonly associated with severe thunderstorm winds (exceeding 58 mph) as well as tornadoes, hurricanes, tropical storms and nor'easters. High winds can also occur in the absence of other definable hazard conditions, events often referred to as simply "windstorms." High wind events might occur over large, widespread areas or in a very limited, localized area. They can occur suddenly without warning, at any time of the day or night.

Typically, high winds occur when large air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for severe thunderstorms, tornadoes and other windstorm events. These storms can occur singularly, in lines or in clusters. They can move through an area very quickly or linger for several hours. While scales exist to measure the effects of wind, they can be conflicting or leave gaps in the information. For the purposes of this plan, we use the Beaufort Wind Scale (Figure 4-114) because it is specifically adapted to wind effects on land.

Figure 4-114 Beaufort Scale[80]

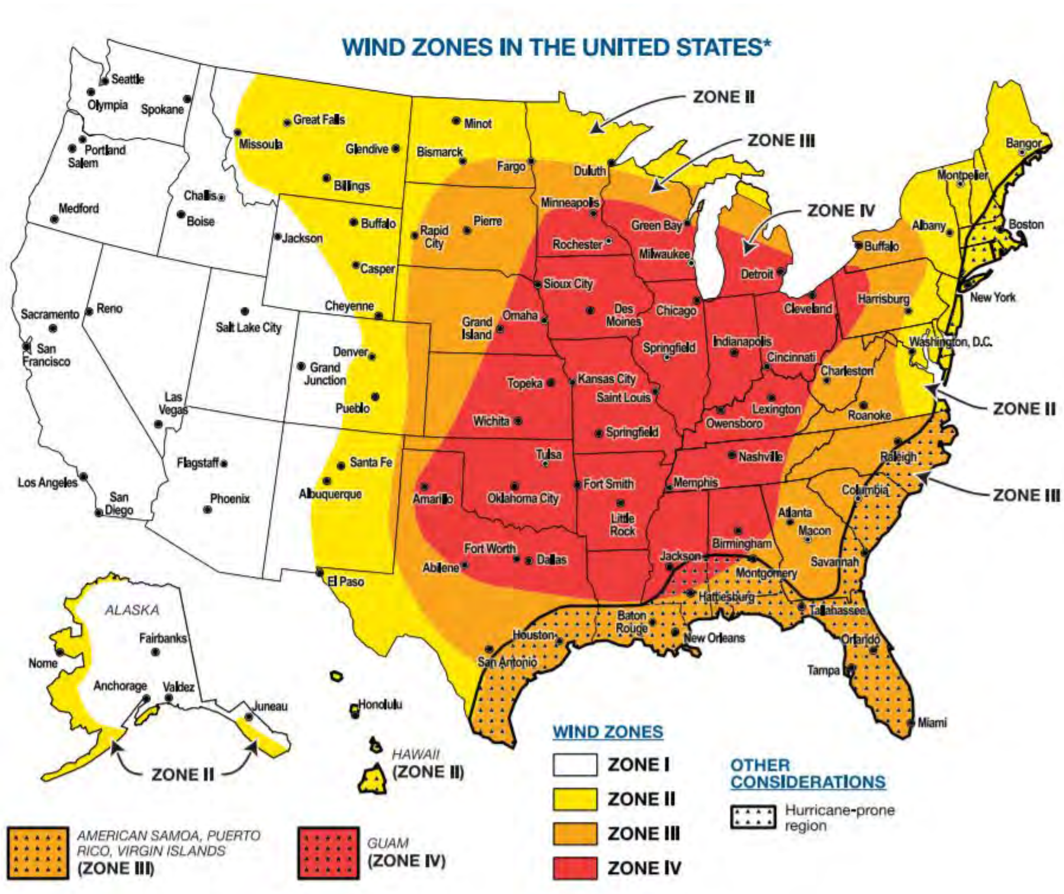
Beaufort Wind Scale			
Beaufort Number	**Wind Speed mph**	**Description**	**Land Conditions**
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke.
2	4-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate breeze	Dust and loose paper rises. Small branches begin to move.
5	19-24	Fresh breeze	Smaller trees sway.
6	25-31	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	Near gale	Whole trees in motion. Effort needed to walk against the wind.
8	39-46	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong gale	Light structure damage.
10	55-63	Storm	Trees uprooted. Considerable structural damage.
11	64-73	Violent storm	Widespread structural damage.
12	73-95	Hurricane	Considerable and widespread damage to structures.

[80] Source: http://www.spc.noaa.gov/faq/tornado/beaufort.html

All areas of the State can experience all 12 Beaufort categories. As used in this section, windstorms are both high velocity straight-line winds and violent wind gusts not associated with thunderstorms. Dust storms are strong windstorms that fill the air with thick dust, sometimes reducing visibility to resemble a dense fog. Other wind events include wet or dry microbursts that may produce damaging convective winds and dust devils even on a clear and otherwise calm day.

High wind events are experienced in every region of the United States. Figure 4-115 illustrates various wind zones throughout the country based on design wind speeds established by the American Society of Civil Engineers. It divides the country into four wind zones, geographically representing the frequency and magnitude of potential high wind events including severe thunderstorms, tornadoes, and hurricanes. The figure shows that New Mexico is located in Zone I, II and III wind speeds for shelters of up to 160 mph. Figure 4-116 shows where New Mexico Preparedness Areas relate to the wind speed map.

Figure 4-115 Wind Zones in the United States[81]



[81] *Taking Shelter from the Storm*, FEMA P-320, Fourth Edition, 2014, available at: https://www.fema.gov/media-library-data/1418837471752-920f09bb8187ee15436712a3e82ce709/FEMA_P-320_2014_508.pdf

Figure 4-116 Wind Speed Experienced by New Mexico Preparedness Areas[82]

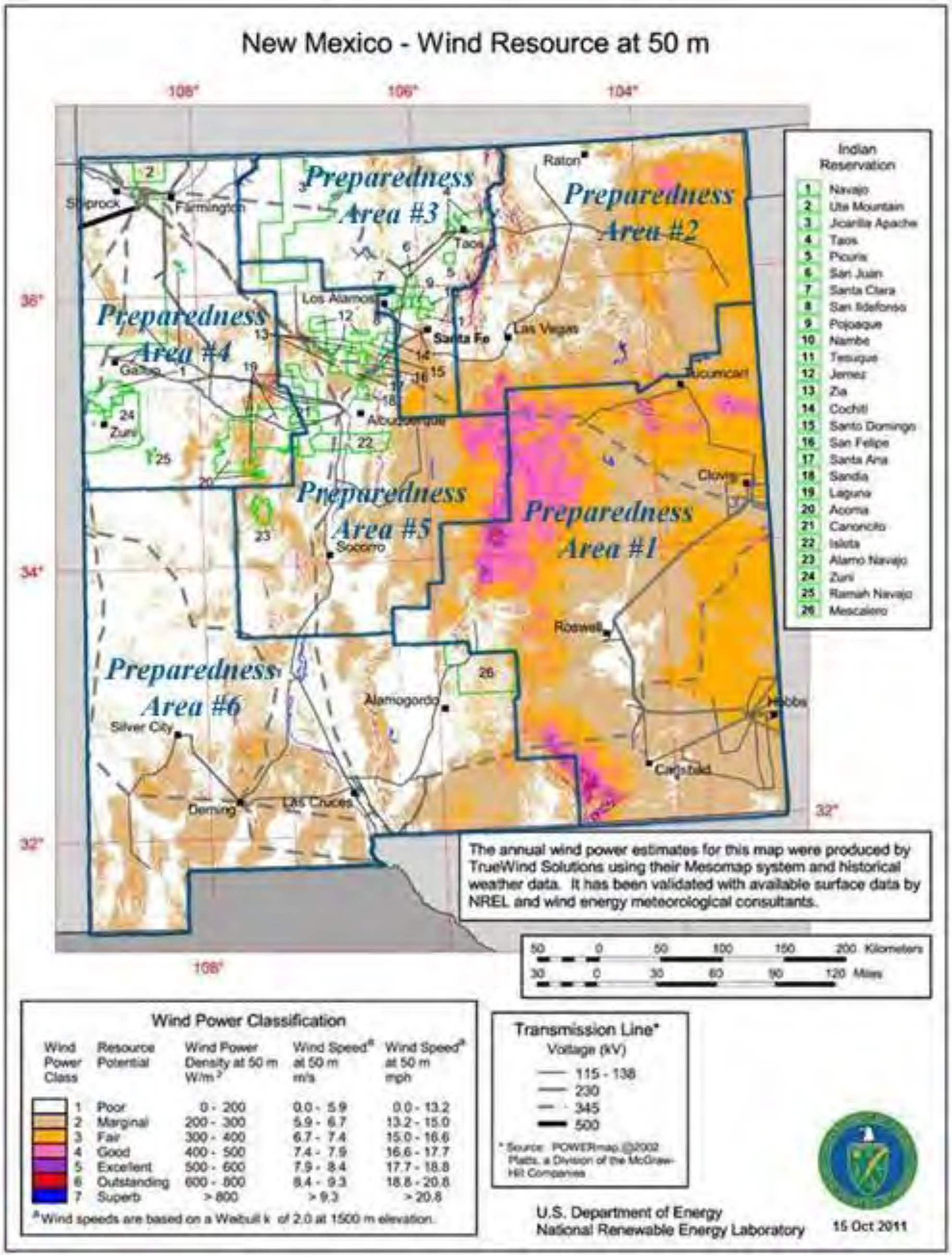
Location	Wind Speed Zone
Preparedness Area 1	Zone II (Winds up to 160 mph)
Preparedness Area 2	Zone I and II (Winds from 130 up to 160 mph)
Preparedness Area 3	Zone I and II (Winds from 130 up to 160 mph)
Preparedness Area 4	Zone I (winds up to 130 mph)
Preparedness Area 5	Zone I and II (Winds from 130 up to 160 mph)
Preparedness Area 6	Zone I and II (Winds from 130 up to 160 mph)

The entire State of New Mexico is subject to high wind conditions, but areas most vulnerable where the population is concentrated and buildings are of older design. Figure 4-117 shows average wind speeds in New Mexico as provided by the U.S. Department of Energy's (Energy Department's) Wind Program and the National Renewable Energy Laboratory.[83] This resource map shows estimates of wind power density at 50 m above the ground. This map indicates that New Mexico has wind resources consistent with community-scale production. The largest contiguous area of good-to-excellent resource is in central New Mexico between Albuquerque (Preparedness Area 1) and Clovis (Preparedness Area 1). Other notable areas of good-to-excellent resource are located near the Guadalupe Mountains in southern New Mexico, near Tucumcari (Preparedness Area 1), and in the northeastern part of the State (Preparedness Area 2 and 3) near the Colorado and Oklahoma borders.

[82] Source: https://www.fema.gov/media-library-data/1418837471752-920f09bb8187ee15436712a3e82ce709/FEMA_P-320_2014_508.pdf

[83] Source: U.S. Department of Energy, http://apps2.eere.energy.gov/wind/windexchange/

Figure 4-117 Average Wind Speeds in NM by Preparedness Area – October 15, 2011



4.5.7.2 *Previous Occurrences*

The current online NCDC database only contains data from January 1996 to December 2017, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total 1,942 high wind events with 24 injuries, eight deaths, $17,866,750 in property damage, and $3,500 in crop damage between 1996 and December 2017.

Figure 4-118 describes significant events that have occurred in New Mexico within specific Preparedness Areas.[84]

Figure 4-118 Significant Past Occurrence - High Wind

Date	Location	Significant Event
June 2017	Lordsburg, NM (Hidalgo County) (Preparedness Area 6)	Six people died in a 25-vehicle pileup caused by a sudden dust storm along Interstate 10 near Lordsburg. High winds and limited visibility caused 18 commercial trucks and seven passenger vehicles to crash. The highway was closed for one day, and drivers were forced to take a long detour on a two-lane highway. Removing the damaged vehicles was a slow process due to the lack of tow trucks in the area.
February 2017	Lordsburg, NM (Hidalgo County) (Preparedness Area 6)	Two women were killed when their car got sandwiched between two semitrailers in a dust storm along Interstate 10 near Lordsburg.
May 2014	Lordsburg, NM (Hidalgo County) (Preparedness Area 6)	Seven people died when a driver suddenly hit the brakes as blowing dust shrouded visibility along Interstate 10 near Lordsburg.
December 2009	Magdalena, NM (Socorro County) (Preparedness Area 5)	As reported by the Mountain Mail, after a weekend of wintry weather, high winds were a cause of concern for many county residents, especially those traveling on Highway 60, which had to be shut down near Magdalena for over an hour. The closure was the result of diesel fuel leaking from the tank of a wrecked semi-tractor trailer. According to the Magdalena Marshal, two semis were blown off the road; one at mile marker 126, and the other at mile marker 119. The semi at 119 leaked 240 gallons of diesel fuel causing the highway to be closed until a HAZMAT operation had been completed. The truck driver from Boise, Idaho, said he was on his way to Tucson when he experienced the estimated 100 mph gusts on Highway 60. Higher winds were recorded at other stations in the county. Magdalena Ridge Observatory sustained wind speeds at the 10,600 foot facility averaged about 100 mph over a seven hour period with gusts up to 128 mph.

[84] Source: NCDC, local Emergency Managers, and "Pileup during I-10 dust storm kills 6." *The New Mexican*. 21 June 2017.

Date	Location	Significant Event
April 2003	Silver City, NM (Grants County) Deming, NM Columbus, NM (Luna County) (Preparedness Area 6)	Strong winds blew dust from northern Mexico and caused a 10- car accident on US-180 near Deming in the southern part of the State. In Milan, two people were killed and five more injured when the blowing dust reduced visibility and caused a multiple car accident. State Police shut down several roads around Deming, including Interstate 10, U.S. 180 to Silver City, NM 11 from Deming to Columbus, NM 549 near Deming, NM 26 between Deming and Hatch, and NM 212 near Fort Sumner. High winds also blew a roof off a school and destroyed a church under construction. Over $200 thousand in damages were reported.
April 6, 2001	Artesia, NM Carlsbad, NM (Eddy County) (Preparedness Area 1)	A strong upper level storm system moving across the area produced strong gradient winds across southeast New Mexico during the afternoon of April 6. Wind gusts in excess of 70 mph at times resulted in a six-vehicle accident on Highway 2 north of the city of Artesia and a four-vehicle accident in the same area minutes later. The wind snapped large tree branches and electric power lines. The wind was responsible for disrupting cable television transmitters and for blowing a parking canopy support through the windshield of a pickup truck. In Carlsbad, winds as high as 67 mph blew down a 60-foot Arizona Cypress tree and caused major roof damage to a greenhouse. Total damage was estimated to be in excess of $600,000.
May 24, 1999	Socorro Count Valencia County (Preparedness Area 5)	Over $1.2 million in damages were caused by a severe storm which began near Alamo in northwest Socorro County that swept northeast across central Valencia County with high winds and large hail. Heavy wind damage from sustained winds estimated near 80 mph overturned and destroyed about 15 mobile homes and caused damage to about 150 other homes with many small outbuildings and sheds blown down in the area from Los Chavez to Tome Hill between Los Lunas and Belen. Large hail also knocked out numerous windows and broke windshields. Only two relatively minor injuries were reported in the hardest hit area. Residents had 40-60 minutes advanced warning and school officials successfully evacuated numerous portable classroom buildings without incident or injury to students before high winds struck.

Date	Location	Significant Event
May 1, 1999	Chaves County (Preparedness Area 1)	High winds were blamed in a fatal travel trailer-church bus accident in southwest Chaves County that claimed seven lives. State Police concluded that winds of 50-55 mph swept a truck pulling a travel trailer into the opposing lane and slicing into an on-coming bus filled with teenagers returning from a church retreat. One adult and six teenage girls died at the scene with other serious injuries reported.
April 9, 1999	White Sands, NM (Preparedness Area 6)	A major dust storm event occurred in the White Sands area when large clouds of milky white dust were observed overtopping the nearby Sacramento Mountains and blowing to the northeast. The dust storm started quickly and lasted for more than eight hours, with visibilities reduced to as low as 1.5 miles and winds gusting to at least 38 knots (44 mph). NOAA wind data from White Sands National Monument indicated winds at approximately 10,000 feet above ground level in excess of 50 knots. Reduced visibility continued long after the active production of blowing dust ended.
March – April 1993	Albuquerque, NM (Preparedness Area 5)	Wind storms/Dust storms. Numerous days with high winds and blowing dust. Albuquerque Airport recorded a peak gust of 80 MPH in March, Sandia Peak a gust of 106 MPH.
December 1977	Albuquerque, NM (Bernalillo County) (Preparedness Area 5)	The central Rio Grande Valley is occasionally subject to mountain wave-induced winds, which can become exceptionally strong. One such wave-induced windstorm occurred when surface winds with gusts between 50 and 70 mph were reported at the airport in Albuquerque. Wind reports from around the Albuquerque metro area included a peak wind of 71 mph at the airport, 97 mph at the base of the Sandia Tramway and gusts between 80 and 90 mph at Coronado Airport.
March 1977	Roswell and Clovis, NM (Preparedness Area 1)	Dust from White Sands was visible on the Geostationary Operational Environmental Satellite (GOES) imagery. It formed a plume more than 400 kilometers long, and blew eastward through Roswell, across eastern New Mexico to Clovis and then into the Texas Panhandle, where it eventually dissipated.

Figure 4-119 provides a cumulative overview of significant high wind events that have occurred in all Preparedness Areas. Column “Mag” is “Maximum Magnitude.” Note the information in the table below only includes data presented by county, and does not include data presented by National Weather Service Forecast Zones.

Figure 4-119 Preparedness Areas 1 - 6 High Wind History (January 1996 - December 2017)[85]

Preparedness Area 1
Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln, Quay and Roosevelt

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	670	35-86 kts	1	12	$2,739,050	$0
Strong Wind	3	39-49 kts	0	0	$10,200	$0
Dust Storm	10	0	0	0	$15,000	$0
Total	**683**	**35-86 kts**	**1**	**12**	**$2,764,250**	**$0**

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	332	35-72 kts	0	0	$1,182,500	$0
Strong Winds	4	33-47 kts	1	0	$141,000	$0
Dust Storm	1	0	0	0	$0	$0
Total	**337**	**33-72 kts**	**1**	**0**	**$1,323,500**	**$0**

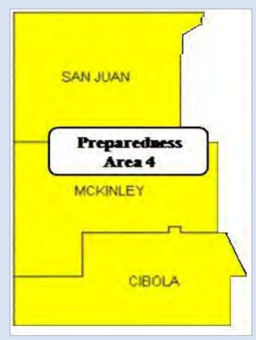
[85] Source: NCDC http://www.ncdc.noaa.gov

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	211	35-82 kts	0	0	$34,000	$500
Strong Wind	7	35-48 kts	0	0	$35,100	$0
Dust Storm	0	0	0	0	$0	$0
Total	**218**	**35-82 kts**	**0**	**0**	**$69,100**	**$500**

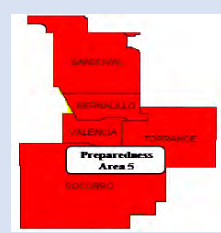
Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	41	35-65 kts	0	0	$474,000	$0
Strong Wind	1	45 kts	0	0	$2,500	$0
Dust Storm	0	0	0	0	$0	$0
Total	**42**	**35-65 kts**	**0**	**0**	**$476,500**	**$0**

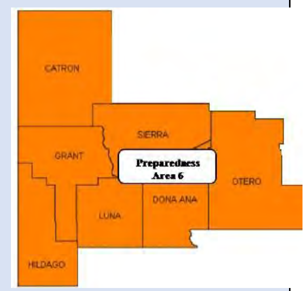


Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	352	35-96 kts	0	0	$5,745,200	$2,500
Strong Wind	19	35-48 kts	3	3	$133,600	$0
Dust Storm	2	0	0	0	$0	$0
Total	**373**	**35-96 kts**	**3**	**3**	**$5,878,800**	**$2500**



Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Event**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
High Wind	60	35-96 kts	0	0	$0	$0
Strong Wind	1	0	0	0	$75,000	$0
Dust Storm	0	0	0	0	$0	$0
Total	**61**	**35-96 kts**	**0**	**0**	**$75,000**	$0



4.5.7.3 *Frequency*

The State of New Mexico experiences high wind events annually, based on seasonal meteorological patterns and local topographical conditions. The north/south east section of the State is susceptible to high wind events. One type of wind event is the gap wind or canyon wind. This occurs as the wind rushes over mountain passes, “gaps,” in the ridgeline of a mountain chain. Wind speeds are generally strongest at narrow canyon openings. Another type of wind event is referred to as the spillover wind, which occurs when cold air to the east of the mountains has a sufficient depth (approximately 10,000 feet above sea level) to overtop the Sandia and Manzano Mountain ranges and spill over to the west, typically down slope toward the Albuquerque metropolitan area (Preparedness Area 5).

Wind speeds over the State are usually moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months and sometimes occur just in advance of thunderstorms. Frontal winds may exceed 30 mph for several hours and reach peak speeds of more than 50 mph. Spring is the windy season in New Mexico. Blowing dust and serious soil erosion of unprotected fields may be a problem during dry spells. Winds are generally stronger in the eastern plains than in other parts of the State. Winds generally predominate from the southeast in summer and from the west in winter, but local surface wind directions will vary greatly because of local topography and mountain and valley breezes.

Every Preparedness Area experiences some type of wind event as illustrated in Figure 4-119. A study conducted by the National Weather Service – Albuquerque dated May 2010 conducted a study titled, “A Climatology of High Wind Warning Events for Northern and Central New Mexico: 1976-2005.” The study conducted an assessment of climatological wind data across northern and central New Mexico in an effort that would benefit forecasters by providing supplemental knowledge of the synoptic regimes and frequency of high wind events.

The climatological record of high wind events was built for eight observational sites across New Mexico utilizing a 30-year period of record from 1976 to 2005. Locations included Albuquerque – Preparedness Area 1, Clayton – Preparedness Area 2, Farmington – Preparedness Area 4, Gallup – Preparedness Area 4, Los Vegas – Preparedness Area 2, Roswell – Preparedness Area 1, Santa Fe – Preparedness Area 3 and Tucumcari – Preparedness Area 1. NWS staff conducted hourly, monthly, seasonal, and yearly intervals and interim surface observations from these eight sites to determine the frequency of high wind events. The observations provided the NWS with information that with continued future work will hopefully include the construction of a database that will allow improved methods for inter-site comparisons of events on an individual and collective basis.[86]

As the past occurrences show, each Preparedness Area in New Mexico experienced high wind events every year based on the climate, topography of the land and due to the annual spring and monsoon season weather patterns. Preparedness Area 1 shows the highest probability of experiencing a high wind event.

4.5.7.4 *Probability of Occurrence*

High winds are difficult to predict precisely in pattern, frequency, and degree of severity. The windiest time of the year is during the spring months of April and May, with March and June often times not far behind.

To determine the probability of New Mexico experiencing future high wind occurrences, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 1996 – December 2017 (263 months/21 years) and from local emergency management officials. Probability was determined by dividing the number of events observed by the number of years (21 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. Figure 4-120 provides the probability of occurrence in each Preparedness Area based on the probability formula.

Figure 4-120 Probability of Occurrence - High Winds

Probability of Occurrence			
Preparedness Area	**High Wind**	**Strong Wind**	**Dust Storm**
Preparedness Area 1	100%	14%	48%
Preparedness Area 2	100%	19%	5%
Preparedness Area 3	100%	33%	0%
Preparedness Area 4	100%	5%	0%
Preparedness Area 5	100%	90%	10%
Preparedness Area 6	100%	5%	0%

4.5.7.5 *Risk Assessment*

No areas of New Mexico are immune from damaging high winds. High wind is a fact of life for State residents, especially in the spring. Extremely high velocity wind over a prolonged period is rare. Such occurrences can result in downed power lines, roof damage, trees being blown down, and difficulty in controlling high profile vehicles on the highways. Microburst wind damage is more common, since it is

[86] Source: https://www.weather.gov/media/abq/LocalStudies/hww_studyBTS2010.pdf

often associated with powerful downdrafts originating from thunderstorms. These winds are of relatively short duration. Certain areas of the State are subject to hazardous dust storms when high winds blow over terrain that is relatively devoid of vegetation. The southwestern part of the State between Deming and the Arizona border is especially susceptible to this hazard, and highway closure is sometimes required. Localized dust storms can arise unexpectedly when high winds pick up dust and debris from construction sites.

These large-scale dust storms occasionally occur in the White Sands region of New Mexico and in the region between Deming (Luna County – Preparedness Area 6) westward to the Arizona border. Major dust events can transport mineral aerosols (dust) for long distances, obscuring vision for motorists and causing breathing problems for people with respiratory difficulties. Examples of these incidents in Preparedness Area 6 are described below.

> In June 2017, six people died in a 25-vehicle pileup caused by a sudden dust storm along Interstate 10 near Lordsburg. High winds and limited visibility caused 18 commercial trucks and seven passenger cars to crash on westbound Interstate 10, and the highway was closed until the next day. This stretch of highway experiences dust storms due to the desert landscape and a dry lakebed, and because of the topography of the area, when high winds come through there is nothing there to stop them. On the same stretch of highway two women were killed in a car accident in February 2017 due to a dust storm, and seven people died in a car accident during a dust storm in May 2014. The state airs public service announcements and posted signs that span 100 miles warning drivers about sudden winds. Drivers are advised to pull over when visibility is low.[87] Additionally, the following actions are recommended when driving during a wind storm[88]:

- Dust storms usually last a few minutes, and up to an hour at most. Stay where you are until the dust storm passes.
- Avoid driving into or through a dust storm. If you encounter a dust storm:
  - Immediately check traffic around your vehicle (front, back and to the side) and begin slowing down.
  - Do not wait until poor visibility makes it difficult to safely pull off the roadway -- do it as soon as possible. Completely exit the highway if you can.
  - Do not stop in a travel lane or in the emergency lane. Look for a safe place to pull completely off the paved portion of the roadway.
  - PULL OFF! LIGHTS OFF! FOOT OFF!
- If you encounter a dust storm while driving, pull off the road immediately.
  - Turn off your headlights and taillights, put your vehicle in "PARK," and take your foot off the brake (so your brake lights are not illuminated.) Other motorists may tend to follow taillights in an attempt to get through the dust storm, and may strike your vehicle from behind.
  - Stay in the vehicle with your seatbelts buckled and wait for the storm to pass.
- Drivers of high-profile vehicles should be especially aware of changing weather conditions and travel at reduced speeds.

[87] Source: "Pileup during I-10 dust storm kills 6." *The New Mexican.* 21 June 2017.
[88] Source: https://ein.az.gov/hazards/dust-storms#1

Strong winds can damage buildings and uproot trees, but can also produce areas of blowing dust that can reduce visibilities making road travel hazardous. The NWS Albuquerque issues high wind warnings when winds are expected to have sustained speeds of 40 mph or greater and/or instantaneous gusts of 58 mph or higher. A study was recently completed to determine the frequency of high wind events across New Mexico, and to evaluate the synoptic regime associated with these events. This study showed that high wind events are also most common in the Spring.

High wind events often have a westerly component. During the Spring months two factors work in tandem to create strong winds. By March or April, the polar jet stream migrates northward but can still often influence the southwest U.S., such that wind speeds increase dramatically with height. Meanwhile, the sun angle is higher in the sky and creates greater heating near the surface of the earth. The heated surface air rises to a greater depth of the atmosphere during these spring months, often to a height between 7,500 and 10,000 feet above the surface. The rising air mixes with stronger winds aloft, resulting in stronger and turbulent winds mixing down to the surface. Strong surface pressure gradients can enhance surface winds. High wind events across New Mexico can also occur with strong surface fronts, especially those that race through the eastern plains.[89]

Figure 4-121 identifies impacts related to high wind events for the purposes of EMAP compliance.

Figure 4-121 Impact from a High Wind Event

Subject	Impacts
Agriculture	Row crops, those standing above ground level, are most susceptible to high wind damage. Agriculture infrastructure such as grain silos and windmills can be damaged or destroyed.
Health and Safety of the Public	The public can face severe injuries and even death because of high wind events.
Health And Safety of Responders	Responders face the same risks as the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Property, Facilities, Infrastructure	High wind can cause anywhere from minor damage to total destruction of facilities and infrastructure depending on the size of the event. Extensive damages are anticipated.
Environment	Wind can cause widespread extensive damage to the environment in the form of damaged or downed trees and crops, and debris or contamination dispersal.
Economic Condition	A small community can be heavily damaged by wind. The economic base (businesses) and individuals can lose everything, and recovery may require substantial investment.

[89] Source: http://www.srh.noaa.gov/abq/?n=features_highwind

Subject	Impacts
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

4.5.7.6 *Data Limitations*

Manufactured homes that are not adequately anchored are the most vulnerable structures for damage from high wind events. The information necessary to determine the location and condition of manufactured homes and aged or dilapidated structures was not available during the development of this mitigation plan. Consequently, the SHMPT could not quantify vulnerability of individual structures to damage from high winds. In addition, accurate methods to quantify potential future damages are not readily available. The amount of business lost due to high wind events has not been calculated due to the difficulty of attaining this information. The SHMPT could also not specify which critical facilities were vulnerable to high wind events. Subsequent versions of this Plan Update will need to incorporate and respond to these data deficiencies.

4.5.7.7 *What Can Be Mitigated?*

One important part of mitigating high wind hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to high wind events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending wind events. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to wind events. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

4.5.7.8 *Changing Weather Patterns*

At the time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of high winds in the State of New Mexico.

4.5.8 Landslide

4.5.8.1 *Hazard Characteristics*

Landslides are the downward and outward movement of rock or soil on slopes. Although generally associated with mountainous regions, sometimes they can occur in low-relief areas. Human activity can potentially promote landslide activity. These activities include steep slopes created during excavations or road cuts, unstable mine waste dumps or tailings piles, or saturation of slopes (e.g., due to irrigation or irrigation ditches). The USGS has produced an informative, short publication regarding landslide types and processes that serves as a valuable reference[90], from which much of the summary material presented below was derived.

Landslides include a wide range of ground movement, such as rock falls, rock topple, deep failure of slopes, and shallow failure of slopes (the latter of which may become debris flows if saturated).

[90] U.S. Geological Survey, 2004, Landslide Types and Processes: USGS Fact Sheet 2004-3072, 4 p.

Although gravity is an essential driving force, landslides are often prompted by the occurrence of other phenomena such as seismic activity or heavy rainfall. Other contributing factors include the following:

- Over-steepened slopes created by erosion associated with rivers, glaciers, or waves.
- Over-steepened slopes caused by construction activity, such as excavations or road cuts.
- Rock and soil slopes weakened through saturation by snowmelt or heavy rains.
- Earthquakes waves creating forces contributing to slope failure.
- Volcanic eruptions producing loose ash deposits, heavy rain, and debris flows.
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore or waste piles, or from manmade structures stressing weak slopes.
- Floods or long duration precipitation events creating saturated, unstable soils that are more susceptible to failure.
- Addition of water from irrigation ditches crossing steep slopes and saturating the substrate.
- Moist clay on slopes that deform, slide, and flow easily.

During heavy or sustained precipitation (including snow melt), slope material can become saturated with water and, if it fails, a debris or mudflow may develop. In this saturated state, the water weakens the soil and rock by reducing cohesion and friction between particles. Cohesion, which is the tendency of soil particles to "stick" to each other, and friction affect the strength of the material in the slope and contribute to a slope's ability to resist down-slope movement. Moist clays on slopes are plastic, deforming and sliding under slight loads; clays also prevent water from percolating downward and may promote local saturation of soils. Saturation increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope. Undercutting of a slope reduces the slope's resistance to the force of gravity by removing buttressing mass at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible fracturing of rock, thereby weakening it and increasing susceptibility for slope failure or rockfall. Slopewash associated with intense precipitation may wash small stones off of steep cliffs, causing rockfall events. Intense precipitation also may promote shallow failure of weakly consolidated material, resulting in a debris flow. The resulting slurry of rock and mud causes flooding along its path and can pick up trees, houses, and cars; this slurry can also block or weaken bridges and damage roads. Additionally, removal of vegetation can leave a slope much more susceptible to superficial landslides because of the loss of the stabilizing root systems.

Geologists attempt to identify active landslides and areas subject to slope instability so that they may be avoided or mitigated. Together, geologists and civil engineers develop and implement measures to improve the stability of slopes, repair existing landslides, and prevent damage from future landslides. Slope stability can be improved by removing material from the top of the slope, adding material or retaining structures to the base of the slope, and reducing the degree of saturation by improving drainage within the slope.

Figure 4-122 Google Earth Image Showing an Active Landslide in New Mexico

Figure 4-122 shows a Google Earth image showing an active landslide in New Mexico, located in the Rio Grande Gorge 3.7 miles southwest of the town of Pilar. The road in the foreground is NM State Highway 68, which connects the cities of Española and Taos. Note how the landslide has caused deflection of both the river (to the lower left of the image) and the road crossing the lower part of the landslide. Progressive movement of the landslide has caused narrowing of the river and creation of rapids. This landslide is probably best classified as an earthflow (see Figure 4-124 below).

Figure 4-123 Photographs of "Baby Huey" Boulder

This boulder, estimated at 2.7x105 kg (300 ton), slid and bounced down the steep slope flanking the southeast side of NM State Highway 68, at a location 2.9 mi southwest of Pilar.[91] The source of the boulder is shown by the white arrow in the left photograph. This was the most impressive of the numerous rockfalls that occurred on July 25 of 1991. As it bounced down the slope, it created a 45x15x15 ft crater on Highway 68. The boulder's momentum allowed it to travel across the river, where it came to rest on the lower slope (right photos). It was estimated that this boulder was traveling at approximately 21 m/sec and had a total kinetic energy of about 8.5x107 N-m.[92] These rockfalls, in addition to debris flows, trapped 20 cars and closed Highway 68 for 19 hours. Photos courtesy of Paul Bauer (NM Bureau of Geology and Mineral Resources).

Landslide Types

Landslides are commonly categorized according to the material involved and the type of movement. The material involves either bedrock or unconsolidated material. The type of movement can be classified as follows: slides, falls+topples, flows, lateral spreads, or combinations of these processes.[93] The figures below summarize the types of landslides, followed by text briefly summarizing landslide types (in the

[91] Haneberg, W.C., and Bauer, P.W., 1993, Geologic setting and dynamics of a rockslide along NM 68, Rio Grande gorge, northern New Mexico: Bulletin of the Association of Engineering Geologists, v. 30, p. 7-16.

[92] Haneberg, W.C., and Bauer, P.W., 1993, Geologic setting and dynamics of a rockslide along NM 68, Rio Grande gorge, northern New Mexico: Bulletin of the Association of Engineering Geologists, v. 30, p. 7-16.

[93] Varnes, D.J., 1878, Slope movement types and processes, *in* Schuster, R.L., and Krizek, R.J., eds., Landslides -- Analysis and control: National Research Council, Washington, D.C., Transportation Research Board, Special Report 176, p. 11-33.

order as presented by the figure). Figure 4-124 summarizes the different types of landslides. It is from the USGS Fact Sheet on landslides[94], and is as an abbreviated version of Varnes' classification of slope movements.[95]

Figure 4-124 Summary of Landslide Types

TYPE OF MOVEMENT		TYPE OF MATERIAL		
		BEDROCK	ENGINEERING SOILS	
			Predominantly coarse	Predominantly fine
FALLS		Rock fall	Debris fall	Earth fall
TOPPLES		Rock topple	Debris topple	Earth topple
SLIDES	ROTATIONAL	Rock slide	Debris slide	Earth slide
	TRANSLATIONAL			
LATERAL SPREADS		Rock spread	Debris spread	Earth spread
FLOWS		Rock flow	Debris flow	Earth flow
		(deep creep)	(soil creep)	
COMPLEX		Combination of two or more principal types of movement		

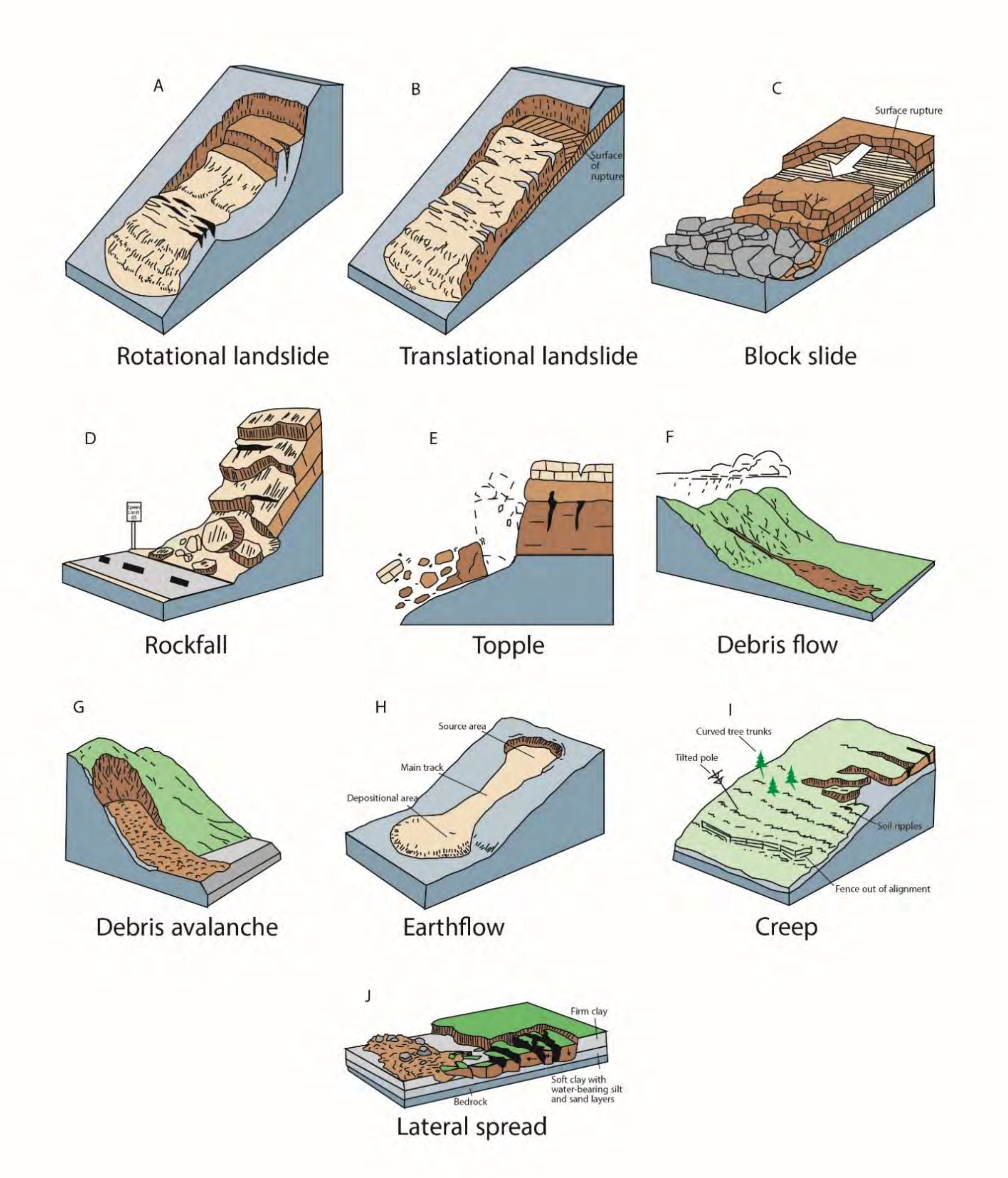
Figure 4-125 shows schematic figures to illustrate the main types of landslides. Figure courtesy of the U.S. Geological Survey.[96]

[94] U.S. Geological Survey, 2004, Landslide Types and Processes: USGS Fact Sheet 2004-3072, 4 p.

[95] Varnes, D.J., 1878, Slope movement types and processes, in Schuster, R.L., and Krizek, R.J., eds., Landslides -- Analysis and control: National Research Council, Washington, D.C., Transportation Research Board, Special Report 176, p. 11-33.

[96] U.S. Geological Survey, 2004, Landslide Types and Processes: USGS Fact Sheet 2004-3072, 4 p.

Figure 4-125 Main Types of Landslides



Rotational landslides – a landslide (A in Figure 4-125 above) consisting of a mass of material moving down slope as a unit along a concave-up, curved plane of failure. Slide movement is approximately rotational about an axis that is parallel to the ground surface and orientated transverse across the landslide. The sliding mass of soil and rock leave an abrupt drop-off at the top of the landslide, known as a main scarp or head scarp. Over much of its length, the moving mass of material is back-tilted towards this head scarp. Repeated movements can often result in terracing, or series of scarps, as secondary failures occur within the landslide mass.

Translational landslides – a landslide (B in Figure 4-125 above) where the mass moves (translates) along an approximately planar surface with little rotation or back-tilting. A translational slide involving bedrock is also referred to as a rockslide, which generally moves along a plane of weakness, such as a bedding plane or joint. If the bedrock mass breaks apart as it moves, then the slide can be termed a block slide (C in figure above). In general, translational slides occur on steep mountain faces, but have been known to occur on slopes as low as 15 degrees.

Rockfall and rock topple – these types of landslides involve freefall of hard blocks (rock or boulders) from a steep slope or cliff (D and E in Figure 4-125 above), eventually coming to rest at a shallower slope. Rockfall involves abrupt downward detachment along a surface (D in Figure 4-125 above). Rock topple, on the other hand, is when the rock body has forward rotation (out from the slope) about a semi-horizontal axis below the center of gravity of the displaced mass (E in Figure 4-125 above).[97] During its transport, the moving block may remain intact or shatter into smaller pieces (depending on the degree of acceleration and the strength of the falling rock). The blocks typically accumulate at the base of the cliff in the form of talus (loose rock). Separation from a cliff occurs along discontinuities such as joints, fractures, or bedding planes. Potential driving forces for rockfalls + rock topples include freeze/thaw weathering or segregation ice growth, expansion of clays in cracks, solar heating of rocks that can form cracks, earthquakes, and precipitation. Rockfalls + rock topples are influenced by bedrock type -- especially its hardness, orientation of bedding planes (if any), or fracture density.

Subject Matter Experts from the New Mexico Bureau of Geology and Mineral resources offered the following informal descriptions for the SHMPT.

- Landslides occur when a mass of rock and/or soil that moves or slides along an inclined surface at its base (basal shear plane). These tend to be much larger than rock topples (involving acres) and a portion of this mass moves out over the original land surface. If the basal sliding surface is relatively planar or undulatory, then the landslide is called a translational slide. If the basal surface is curved (concave-up), then the landslide is called a rotational slide.
- Rockfall is when a chunk of rock falls out of a cliff face with no or very little movement along an inclined surface at its base. The chunk of rock then falls through the air and starts bouncing down the slope until something stops it. This phenomena typically involves boulders ranging from basketball size to semi-truck size. Rock topple is a variant of rock fall, and occurs when this chunk of rocks rolls forward out from a steep slope or cliff face (i.e., rotation is involved).

[97] Highland, L.M., and Bobrowsky, P., 2008, The landslide handbook--A guide to understanding landslides: Reston, Virginia, U.S. Geological Survey Circular 1325, 129 p.

- Rock topple is like a "peeling off" whereas landslides involve sliding similar to a snow avalanche. Using a child on a playground slide as an analogy, jumping off or running down the slide is like a rock fall while sliding down the slide is like a landslide.

Debris flow – a mixture of rock fragments, soil, vegetation, water and, in some cases, entrained air that flows downhill as a fluid (F in Figure 4-125 above). Debris flows include <50% fines (clay+silt+sand) and are commonly caused by intense surface-water flow associated with heavy precipitation or rapid snowmelt. This runoff erodes weakly consolidated material accumulated in gullies or from steep slopes (the latter facilitated by wildfire denudation of vegetation). Shallow landslides on steep slopes that involve saturated, weakly consolidated material can also evolve into debris flows.

Debris avalanche – a debris flow that is emplaced very rapidly due to slope failure (G in Figure 4-125 above), commonly from collapse of an unstable, steep slope (such as a steep flank of a volcano).

Earthflow and mudflow – These landslides types generally involve fine-grained material that behaves in a liquefied manner. The flow is elongate, commonly having an "hourglass" shape, and leaves a bowl or depression near its head (H in Figure 4-125 above). A mudflow is an earthflow that is sufficiently wet to flow rapidly and contains at least 50% sand-, silt-, or clay-sized particles.

Creep – steady, downward movement of material along a slope involving rates that are imperceptibly slow. This phenomenon is evidenced by curved tree trunks, bent fences or retaining walls, or tilted poles (I in Figure 4-125 above). It is common in New Mexico on slopes underlain by shale.

Lateral spread – slides involving lateral extension of material, either weakly consolidated or solid, that occurs in or over liquefied, fine-grained material (J in Figure 4-125 above). Failure is often triggered by rapid ground motions, such as that experienced during an earthquake.

Landslides can be classified by using the Alexander Scale (Figure 4-126). The Alexander Scale provides descriptions of landslide damage and the different levels and type of damage.

Figure 4-126 Alexander Scale for Landslide Damage[98]

Alexander Scale for Landslide Damage		
Level	**Damage**	**Description**
0	None	Building is intact.
1	Negligible	Hairline cracks in walls or structural members; no distortion of structure or detachment of external architectural details
2	Light	Buildings continue to be habitable; repair not urgent. Settlement of foundations, distortion of structure, and inclination of walls are not sufficient to compromise overall stability.

98 Source: Risk Frontiers, Natural Hazards Research Center http://www.riskfrontiers.com/damage_scales13.htm (December 2012)

Alexander Scale for Landslide Damage		
Level	**Damage**	**Description**
3	Moderate	Walls out of perpendicular by one or two degrees, or there has been substantial cracking in structural members, or the foundations have settled during differential subsidence of at least 15 cm; building requires evacuation and rapid attention to ensure its continued life.
4	Serious	Walls out of perpendicular by several degrees; open cracks in walls; fracture of structural members; fragmentation of masonry; differential settlement of at least 25 cm compromising foundations; floors may be inclined by one or two degrees or ruined by heave. Internal partition walls will need to be replaced; door and window frames are too distorted to use; occupants must be evacuated and major repairs carried out.
5	Very Serious	Walls out of plumb by five or six degrees; structure grossly distorted; differential settlement has seriously cracked floors and walls or caused major rotation or slewing of the building [wooden buildings are detached completely from their foundations]. Partition walls and brick infill will have at least partly collapsed; roofs may have partially collapsed; outhouses, porches, and patios may have been damaged more seriously than the principal structure itself. Occupants will need to be re-housed on a long-term basis, and rehabilitation of the building will probably not be feasible.
6	Partial Collapse	Requires immediate evacuation of the occupants and cordoning of the site to prevent accidents with falling masonry.
7	Total Collapse	Requires clearance of the site.

Landslides occur in every State and U.S. territory. The Appalachian Mountains, the Rocky Mountains, the Pacific Coastal Ranges, and some parts of Alaska and Hawaii experience severe landslide problems. Any area composed of very weak or fractured materials resting on a steep slope may experience landslides. Although frequently associated with areas of high rainfall, landslides are a potential hazard in arid or semi-arid States like New Mexico. Landslides in New Mexico range from large, slow-moving, deep-seated masses, which can destroy structures by gradual movement, to shallow, fast-moving debris flows that threaten life and property. Of the various landslide phenomena, debris flows and rockfalls pose the greatest hazards to New Mexico. Although they still have potential to be a modern-day threat (given the right slope conditions and driving forces), most deep-seated landslides observed on the landscape probably happened in cooler or wetter climates prior to 10,000 years ago.[99]

[99] Landslide studies in New Mexico that interpret a >10,000 age for large, deep-seated landslide complexes include the following: 1) Watson, R.A., and Wright, H.E., Jr., 1963, Landslides on the east flank of the Chuska Mountains, northwestern New Mexico: American Journal of Science, v. 261, issue 6, p. 525-548; 2) Reneau, S.L., and Dethier, D.P., 1996a, Pliocene and Quaternary history of the Rio Grande, White Rock Canyon and vicinity, New Mexico, *in* Goff, F., Kues, B.S., Rogers, M.A., McFadden, L.D., and Gardner, J.N., eds., The Jemez Mountains Region: New

The New Mexico Bureau of Geology has recently released State-wide susceptibility maps for rockfall and deep-seated landsliding. These were a product of the Hazard Mitigation Grant Program, and funded by a NM DHSEM sub-grant (FEMA-4152-DR-NM-020). Previous mapping of landslides across the entire State provided essential input data for creating these susceptibility maps.[100] Susceptibility is used to describe the natural propensity of the landscape to produce a given hazard (in this case, landslides and rockfall). In other words, these maps depict the likelihood that a landslide or rockfall event will occur in a specified area based on local terrain conditions, given adequate driving forces or destabilizing phenomena.

Two series of maps depict rockfall susceptibility.[101] The first series show kernel-function contouring of previously mapped rockfall density. Because these mapped rockfalls were interpreted using aerial photography, which likely can only pick out boulders ≥ 3 m in diameter, this rockfall density map is best-suited for hazards posed by large-block rockfalls. Figure 4-127 shows densities of previously mapped rockfalls (mapped rockfall per square kilometer). These densities have been contoured using a kernel function. Note that most rockfalls correspond to mesa flanks or steep mountains slopes.[102] Figure 4-128 to Figure 4-133 show this same data for each Preparedness Area.

The second series of maps (Figure 4-134 to Figure 4-140) depict rockfall susceptibility for a wider range of rock sizes. These maps establish slope bins from statistical analyses of slopes associated with the previously mapped rockfalls,[103] and uses these slopes as proxies for rockfall susceptibility.[104] These maps probably depict hazards posed by a wider range of rockfall sizes than the rockfall density maps. Note correspondence of likely susceptible areas to mountainous areas, canyon sides, and mesa flanks.

Mexico Geological Society, 47th Annual Field Conference, Guidebook, p. 317-324; and 3) Reneau, S.L., and Dethier, D.P., 1996b, Late Pleistocene landslide-dammed lakes along the Rio Grande, White Rock Canyon, New Mexico: Geological Society of America Bulletin, v. 108, issue 11, p. 1492-1507.

[100] Cardinali, M., Guzzetti, F., and Brabb, E.E., 1990, Preliminary maps showing landslide deposits and related features in New Mexico: U.S. Geological Survey, Open-file Report 90-293, scale 1:500,000.

[101] Koning, D.J., and Mansell, M., 2017, Rockfall susceptibility maps for New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 595, 41 p. and 2 plates.

[102] Previous mapping of rockfalls are from: Cardinali, M., Guzzetti, F., and Brabb, E.E., 1990, Preliminary maps showing landslide deposits and related features in New Mexico: U.S. Geological Survey, Open-file Report 90-293, scale 1:500,000. The density-contouring of these rockfalls are from: Koning, D.J., and Mansell, M., 2017, Rockfall susceptibility maps for New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 595, 41 p. and 2 plates.

[103] Cardinali, M., Guzzetti, F., and Brabb, E.E., 1990, Preliminary maps showing landslide deposits and related features in New Mexico: U.S. Geological Survey, Open-file Report 90-293, scale 1:500,000

[104] Koning, D.J., and Mansell, M., 2017, Rockfall susceptibility maps for New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 595, 41 p. and 2 plates.

Figure 4-127 Densities of Previously Mapped Rockfalls in New Mexico

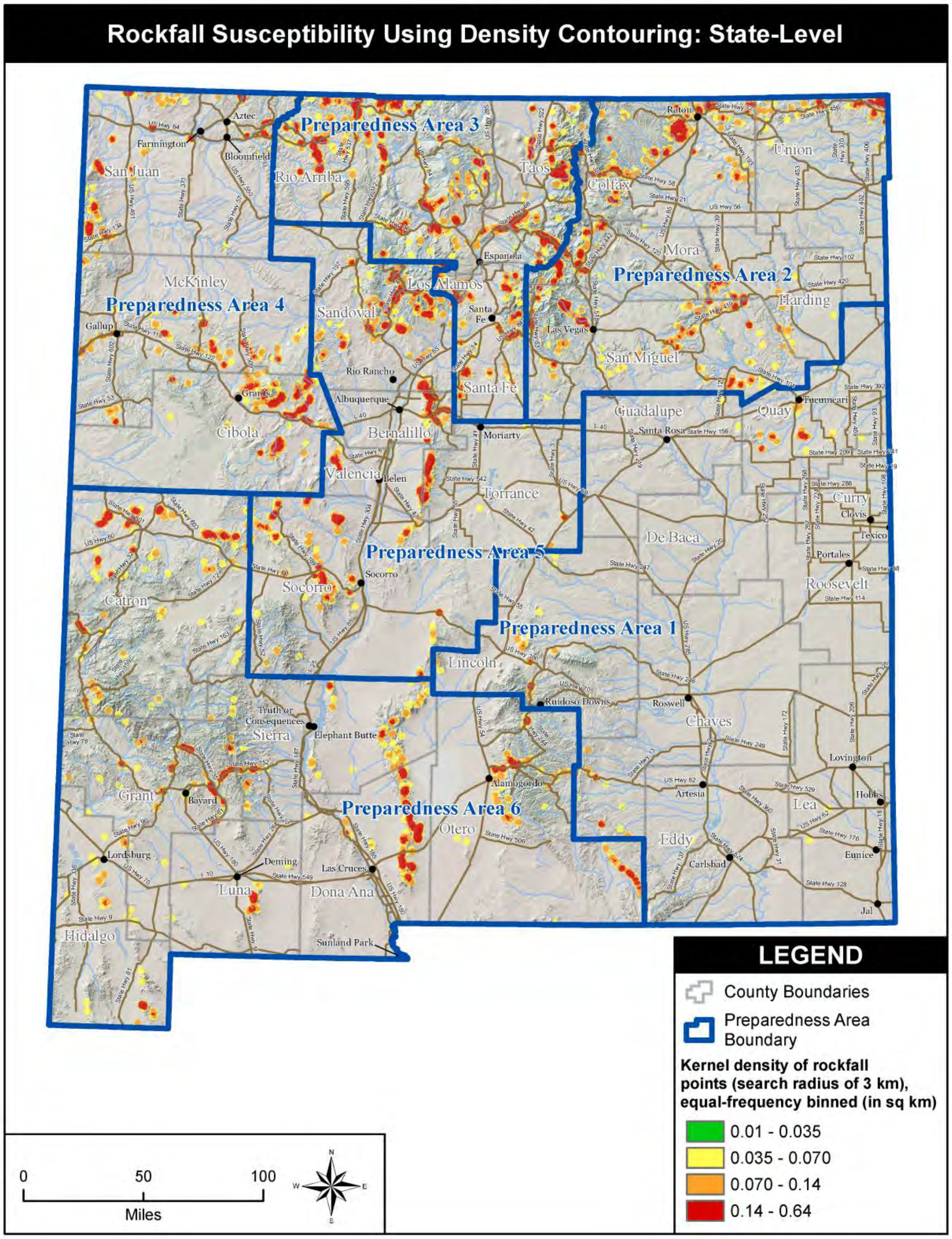


Figure 4-128 Densities of Previously Mapped Rockfalls in Preparedness Area 1

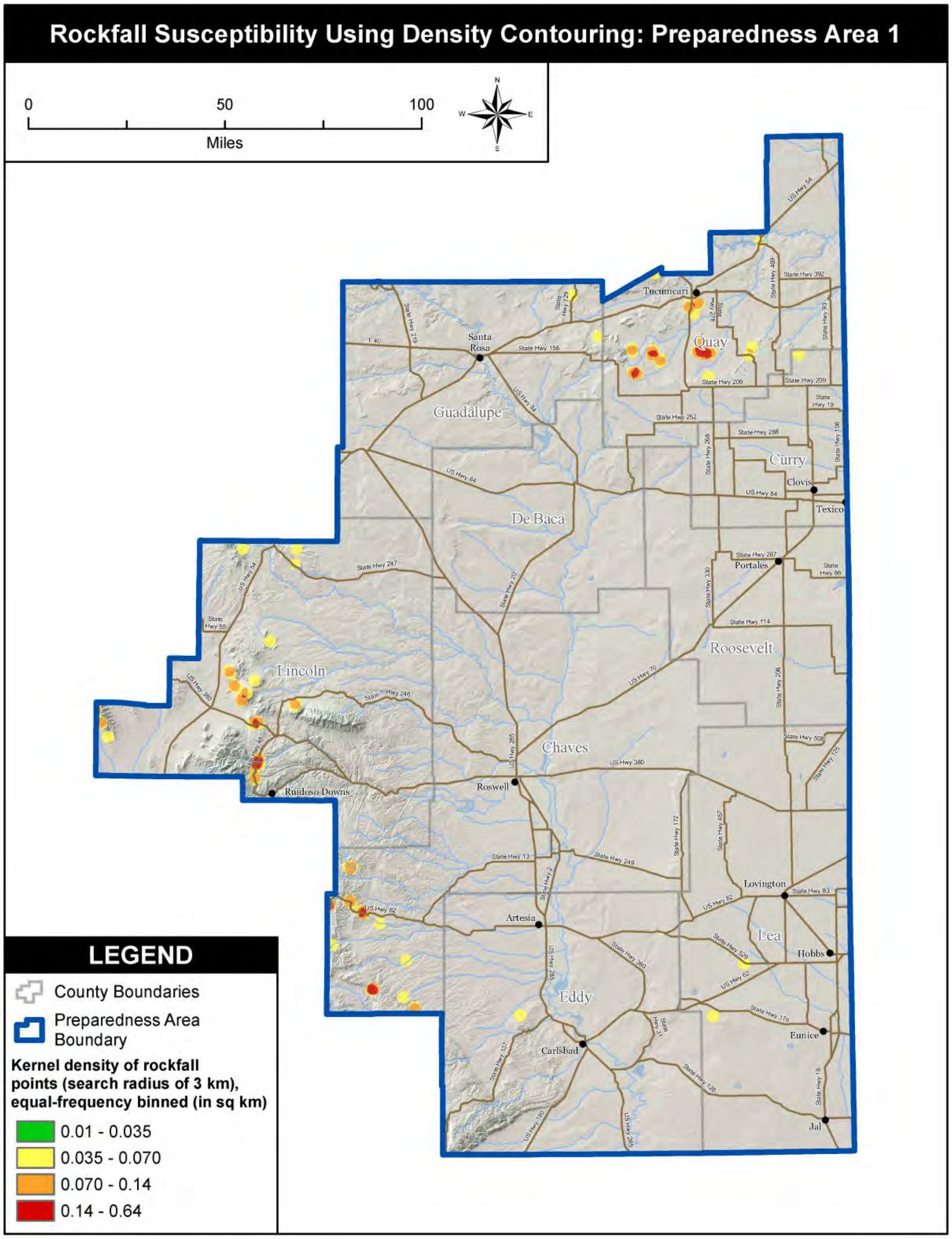


Figure 4-129 Densities of Previously Mapped Rockfalls in Preparedness Area 2

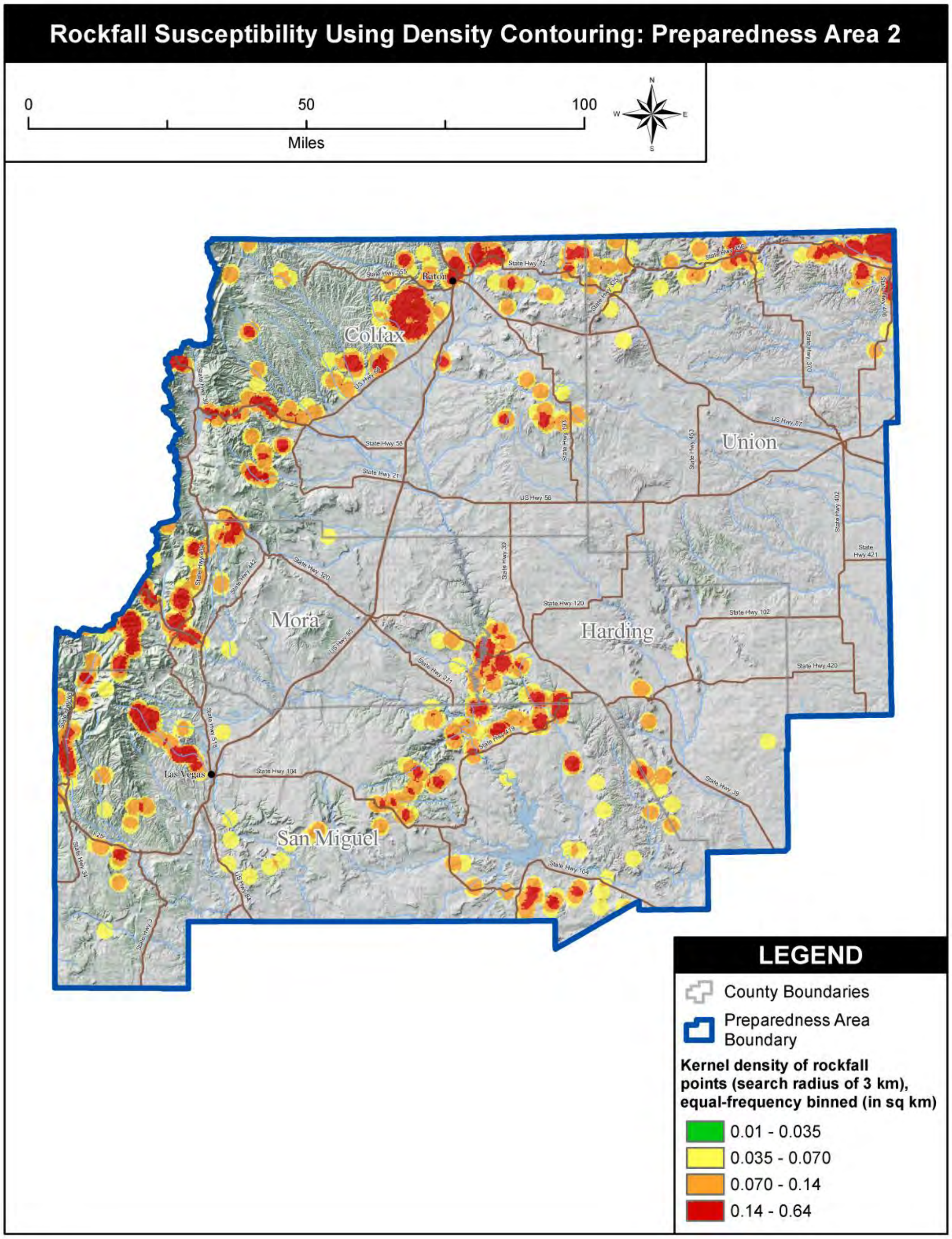


Figure 4-130 Densities of Previously Mapped Rockfalls in Preparedness Area 3

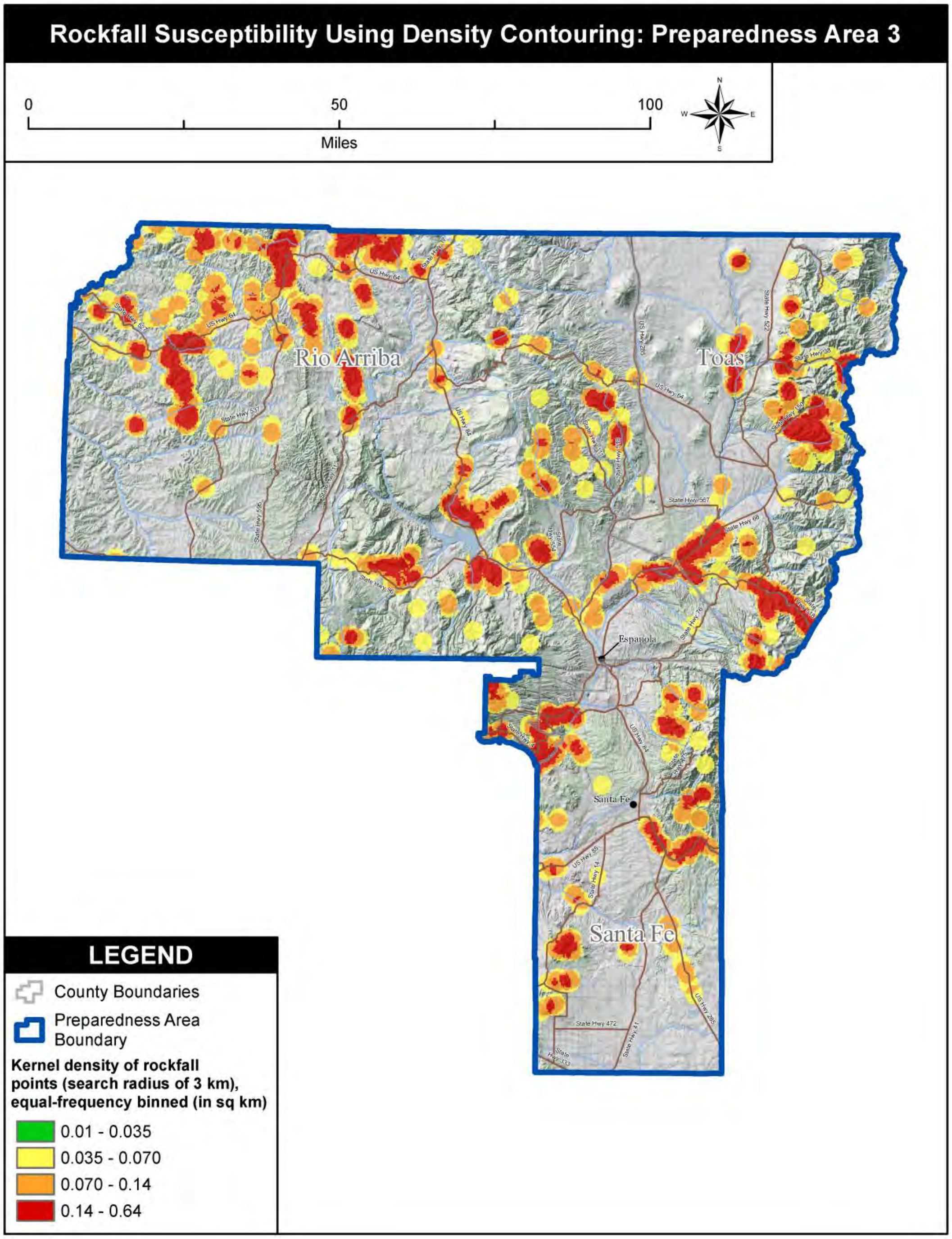


Figure 4-131 Densities of Previously Mapped Rockfalls in Preparedness Area 4

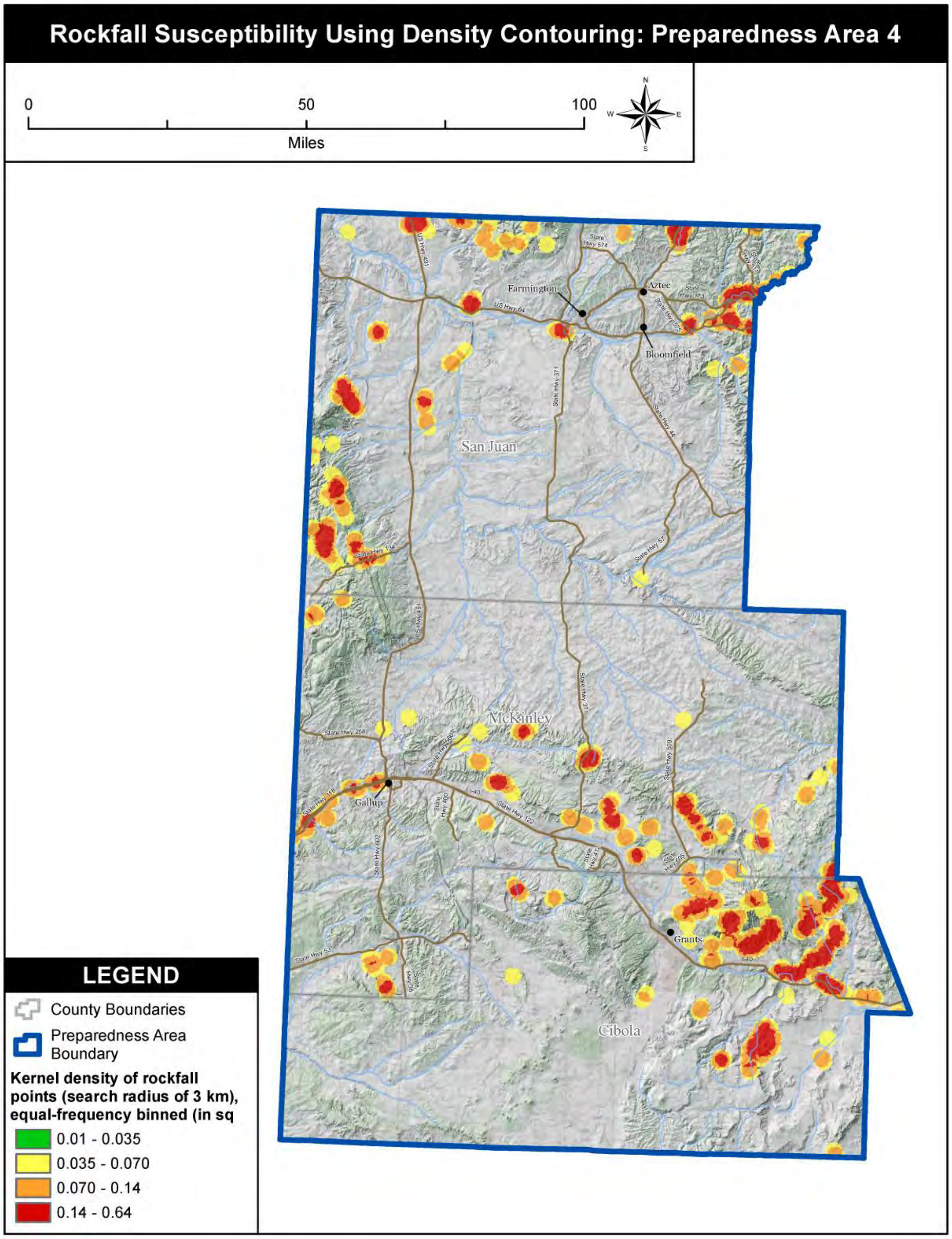


Figure 4-132 Densities of Previously Mapped Rockfalls in Preparedness Area 5

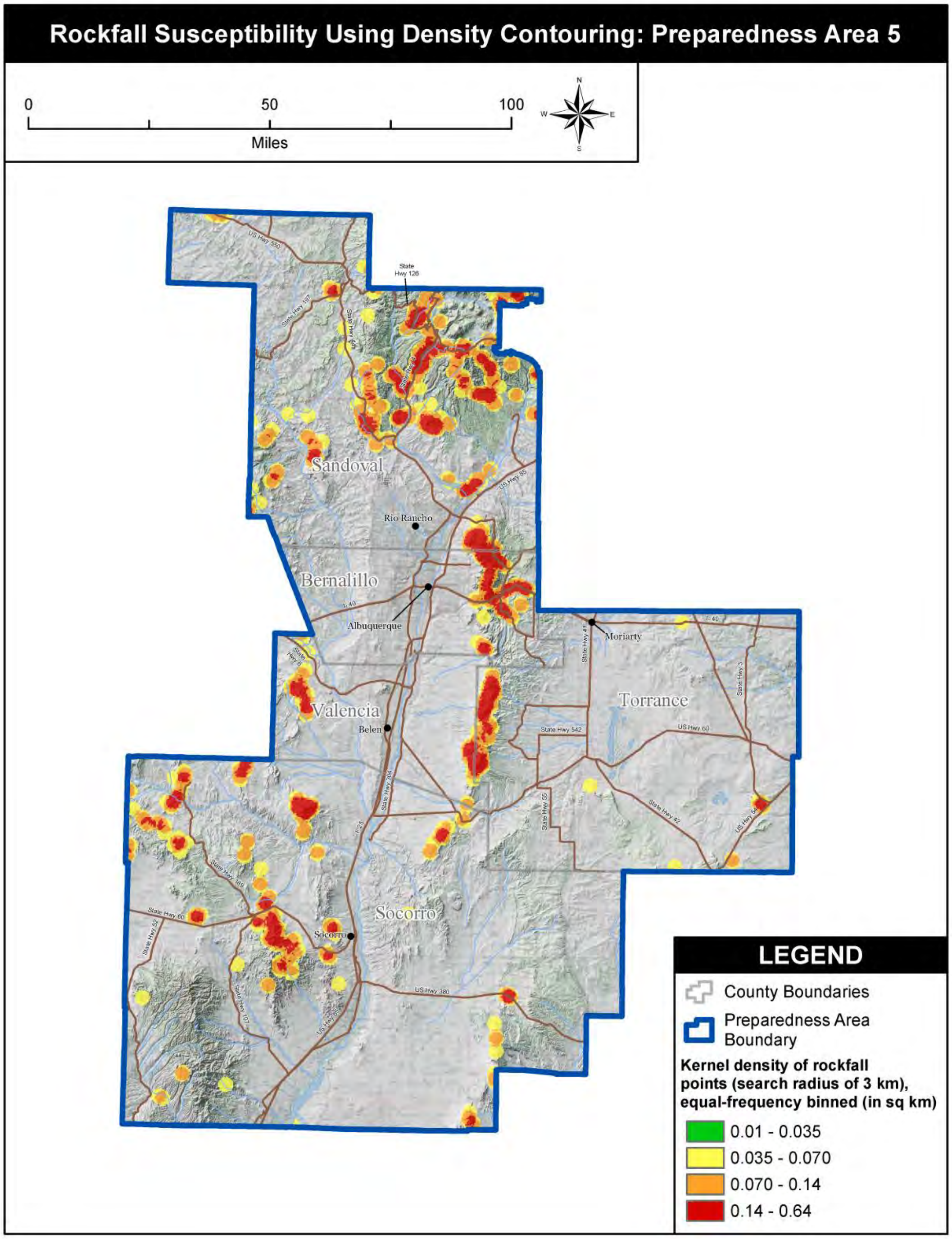


Figure 4-133 Densities of Previously Mapped Rockfalls in Preparedness Area 6

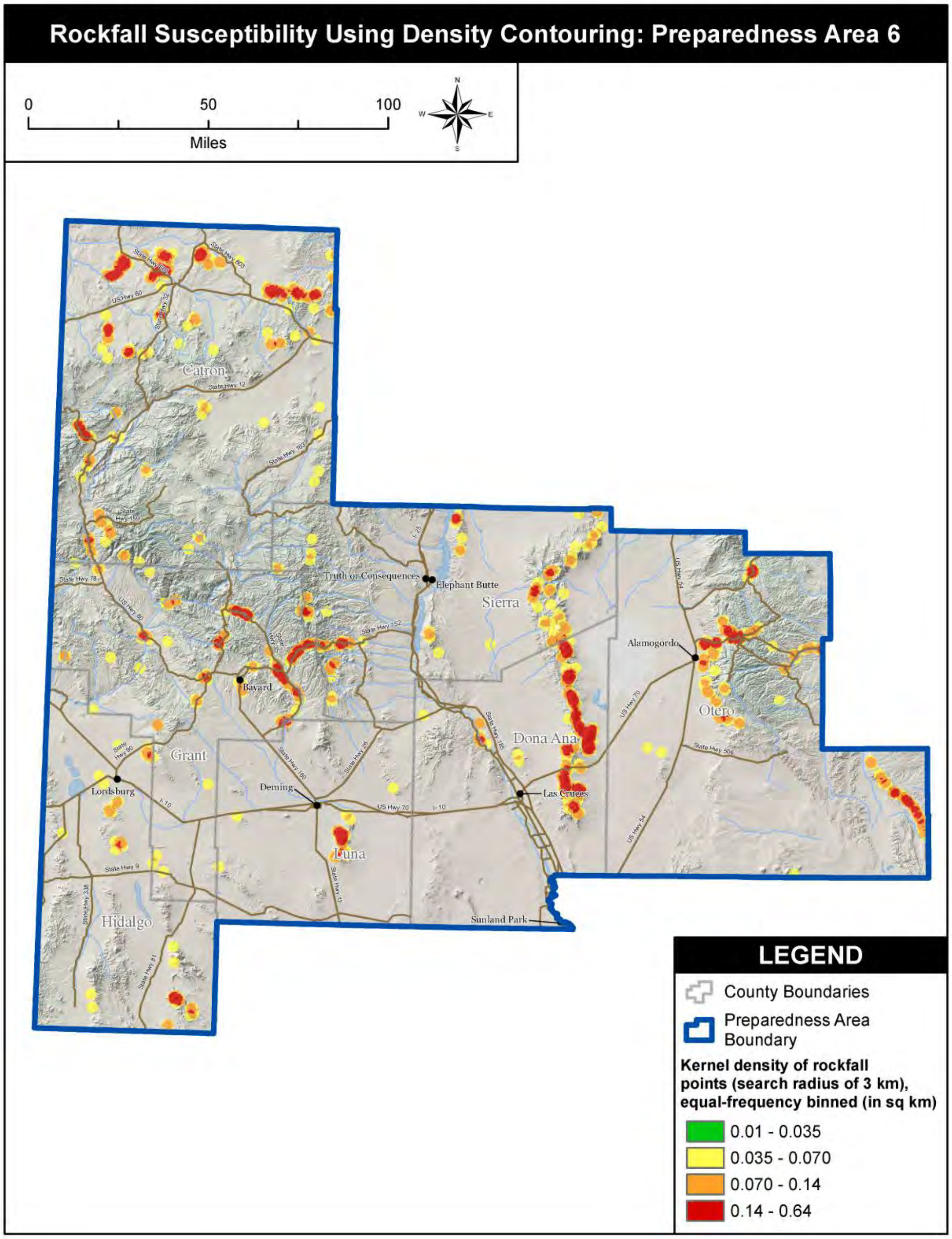


Figure 4-134 to Figure 4-140 (below) show rockfall susceptibility based on statistical analysis relating slope angle to previously mapped rockfalls.[105]

[105] Koning, D.J., and Mansell, M., 2017, Rockfall susceptibility maps for New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 595, 41 p. and 2 plates.

Figure 4-134 Rockfall Susceptibility using Slope Angle in New Mexico

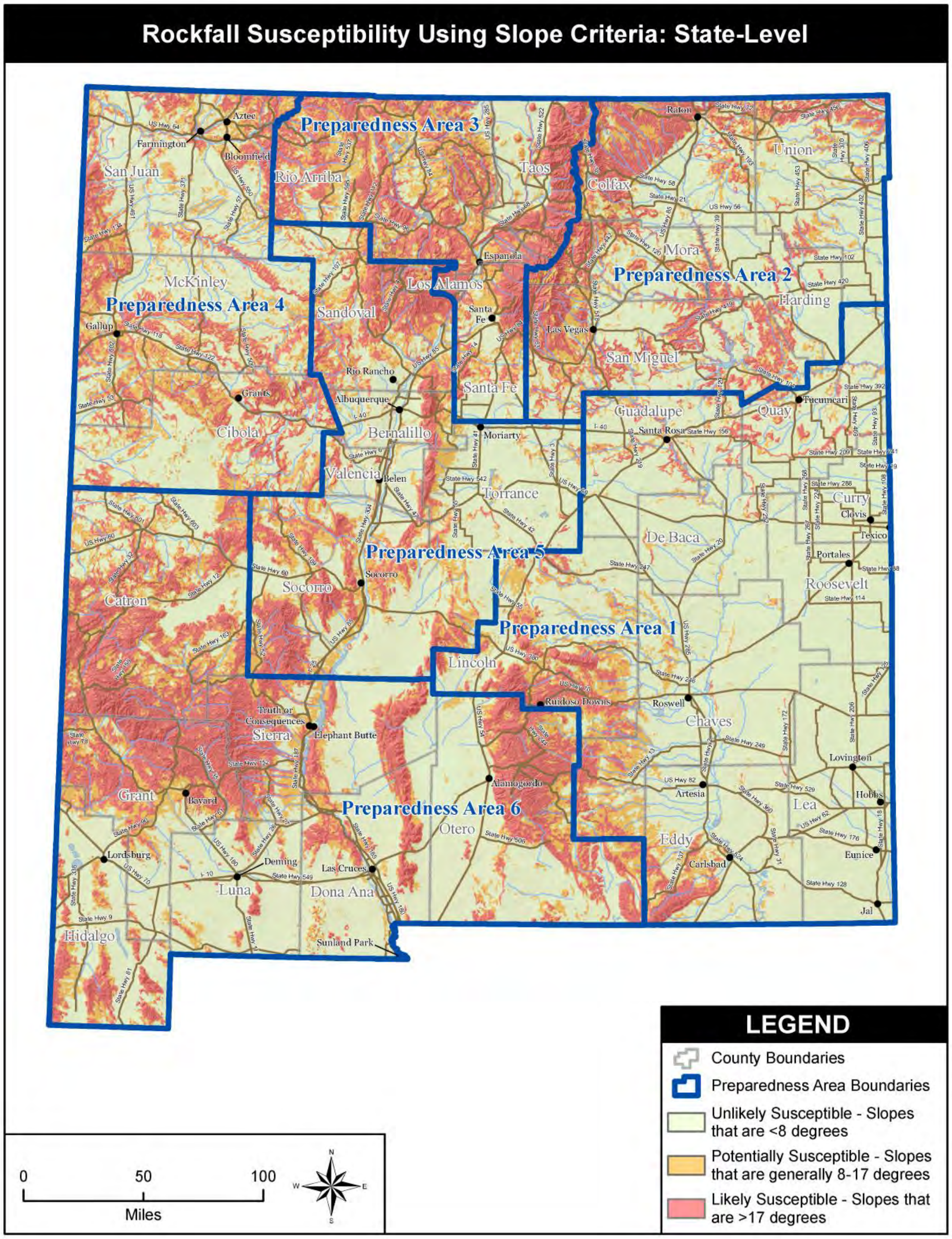


Figure 4-135 Rockfall Susceptibility using Slope Angle in Preparedness Area 1

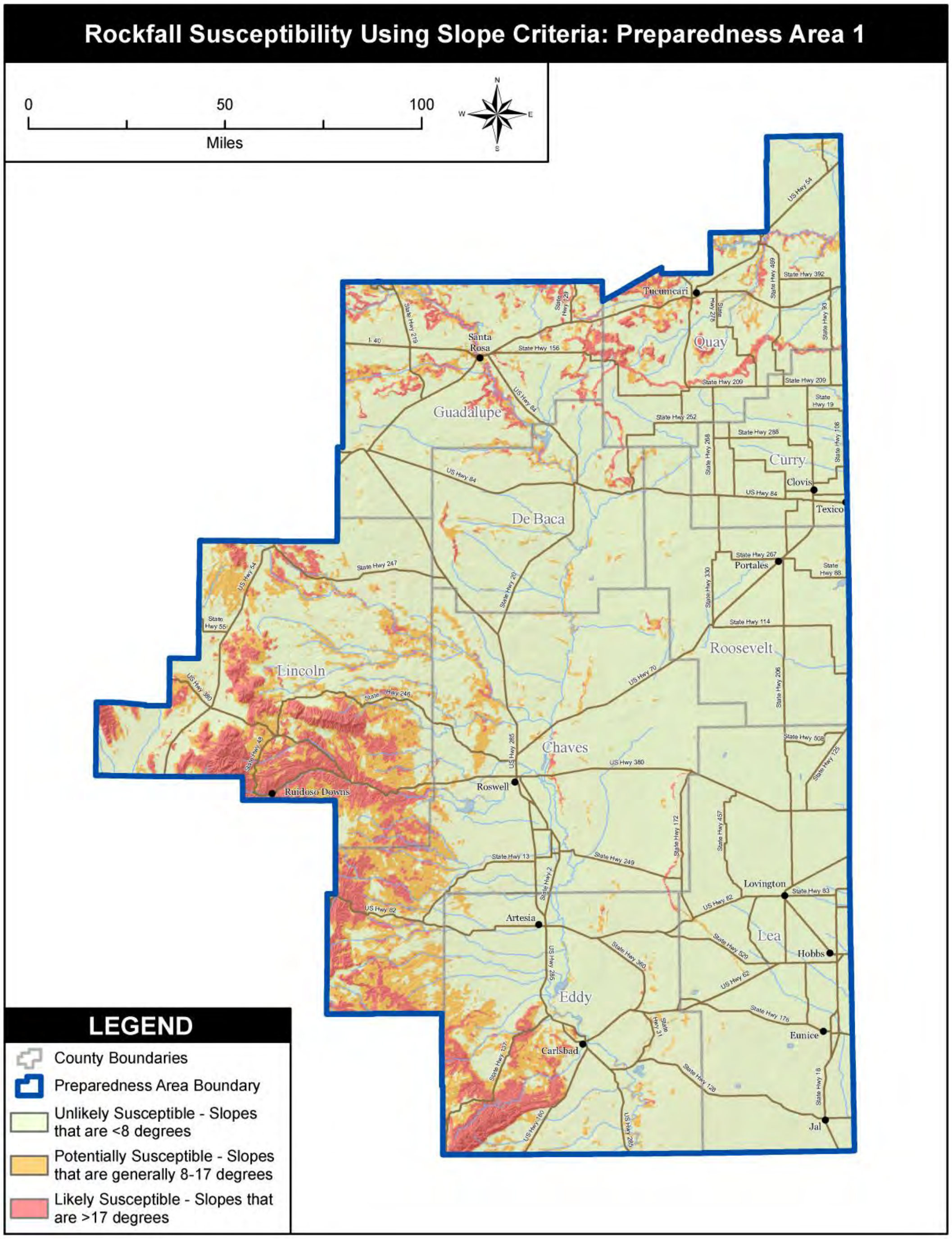


Figure 4-136 Rockfall Susceptibility using Slope Angle in Preparedness Area 2

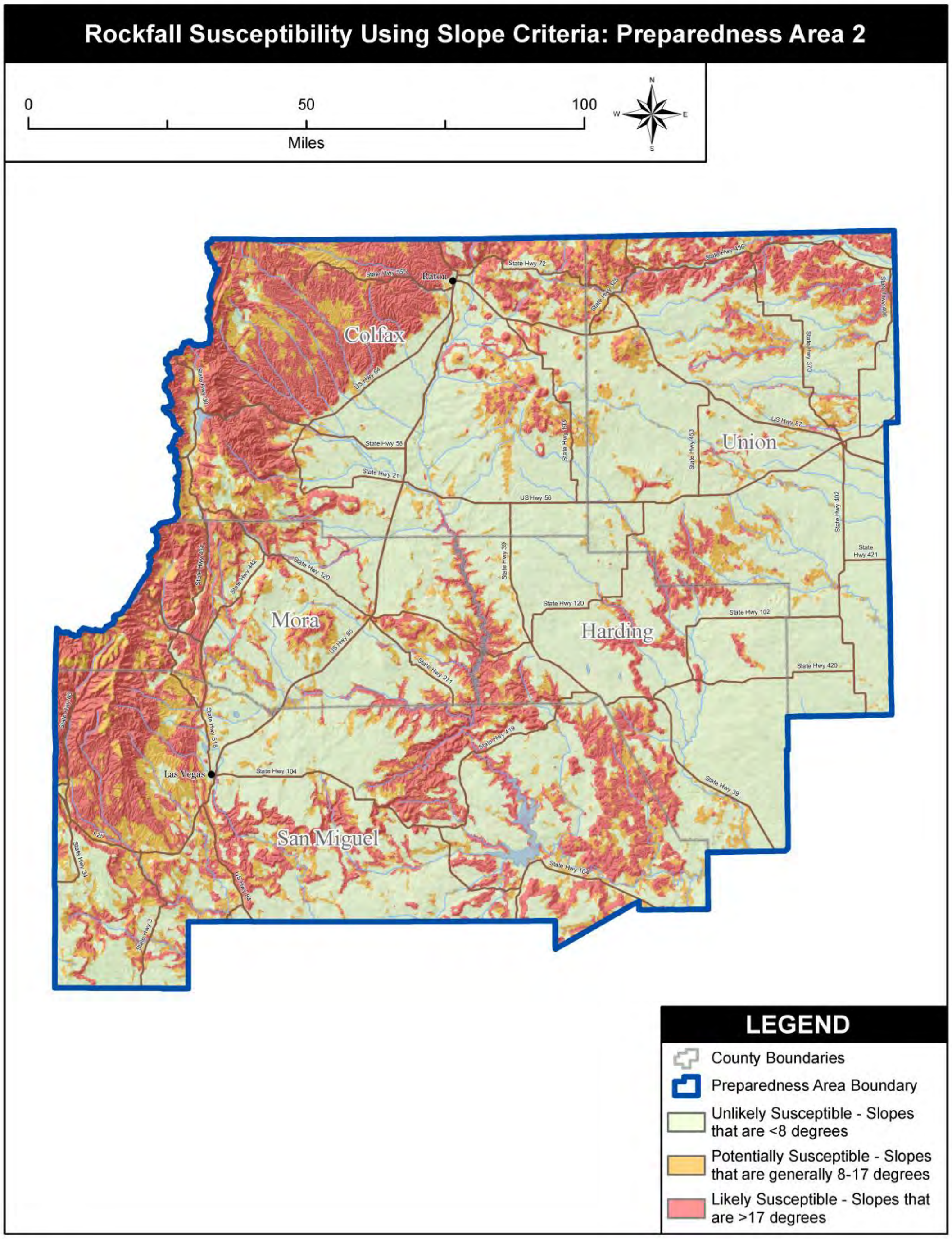


Figure 4-137 Rockfall Susceptibility using Slope Angle in Preparedness Area 3

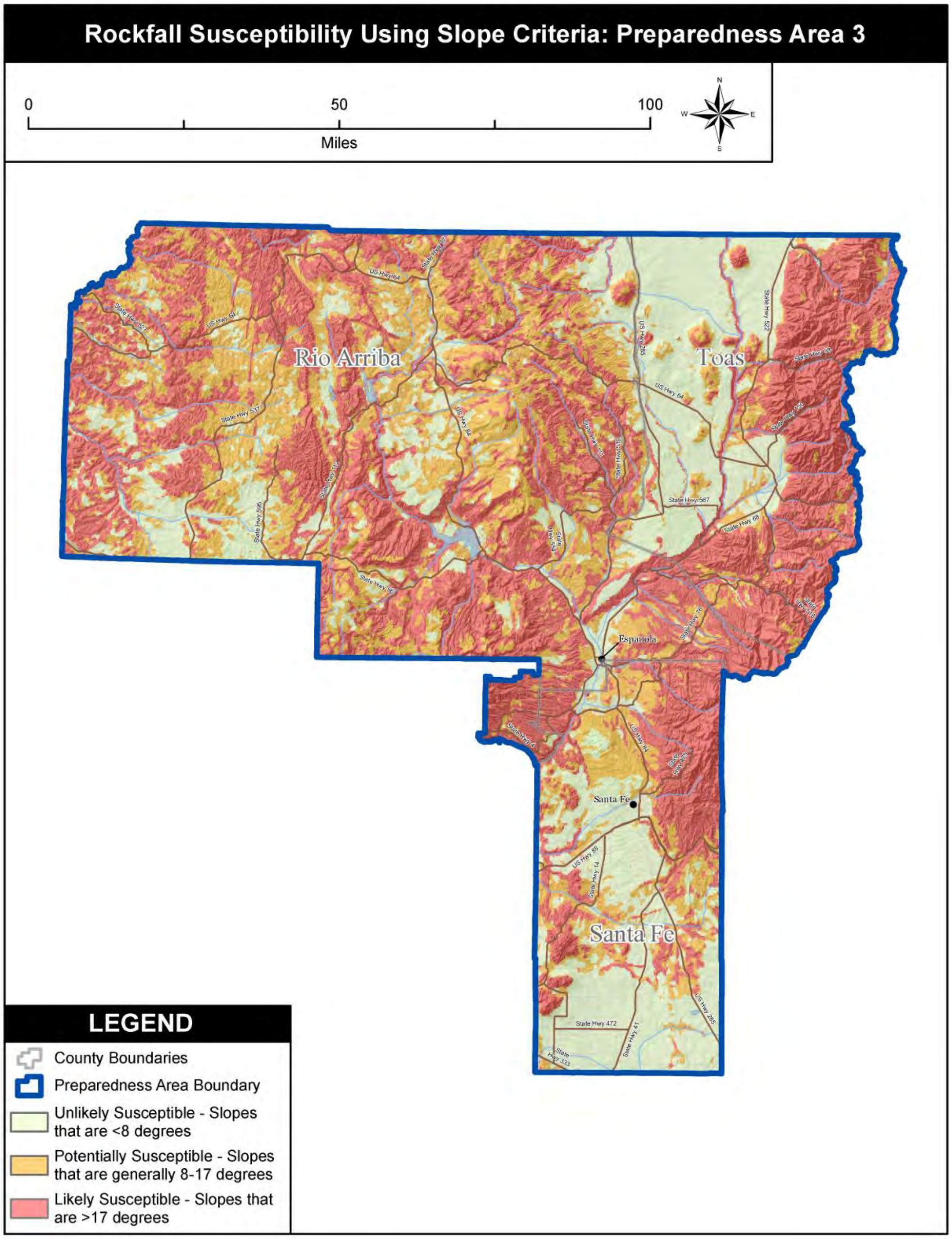


Figure 4-138 Rockfall Susceptibility using Slope Angle in Preparedness Area 4

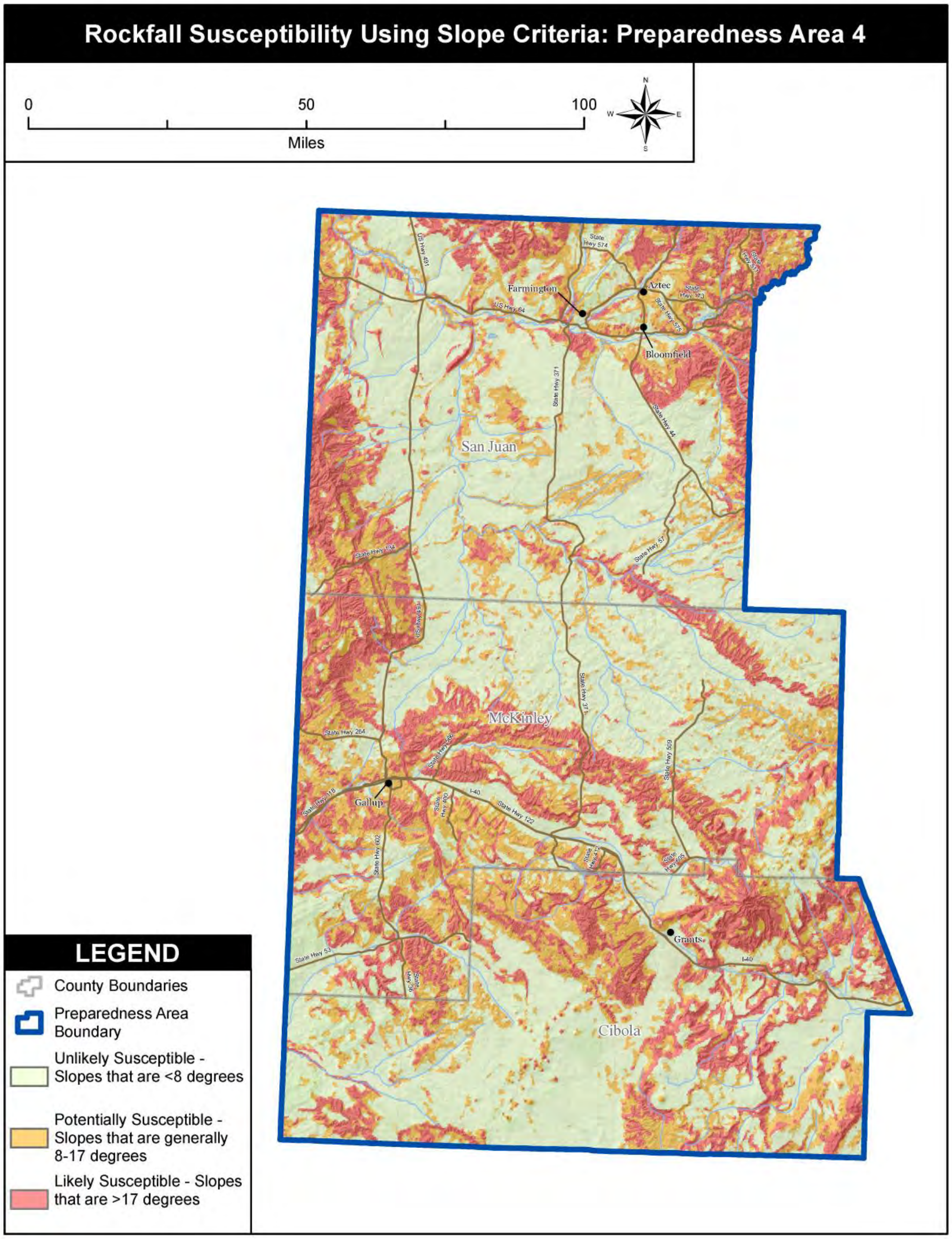


Figure 4-139 Rockfall Susceptibility using Slope Angle in Preparedness Area 5

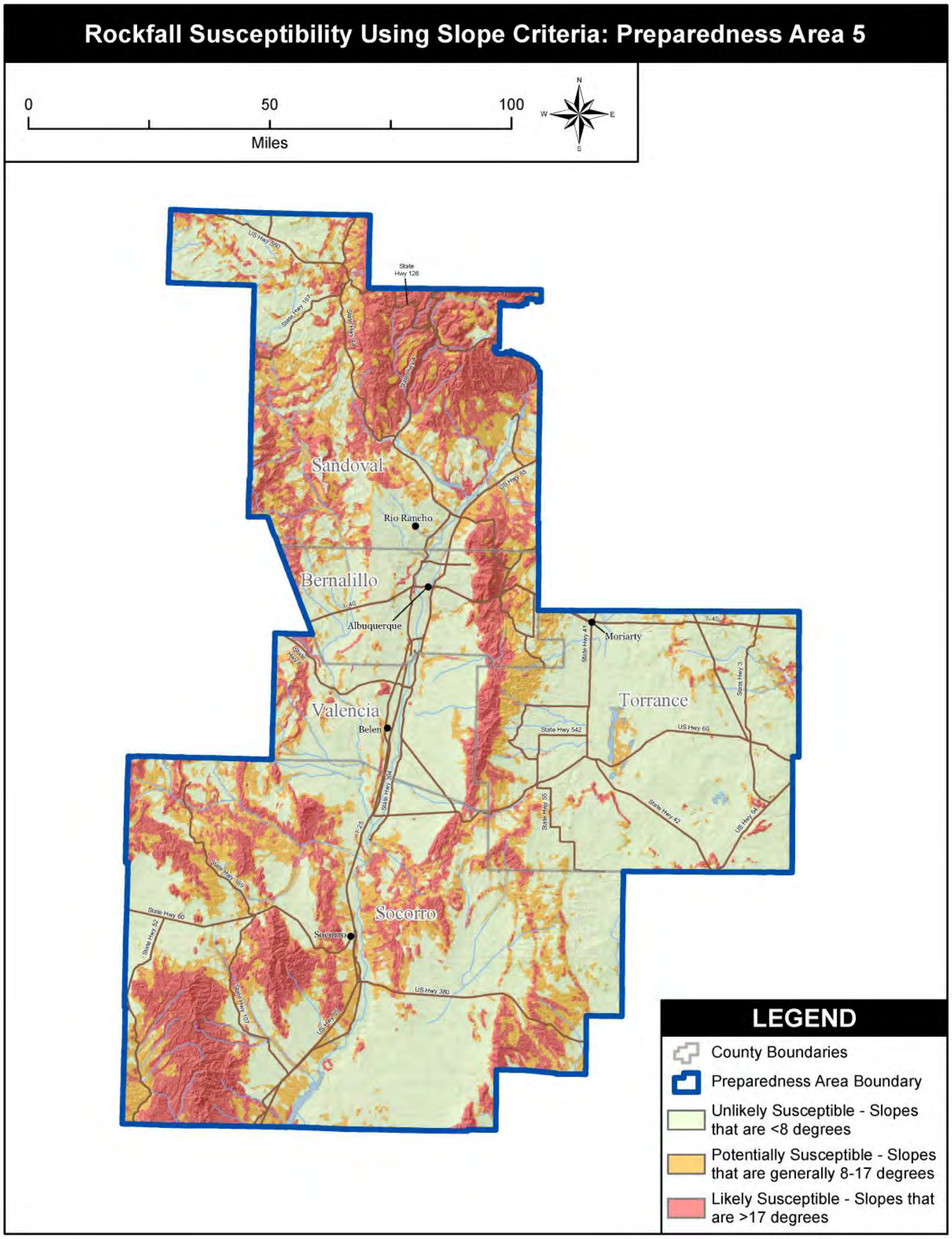
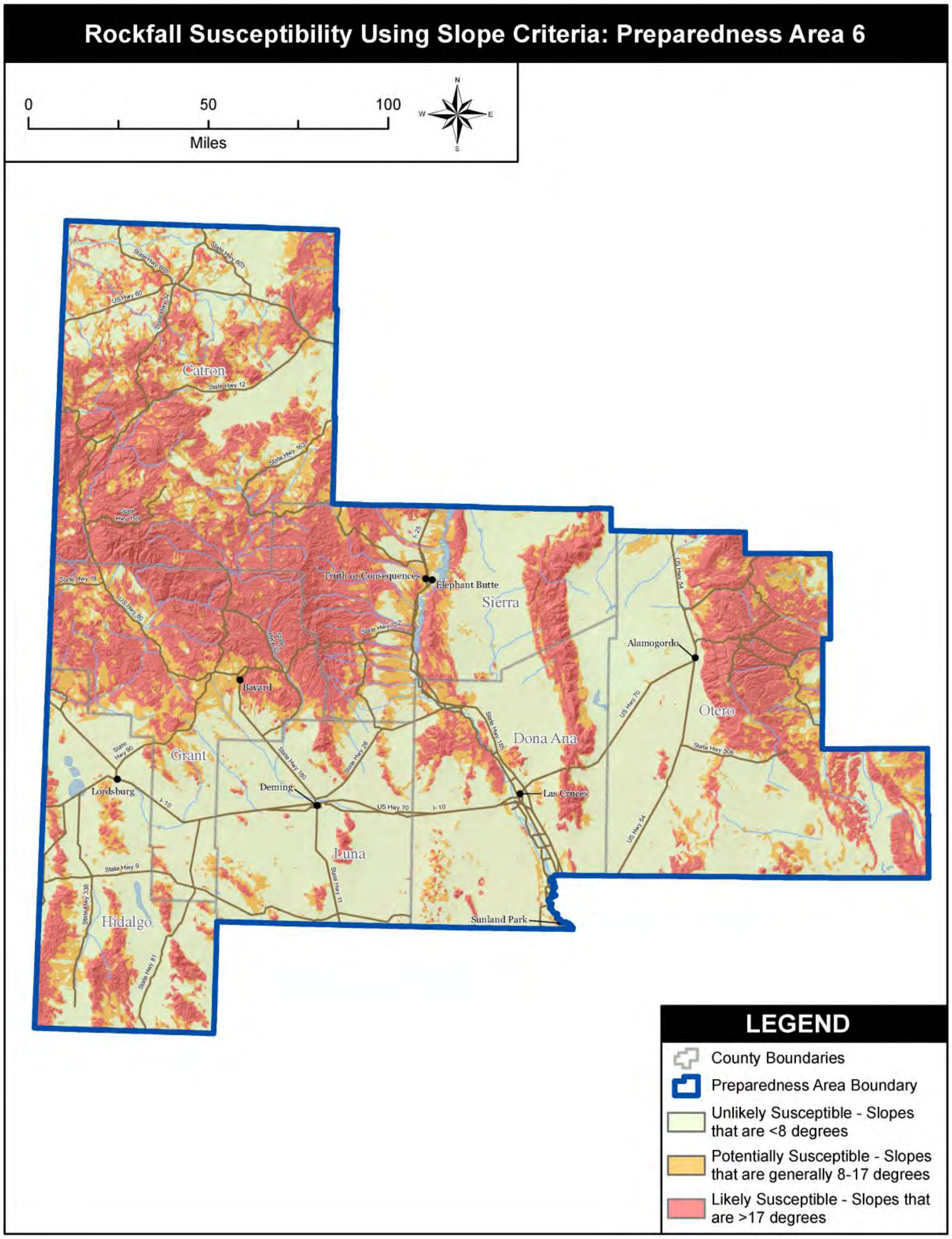


Figure 4-140 Rockfall Susceptibility using Slope Angle in Preparedness Area 6



Two series of maps are associated with deep-seated landslide hazard.[106] The first shows an inventory of deep-seated landslide mapping State-wide and by Preparedness Area (Figure 4-141 to Figure 4-147).[107]

[106] Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.

The second series shows deep-seated landslide susceptibility State-wide and by Preparedness Area (Figure 4-148-Figure 4-154). The susceptibility maps were constructed using the logistic regression method, which models landslide susceptibility by statistically correlating previously mapped landslides with various landscape features (such as slope steepness, rock type, and slope aspect).[108]

[107] The statewide inventory is from: Cardinali, M., Guzzetti, F., and Brabb, E.E., 1990, Preliminary maps showing landslide deposits and related features in New Mexico: U.S. Geological Survey, Open-file Report 90-293, scale 1:500,000. The original inventory was modified in many areas of the state to improve accuracy. Details of this modification and where it occurred is found in: Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.
[108] Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.

Figure 4-141 Deep-Seated Landslides in New Mexico

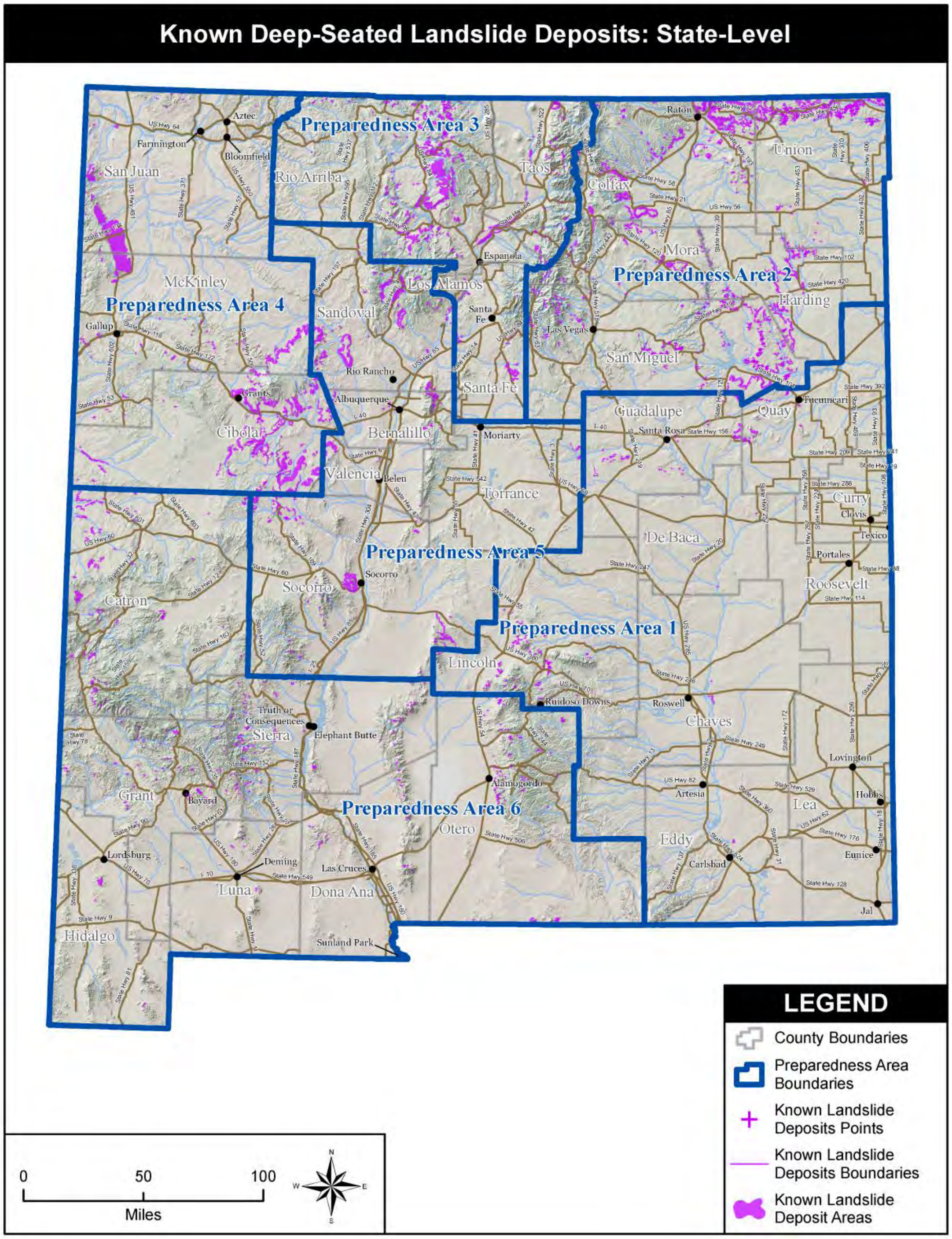


Figure 4-142 Deep-Seated Landslides in Preparedness Area 1

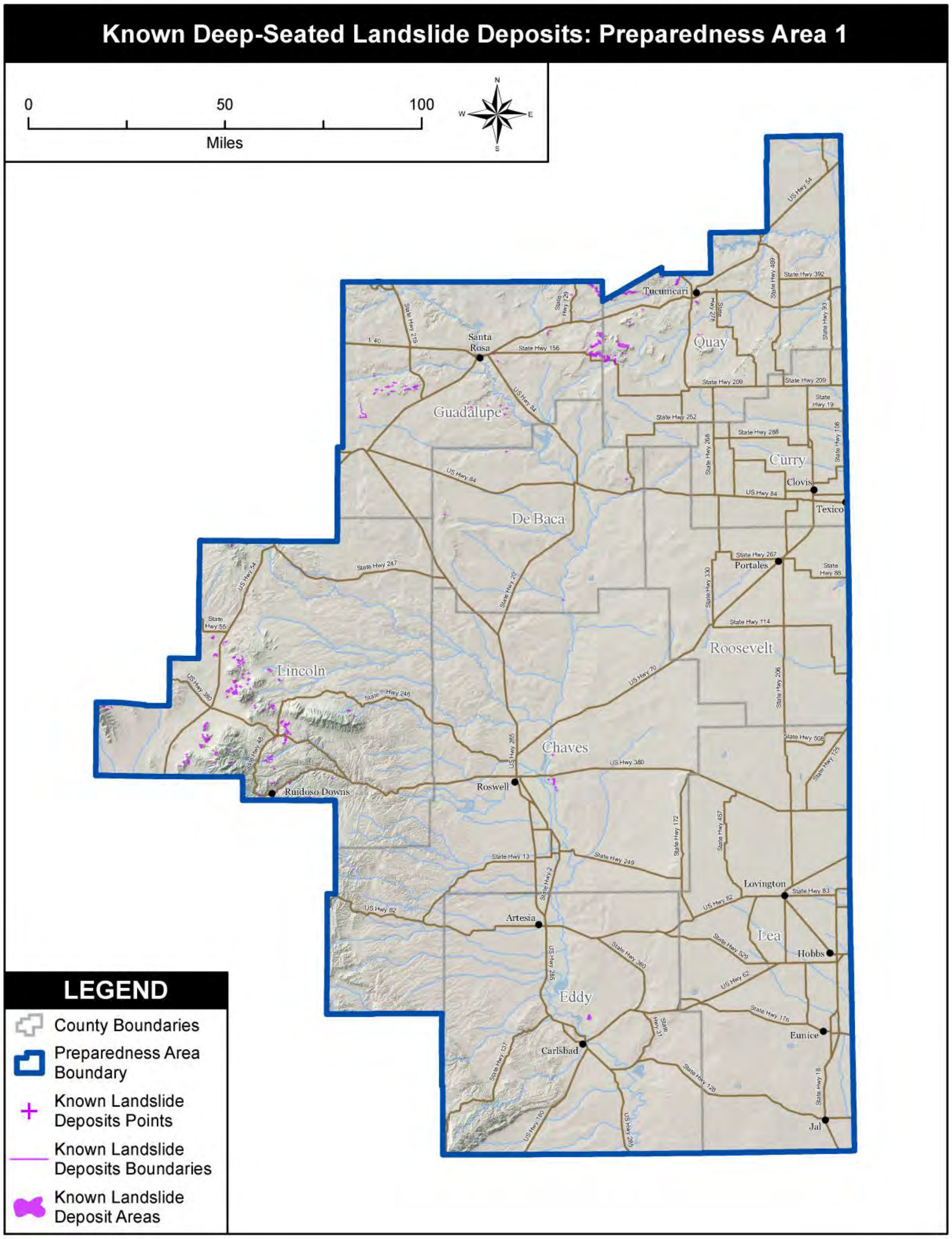


Figure 4-143 Deep-Seated Landslides in Preparedness Area 2

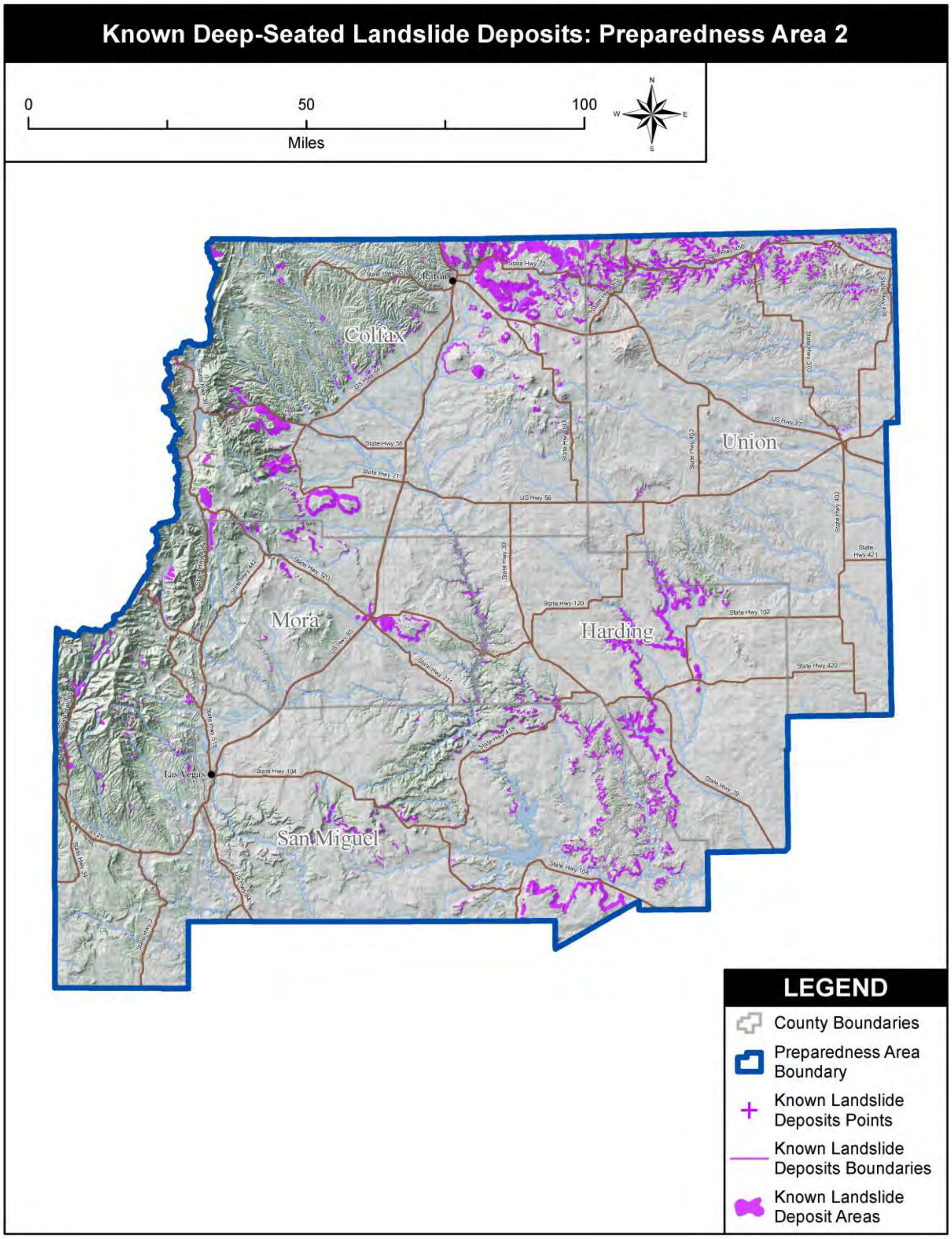


Figure 4-144 Deep-Seated Landslides in Preparedness Area 3

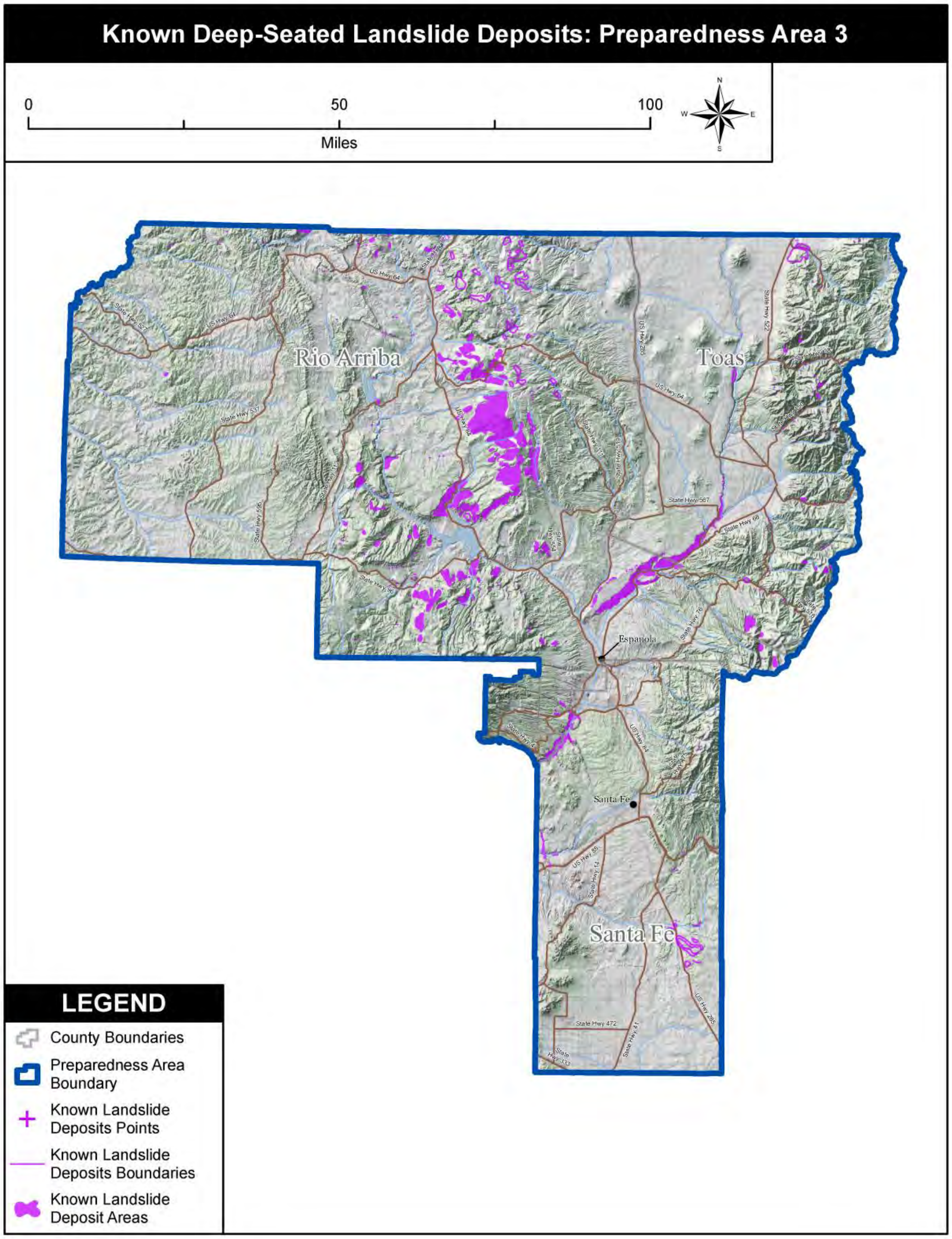


Figure 4-145 Deep-Seated Landslides in Preparedness Area 4

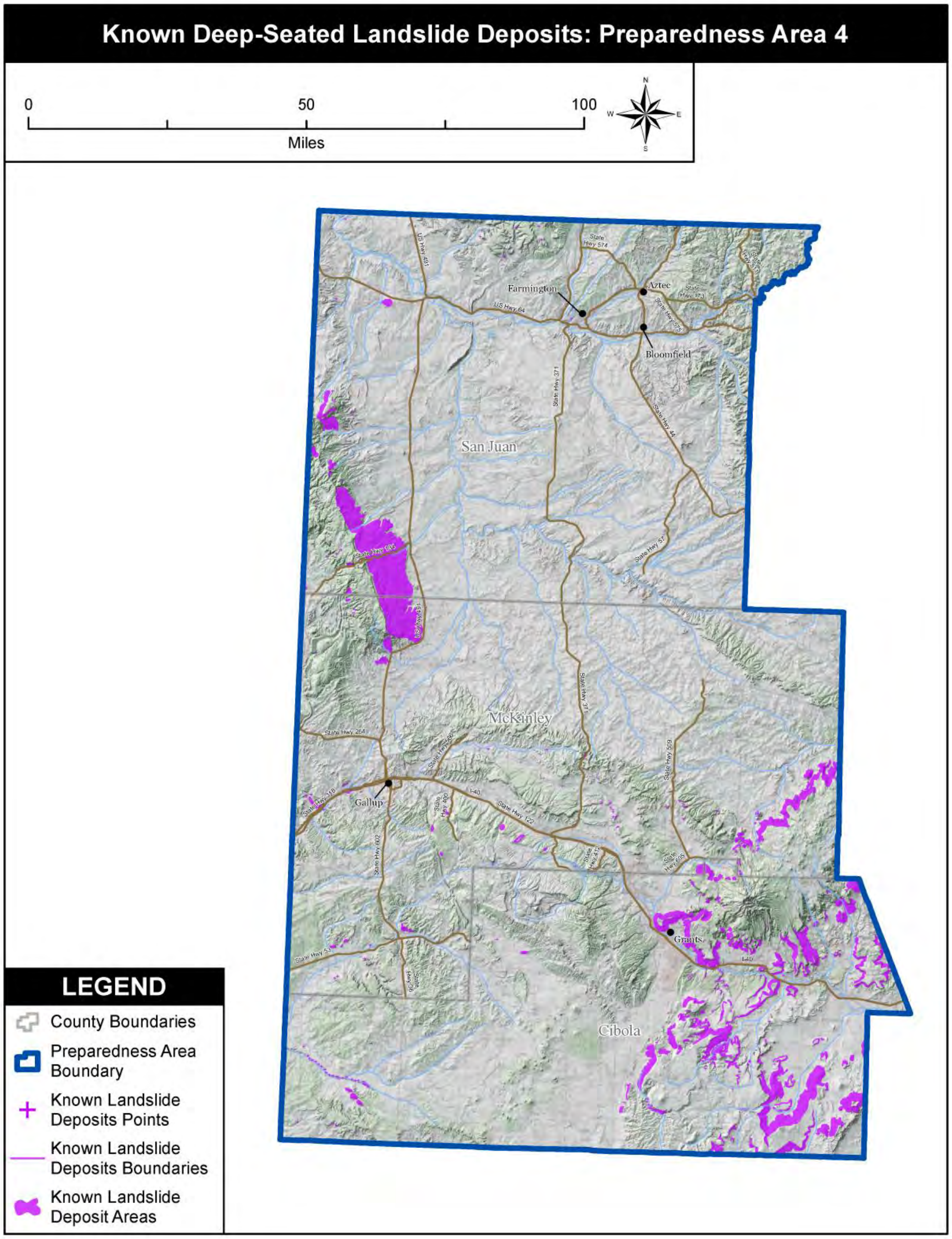


Figure 4-146 Deep-Seated Landslides in Preparedness Area 5

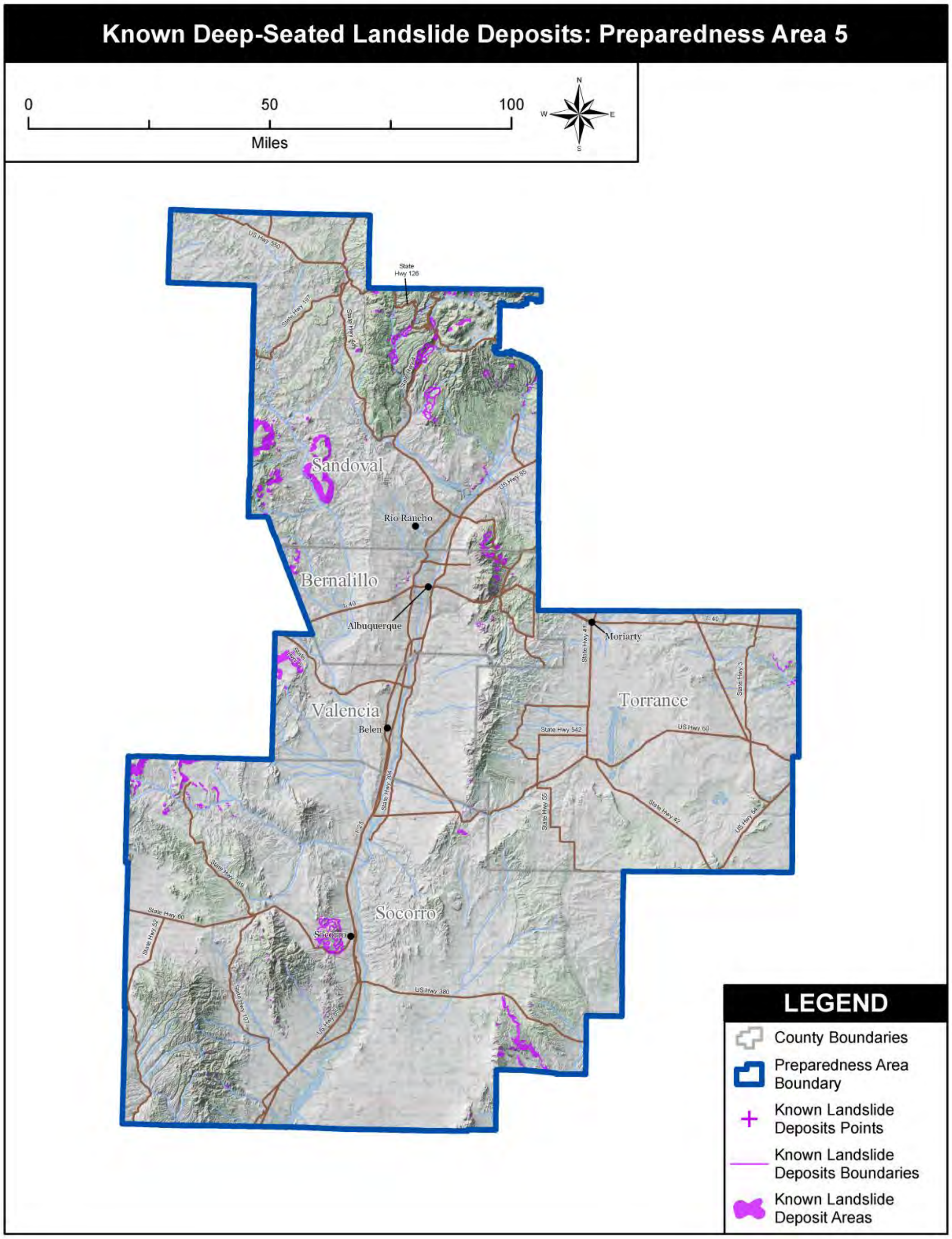


Figure 4-147 Deep-Seated Landslides in Preparedness Area 6

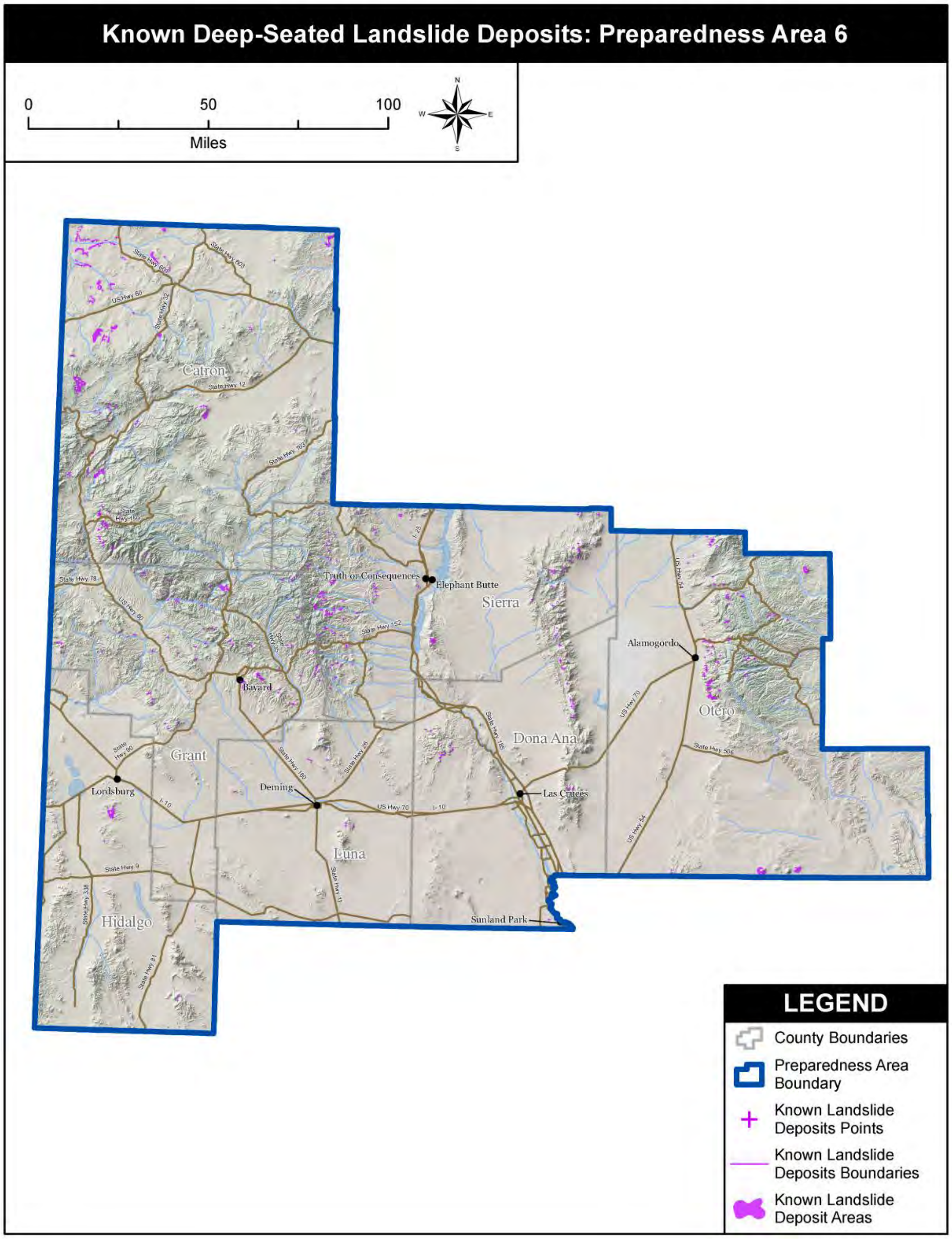
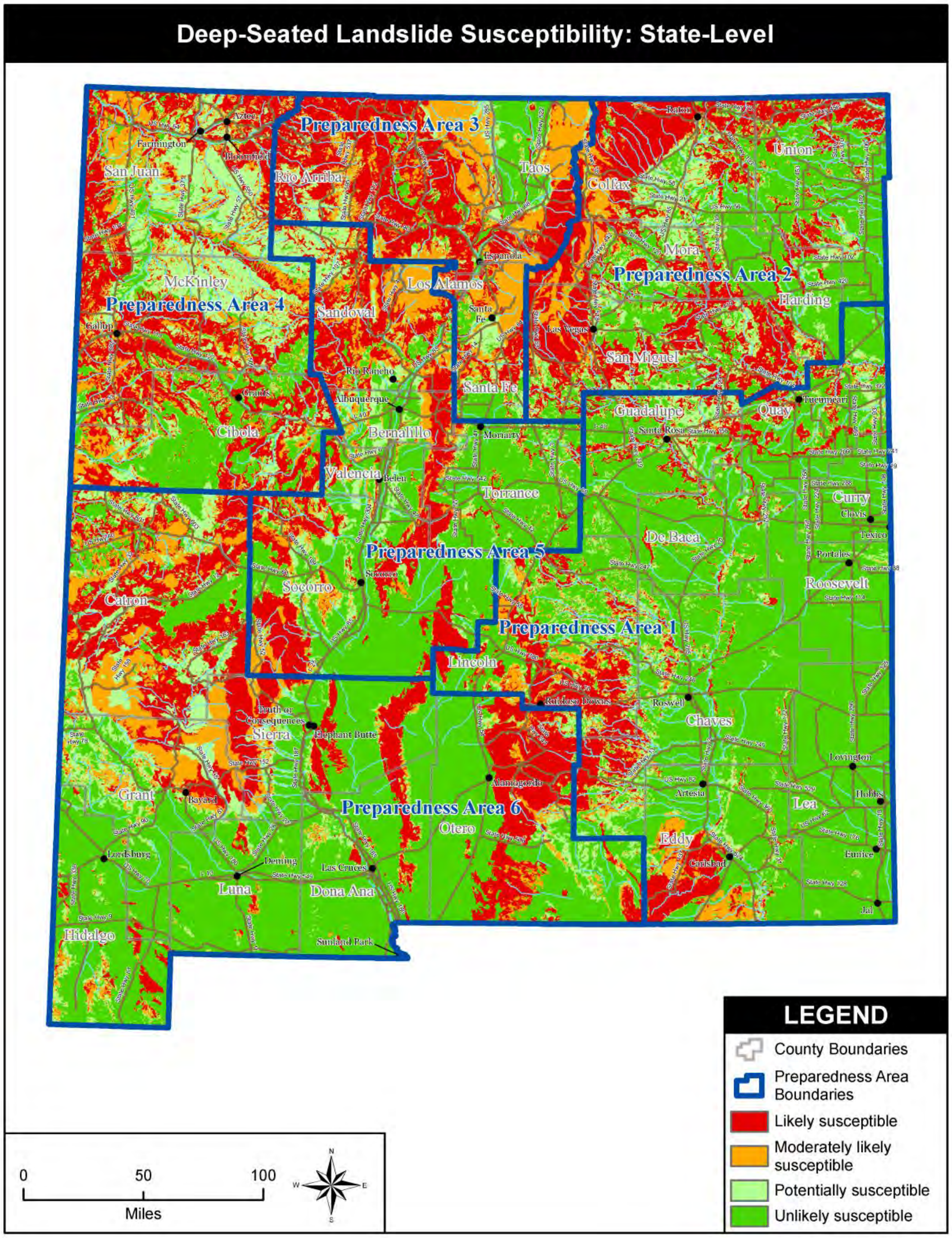


Figure 4-148 to Figure 4-154 shows deep-seated landslide susceptibility. Redder colors indicate areas with likely susceptibility. Slightly lesser susceptible areas are shown by orange colors. Green colors are only potentially susceptible or unlikely susceptible This map was created using the logistic regression method, with minor additional refinements. It was found that the most consistent controls on susceptibility were steep slopes and rock type.[109]

Figure 4-148 Deep-Seated Landslide Susceptibility in New Mexico



[109] Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.

Figure 4-149 Deep-Seated Landslide Susceptibility in Preparedness Area 1

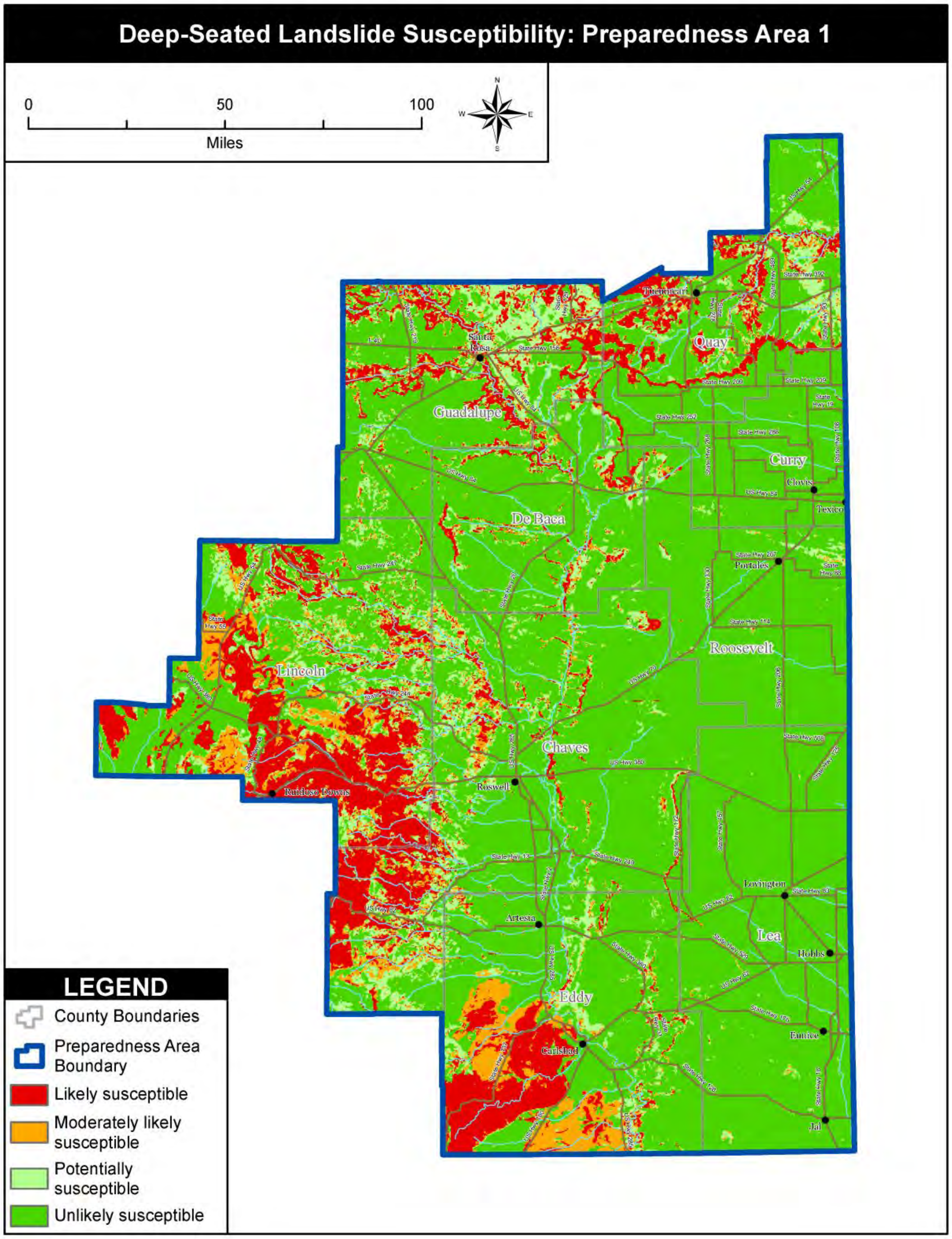


Figure 4-150 Deep-Seated Landslide Susceptibility in Preparedness Area 2

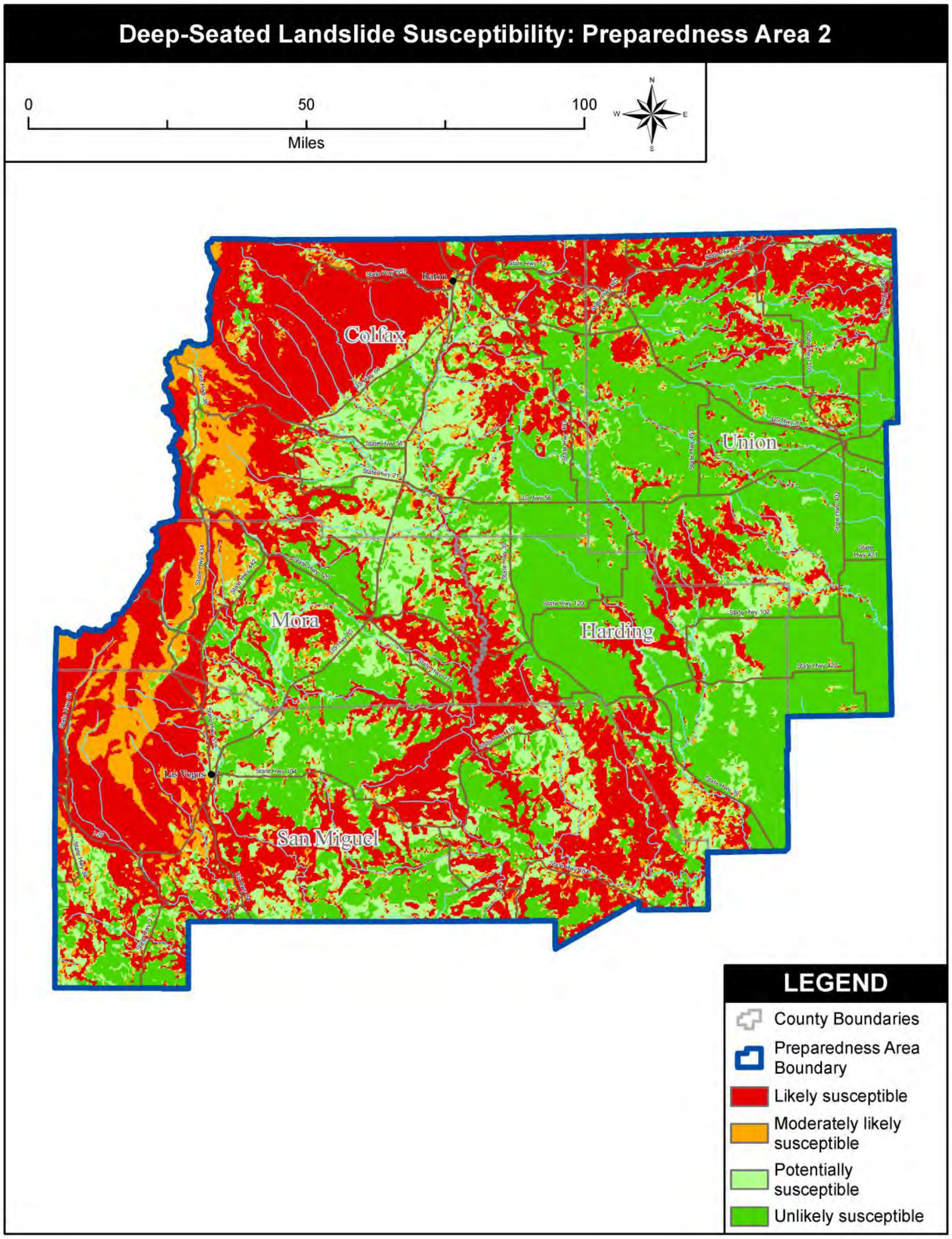


Figure 4-151 Deep-Seated Landslide Susceptibility in Preparedness Area 3

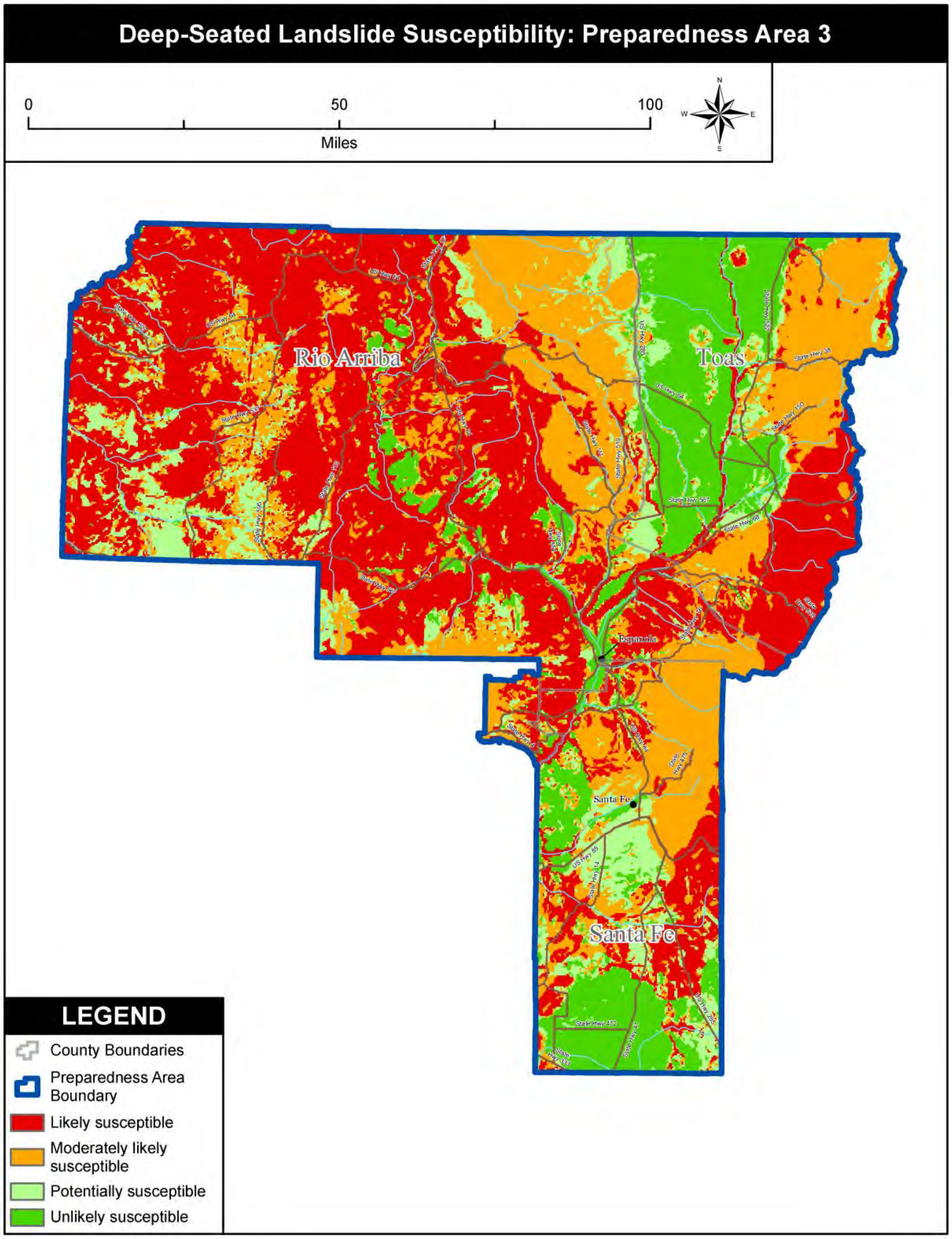


Figure 4-152 Deep-Seated Landslide Susceptibility in Preparedness Area 4

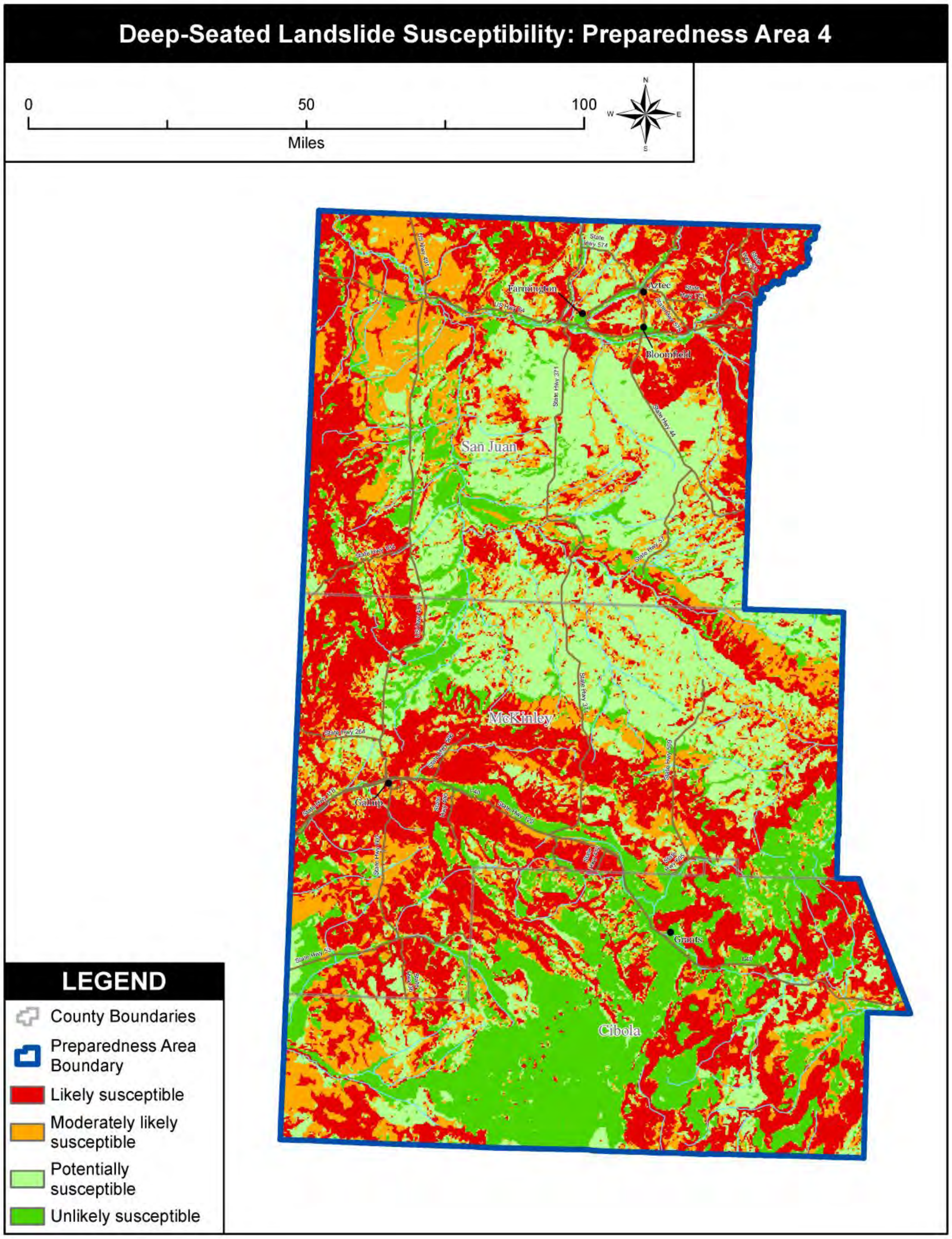


Figure 4-153 Deep-Seated Landslide Susceptibility in Preparedness Area 5

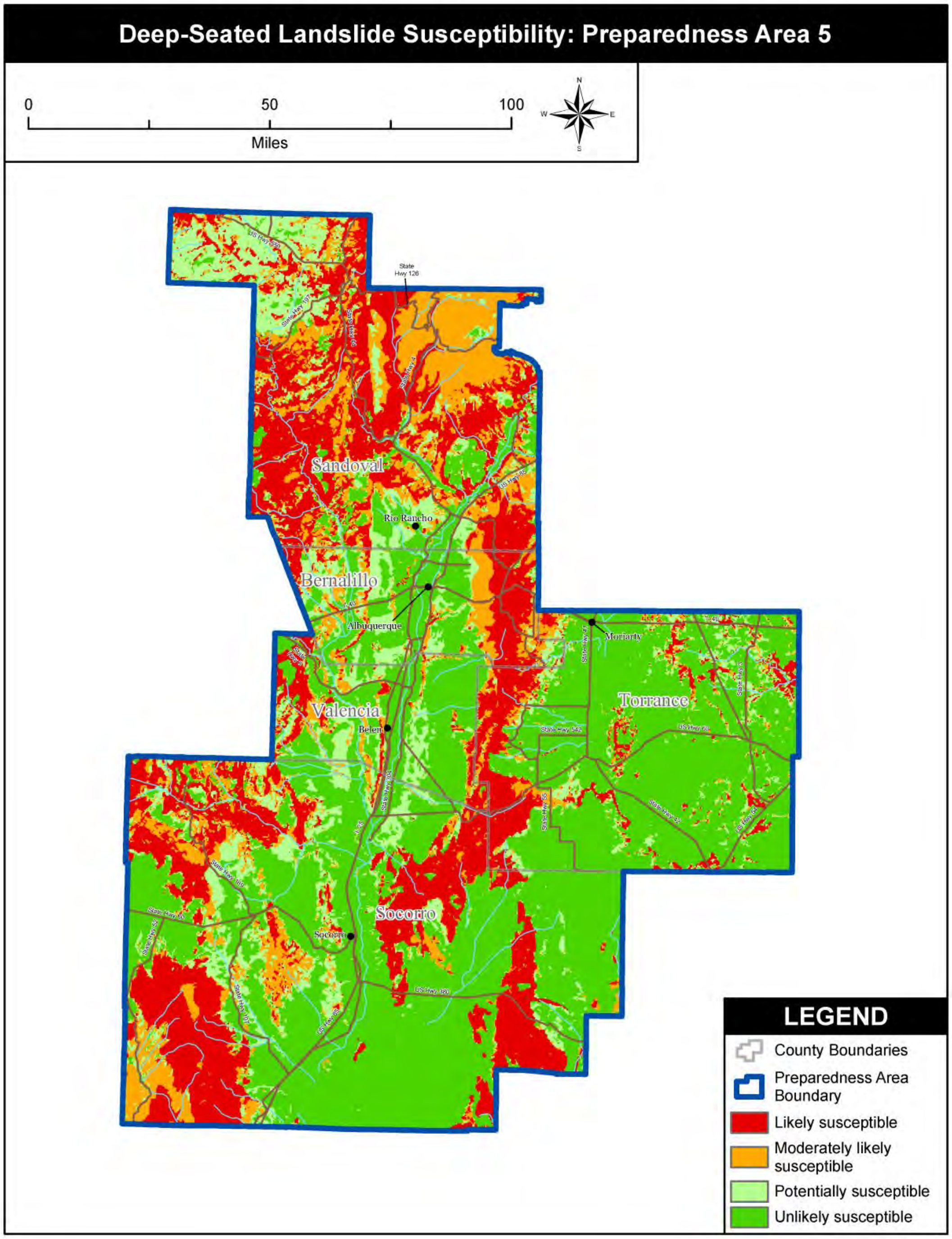
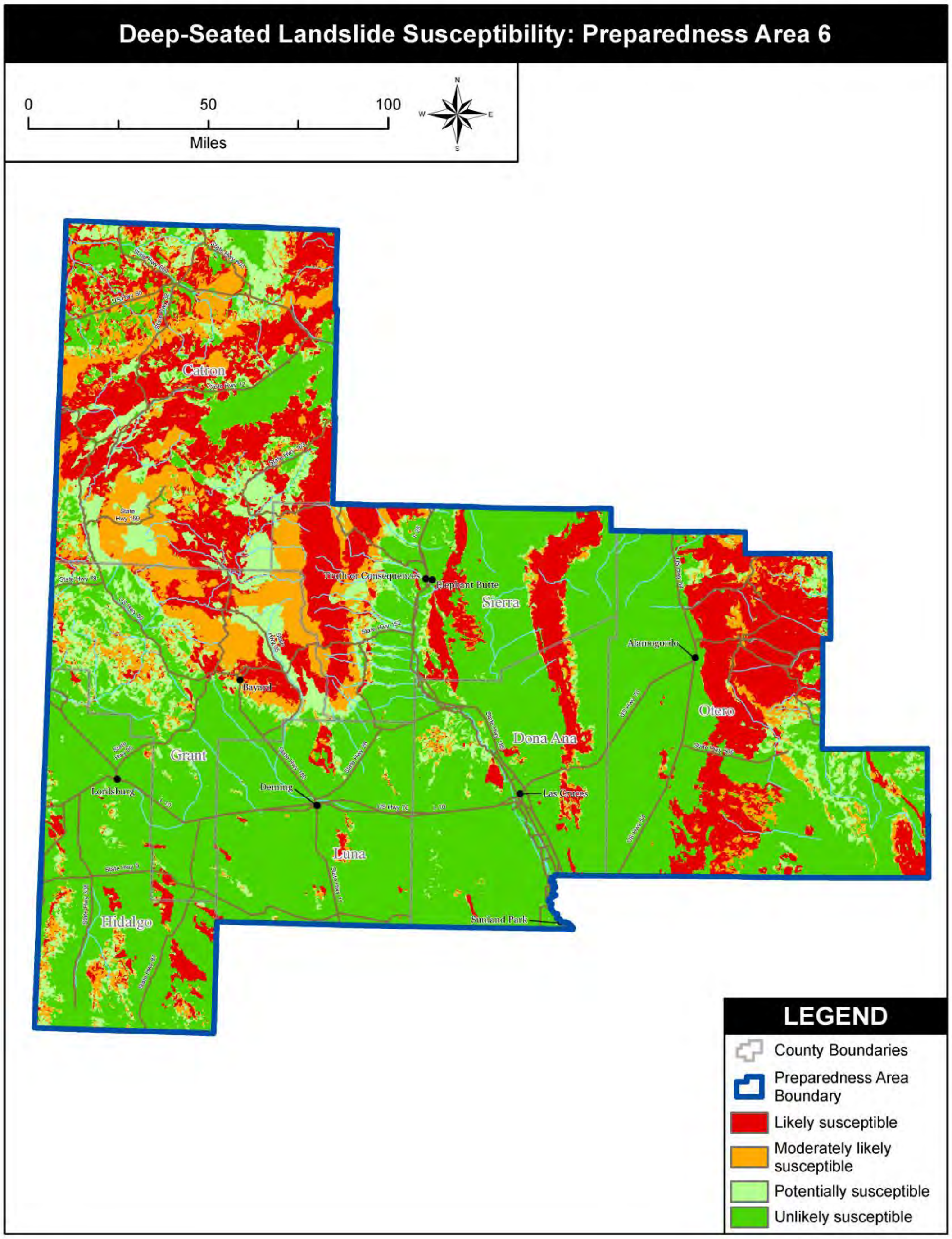


Figure 4-154 Deep-Seated Landslide Susceptibility in Preparedness Area 6



Collectively, these maps show where rockfall and deep-seated landslides could be expected to occur in the State -- denoted by "Likely susceptible" and "Moderately likely susceptible." These areas generally correspond with steep slopes; mountainous regions, canyon sides, and mesa flanks are mapped as having higher susceptibilities. However, there is some spatial variability in susceptibilities for deep-seated landslides due to rock type, even within a given mountain range.[110] For example, the east slope of the Sandia Mountains has a higher (more likely) susceptibility for deep-seated landsliding than the steeper western slope. This difference is attributable to rock type differences. The rock type underlying the eastern slope, consisting of Paleozoic sedimentary rocks, is better correlated to past landsliding events (using the logistic regression method) than the granite underlying the western slope. This same rock type also creates higher susceptibility areas in the Sangre de Cristo Range east of Taos and Santa Fe.[111]

4.5.8.2 *Previous Occurrences*

In referencing the NCDC, no previous occurrences are listed in the database. There is little information capturing previous landslide events in New Mexico, specifically at the Preparedness Area level. Data that has been captured is identified in Figure 4-155 and briefly explains those significant events that have occurred. Information is provided by local jurisdictions and DHSEM.

Figure 4-155 Significant Past Occurrence - Landslide

Date	Location	Significant Event
July 8, 2015	Highway 38, west of Red River (Taos County) (Preparedness Area 3)	A mudslide covered State Highway 38 after heavy rain and hail ripped through the area. The New Mexico Department of Transportation closed the road for cleanup crews to clear the mud and boulders.

110 Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.
111 Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.

Date	Location	Significant Event
September 9, 2013	Chaves, Guadalupe, and Eddy County (Preparedness Area 1 Colfax, San Miguel, and Mora County (Preparedness Area 2 Los Alamos and Santa Fe County (Preparedness Area 3) Cibola County, McKinley County (Preparedness Area 4) Sandoval, Socorro, and Torrance County (Preparedness Area 5) Catron and Sierra County (Preparedness Area 6)	A Major Disaster Declaration was issued on October 29, 2013 for DR-4152, New Mexico Severe Storms, Flooding, and Mudslides. The Severe Storms, Flooding, and Mudslides took place September 9 through September 13, 2013, damaging public facilities and roads in 14 New Mexico counties.
January 15, 2013	Guadalupe Mesa (Sandoval County) (Preparedness Area 5)	Thousands of tons of rock (12,000-13,000 cubic yards) fell down the east face of Guadalupe Mesa leaving boulders displaced and a dust slope. A 30-foot thick and 150-foot high slab of rock broke loose. Some residents were awakened by the avalanche and there was a blanket of dust covering everything. No damage was reported in the article. Source: Jemez Thunder, Volume 19, No. 418, February 1, 2013

Date	Location	Significant Event
July 23, 2010	Magdalena Mountains (Socorro County) (Preparedness Area 5)	Heavy rain triggered a mudslide in the Magdalena Mountains blocking a road and isolating researchers at a key New Mexico science facility. The landslide isolated the Langmuir Laboratory for Atmospheric Research located high on 10,700-foot South Baldy Peak. Five New Mexico Institute of Mining and Technology scientists and two technicians were working at the facility whose primary mission is to study thunderstorms. It wasn't long after the storm started that dirt and large boulders tumbled down the mountain sprawling over the only access road. Five members of the lab crew abandoned their vehicles and were picked up by a four-wheel-drive vehicle that took them to safety. The other two walked down part of the mountain to a four-wheel-drive vehicle that also took them to safety. No one was hurt in the landslide.
April 10, 2007	San Juan County (Preparedness Area 4)	The Farmers Mutual Ditch suffered a complete obstruction of the main canal due to a landslide for a length of approximately 300 yards in San Juan County. In this area, the canal runs along the north side of the San Juan River and below a cliff face. The Navajo Nation owns the land on the south side of the river, and their property line is defined as the middle of the river. (BLM owns the land on the north side.) Both up- or down-stream is a wetland and is the home of at least two Threatened or Endangered Species. This water system is quite large and services several communities with irrigation and drinking water. The complexity and severity of the event lead to a State Disaster Declaration The total cost of this landslide event is $263,408.
July 15, 2008	Gallup, NM (Preparedness Area 4)	A rockslide crushed three people in a homeless camp outside of Gallup, NM. One female and two male bodies were recovered after they were found trapped under a roughly 12-foot-wide boulder. Heavy rain had hampered recovery efforts. Gallup police Lt. Rick White says the rock slide might have happened during a rainstorm.
September 1998	Taos, NM (Taos County) (Preparedness Area 3)	A falling boulder (270,000 kg) struck a bus, killed five people, and injured 14, along HWY 68. The boulder left a 5x5x14 meter crater in the highway. The highway was closed for 19 hours and clean-up costs were approximately $75,000.

Date	Location	Significant Event
September 1991	De Baca County (Preparedness Area 1)	In De Baca County, a rockslide occurred that damaged a ranch road and buckled buried PVC pipes.
June 1977	Taos, NM (Taos County) (Preparedness Area 3)	A landslide event caused $50,000 in property damage.

Declared Disasters from Landslide

There has been one State and one Federally declared disaster for Landslide between 2012 and 2017 (Figure 4-156). According to FEMA, DR-4152 was declared on October 29, 2013 for the New Mexico Severe Storms, Flooding, and Mudslides that occurred between September 09, 2013 and September 22, 2013. The Public Assistance Dollars Approved and Obligated was $41,435,522.02 which was split between Emergency Work (Categories A-B) of $13,096,232.75, and Permanent Work (Categories C-G) of $27,002,216.27. The Executive Order in support of DR 4152 is Executive Order 016-034. Executive Order 07-021 is for a State 2007 landslide disaster in the amount of $291,137.

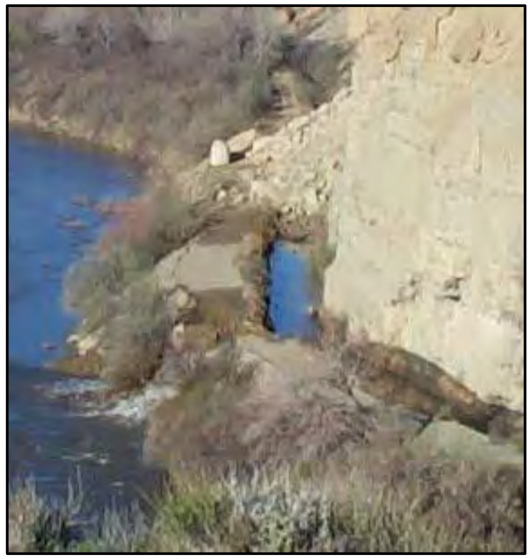
Figure 4-156 New Mexico Landslide Disaster Declarations (2003 – 2017)

Event Type	Disaster Declaration	Dollar Loss
Mudslide	DR-4152	$41,435,522.02
Landslide	016-034	$225,000.00
Landslide	07-021	$291,137.00
Total	**3**	**$41,951,659.02**

Figure 4-157 shows two photos from the State landslide disaster at Farmers Mutual Ditch in San Juan County on April 10, 2007.[112]

[112] Source: Bill Ewing, DHSES

Figure 4-157 Landslide Occurrence at Farmers Mutual Ditch in Preparedness Area 4



Additionally, news reports show that a mudslide covered State Highway 38 on July 8, 2015 west of Red River. Figure 4-158 shows the mudslide covering Highway 38.[113]

Figure 4-158 Mudslide Occurrence on Highway 38 in Preparedness Area 3

Another source of landslide damage information is from the NCDC. Below is a tally of landslide damage as reported by NCDC broken out by Preparedness Area. According to NCDC from 1997 through December 2017, State-wide property damage from landslide damage was $388,408 and no crop damage was reported. Figure 4-159 provides a cumulative overview of all landslide events that have occurred in all Preparedness Areas.

[113] Source: http://www.taosnews.com/stories/mudslide-closes-nm-38-july-8,31039

Figure 4-159 Preparedness Areas 1 - 6 Landslide History (June 1997 – December 2017) [114]

Preparedness Area 1
Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	1	0	0	0	$0	$0
Total	**1**	**0**	**0**	**0**	**$0**	**$0**

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	0	0	0	0	$0	$0
Total	**0**	**0**	**0**	**0**	**$0**	**$0**

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	2	0	0	0	$125,000	$0
Total	**2**	**0**	**0**	**0**	**$125,000**	**$0**

[114] Source: DHSEM and local jurisdictions.

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	3	0	3	0	$263,408	$0
Total	**3**	**0**	**3**	**0**	**$263,408**	**$0**

Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	1	0	0	0	$0	$0
Total	**1**	**0**	**0**	**0**	**$0**	**$0**

Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	0	0	0	0	$0	$0
Total	**0**	**0**	**0**	**0**	**$0**	**$0**

4.5.8.3 *Frequency*

The frequency of landslides in New Mexico is low based on previous occurrences. An issue for consideration is unreported landslide events that may occur in unpopulated areas.

4.5.8.4 *Probability of Occurrence*

Landslides can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. To determine the probability of each Preparedness Area experiencing future landslide occurrences, the probability or chance of occurrence was calculated based on historical data provided by local authorities. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. Figure 4-160 provides the probability of each Preparedness Area experiencing a landslide event.

Figure 4-160 Probability of Annual Occurrence of Landslide

Probability of Occurrence	
Preparedness Area	**Landslide**
Preparedness Area 1	3%
Preparedness Area 2	0%
Preparedness Area 3	7%
Preparedness Area 4	7%
Preparedness Area 5	3%
Preparedness Area 6	0%

One concern that is under review is landslides following a wildfire. In June 2011, the Track Fire burned 113 square kilometers in Colfax County, northeastern New Mexico, and Las Animas County, southeastern Colorado, including the upper watersheds of Chicorica and Raton Creeks. The burned landscape is now at risk of damage from post wildfire erosion that may be accompanied by debris flows and flash floods.

A report by the USGS presents a preliminary hazard assessment of the debris-flow potential from basins burned by the Track Fire. A pair of empirical hazard-assessment models developed using data from recently burned basins throughout the intermountain western United States were used to estimate the probability of debris-flow occurrence and volume of debris flows at the outlets of selected drainage basins within the burned area. The models incorporate measures of burn severity, topography, soils, and storm rainfall to estimate the probability and volume of post-fire debris flows following the fire.

In response to a design storm of 38 millimeters of rain in 30 minutes (10-year recurrence-interval), the probability of debris flow estimated for basins burned by the Track fire ranged between two and 97%, with probabilities greater than 80% identified for the majority of the tributary basins to Raton Creek in Railroad Canyon; six basins that flow into Lake Maloya, including the Segerstrom Creek and Swachheim Creek basins; two tributary basins to Sugarite Canyon, and an unnamed basin on the eastern flank of the burned area. Estimated debris-flow volumes ranged from 30 cubic meters to greater than 100,000 cubic meters. The largest volumes (greater than 100,000 cubic meters) were estimated for Segerstrom Creek and Swachheim Creek basins, which drain into Lake Maloya. The Combined Relative Debris-Flow Hazard Ranking identifies the Segerstrom Creek and Swachheim Creek basins as having the highest probability of producing the largest debris flows.

This finding indicates the greatest post-fire debris-flow impacts may be expected to Lake Maloya. In addition, Interstate Highway 25, Raton Creek and the rail line in Railroad Canyon, County road A-27, and State Highway 526 in Sugarite Canyon may also be affected where they cross drainages downstream from recently burned basins. Although this assessment indicates that a rather large debris flow (approximately 42,000 cubic meters) may be generated from the basin above the City of Raton (basin nine) in response to the design storm, the probability of such an event is relatively low (approximately

10 percent). Additional assessment is necessary to determine if the estimated volume of material is sufficient to travel into the City of Raton. In addition, even small debris flows may affect structures at or downstream from basin outlets and increase the threat of flooding downstream by damaging or blocking flood mitigation structures. The maps presented here may be used to prioritize areas where erosion mitigation or other protective measures may be necessary within a two-to-three-year window of vulnerability following the Track Fire.[115] More information regarding USGS debris-flow studies is discussed in the Flooding and Debris Flow Post-fire section.

4.5.8.5 *Risk Assessment*

New susceptibility mapping indicates relatively higher landslide risk for Preparedness Areas 2, 3, 4, and 5. Recent landslides have occurred in New Mexico, specifically in Preparedness Areas 1, 3 and 4. Based on previous occurrence, Taos County (Preparedness Area 3) would be considered as having the highest risk to deep-seated landslide and rockfall occurrence. Debris flows could be expected across the entire state. Figure 4-161 identifies potential impacts from a landslide for the purposes of EMAP compliance.

Figure 4-161 Potential Landslide Impacts

Subject	Potential Impacts
Agriculture	The greatest threat to agriculture would be the possible isolation of agriculture production by a landslide leaving it inaccessible. Typically, a landslide would not be expected in a field being farmed. Additionally, livestock would have some notice of the landslide through their senses and move.
Health and Safety of the Public	Anyone within the path of a land or rockslide at the time of occurrence, could be injured or killed
Health and Safety of Responders	Same as the public
Continuity of Operations	Any operation in the area of a slide may be unable to continue operations for unspecified time periods, the time being dependent on the extent of the landslide or debris flow.
Delivery of Services	Supply chains could be negatively affected if highways and roads are impacted. Otherwise minor impacts are anticipated.
Property, Facilities, Infrastructure	Buildings and almost all infrastructure would be severely damaged or destroyed in the event of a landslide occurring nearby.
Environment	Long-term severe impacts are unlikely, but short-term impacts may include limited destruction of habitat or degradation of stream water quality

[115] Source: http://pubs.usgs.gov/of/2011/1257/

Subject	Potential Impacts
Economic Condition	The small impact area of landslides lead to minor economic impacts.
Public Confidence	Not likely to be impacted.

4.5.8.6 *Data Limitations*

USGS produced a statewide landslide map approximately 20 years ago based on interpretation of aerial photography (USGS Open-file Report 90-293). These are now available in GIS format, but the spatial accuracy of these maps is variable (100-1200 m).

Also, mapping the debris flow run-out zones would be helpful in understanding the potential impact of landslides. Mapping of run-out zones will be listed as a potential project under the mitigation action section of this Plan Update.

4.5.8.7 *What Can Be Mitigated?*

There is no new information. This will be re-addressed further in the next plan update. One mitigation effort involves educating communities on the effects of landslides and determining which communities in the State have the biggest risk.

4.5.8.8 *Changing Weather Patterns*

More frequent high-magnitude precipitation events would cause more frequent debris flows across the State. Also, the severity of debris flows would correlate to the intensity of these precipitation events. Sustained periods of higher-than-normal moisture could possibly result in more rockfall and deep-seated landslide events.

4.5.9 Land Subsidence

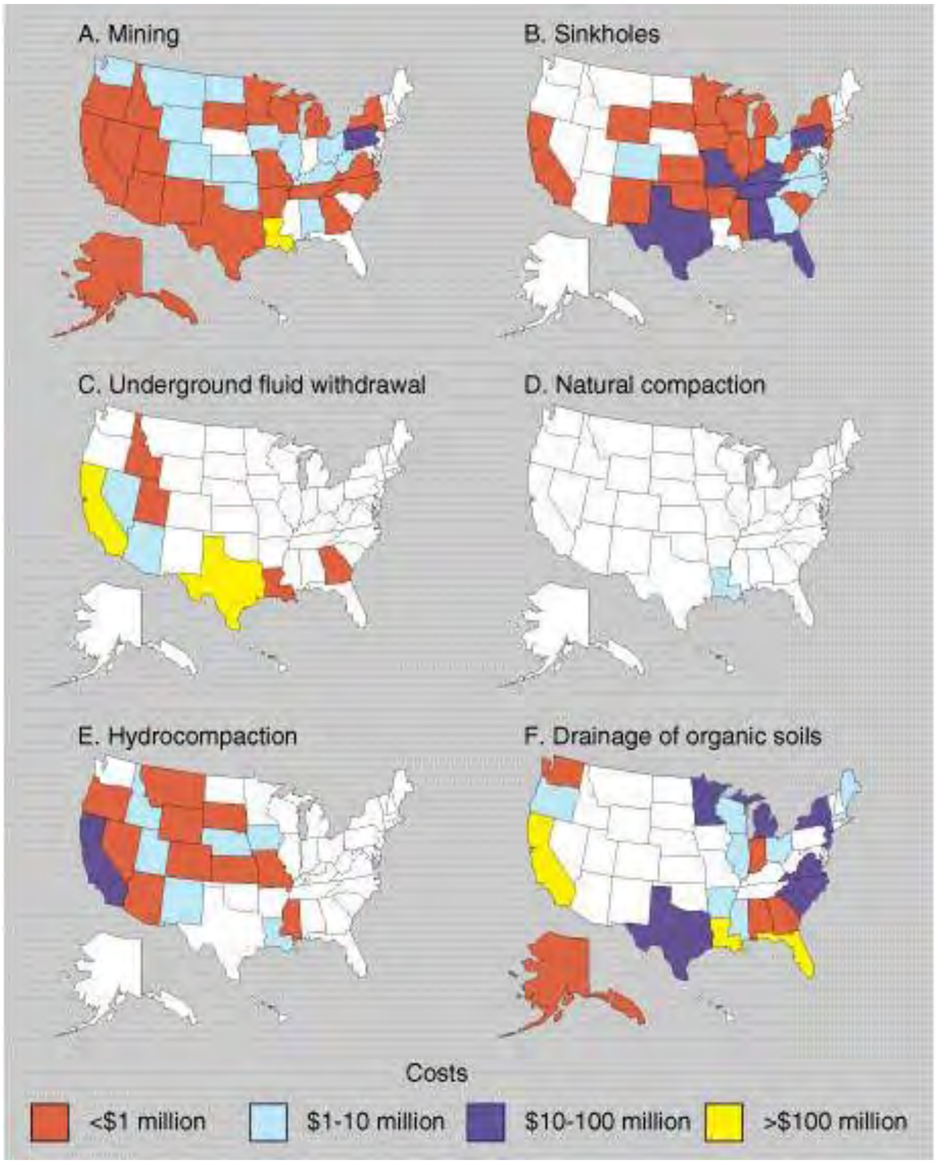
4.5.9.1 *Hazard Characteristics*

Land subsidence is the loss of surface elevation and affects nearly every U.S. State. Land subsidence has several causes such as 1) underground fluid withdrawal, 2) collapse of subsurface caverns, 3) collapse of underground mines, 4) hydrocompaction of collapsible soils, or 5) compaction of organic soils. Subsidence can occur uniformly over large areas or as localized sinkholes. Wide-area compaction commonly occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as unconsolidated fine-grained sediments. The sediments compact because the water is partly responsible for bearing the weight of overlying sediments. When the water is withdrawn, the sediment compacts. Subsidence may occur abruptly or over many years. It can occur uniformly over large areas or as localized sinkholes.

Common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone, gypsum, or other soluble rocks to form sinkholes; collapse of underground mines; drainage of organic soils; and initial wetting of dry soils under load (hydro compaction). Land subsidence from pumping of fluids is usually not noticeable because it occurs over a large area over a period of time, but the ground surface may subside several feet. However, differential subsidence may form along hydrogeologic boundaries when subsidence is caused by regional pumping. Figure 4-162 shows various forms of land subsidence across the United States and shows the associated costs of subsidence-related property damage. The formation of sinkholes in dissolved soluble rocks, collapse of underground mines, drainage of organic soils and hydrocompaction cause local subsidence that is hazardous for structures and, in rare cases for sinkhole collapse and mine collapse, may endanger human life. Subsidence from sinkholes, mining collapse and in organic soils is formed by the increase in void space through dissolution, excavation or drying that leads to loss of structural integrity. Collapsible, or hydrocompactive soils, however are formed by collapse of original porosity due to loss of structural integrity of clays on combined wetting and loading.

In areas where communities nearly exclusively rely on pumped groundwater for freshwater, such as New Mexico, Colorado, Arizona, Utah, Nevada, and California, major aquifers include compressible clay and silt that can compact when the groundwater is pumped. This is especially the case in regions where the aquifer is confined (overpressured). Increased groundwater demand from population growth may likely accelerate land subsidence in areas already subsiding. Land subsidence arising from the depletion of underground petroleum has not been reported from any of the regions of the State where the petroleum industry is active.

Figure 4-162 Subsidence Problems in the U.S.[116]



Land subsidence presents major problems in California, Arizona, Texas, and Florida, all of which have experienced hundreds of millions of dollars of damage over the years. In many areas of the southwest, earth fissures, which can be over 100 feet deep, are associated with land subsidence. They begin as narrow cracks and can erode to widths of over 15 feet. According to Subject Matter Expert, Dr. Dave Love from the New Mexico Institute of Mining and Technology, fissures are evident in the Deming, New Mexico area (Preparedness Area 6).

Figure 4-163 shows the known locations in New Mexico that have experienced subsidence in collapsible soils on a State-wide map, and Figure 4-164 and Figure 4-165 show the same data by Preparedness Area. Only Preparedness Areas 3 and 5 contain known locations of collapsible soils.

[116] Source: New Mexico 2010 State Hazard Mitigation Plan

Figure 4-163 Past Incidences of Collapsible Soil Locations in New Mexico

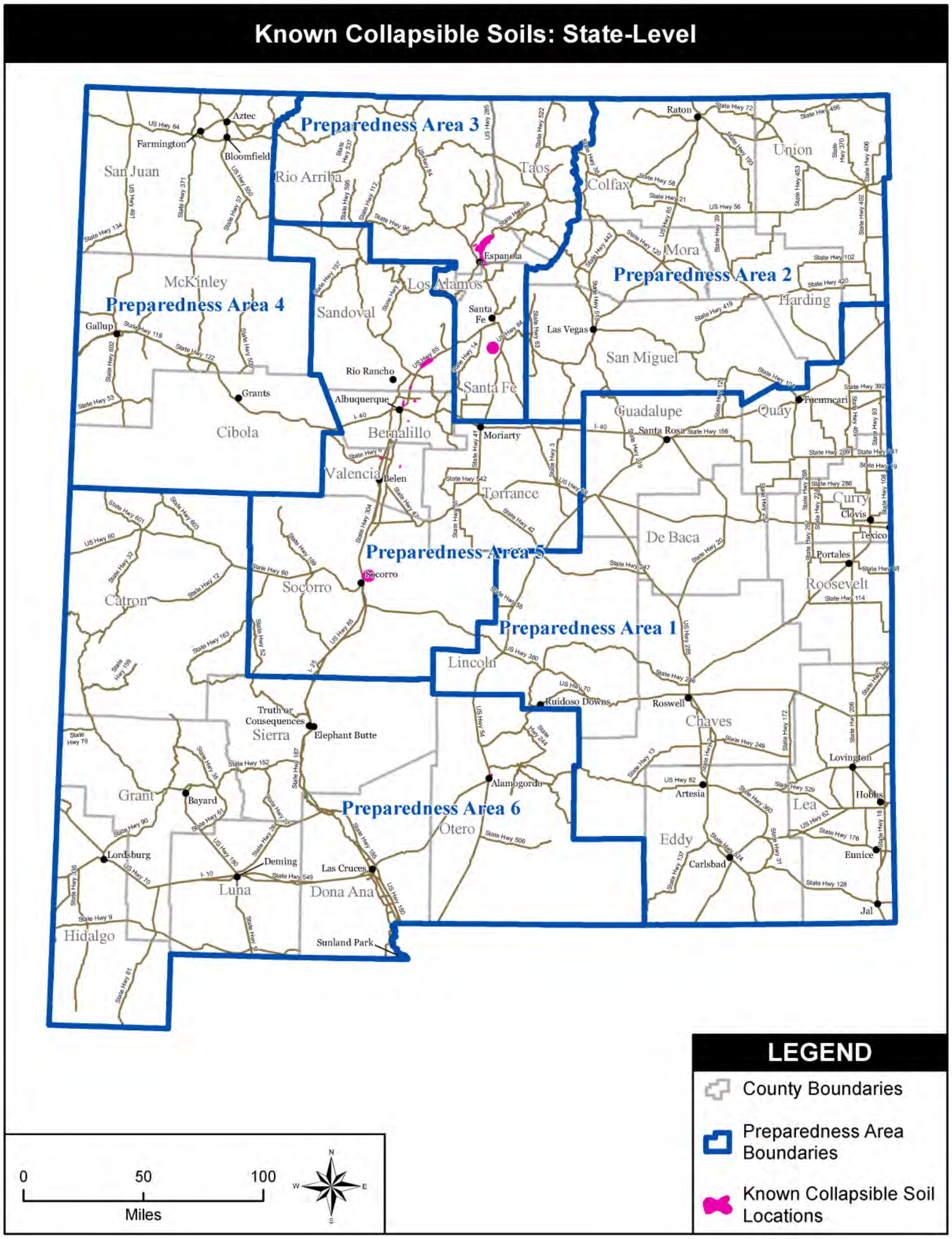


Figure 4-164 Preparedness Area 3 Known Collapsible Soils

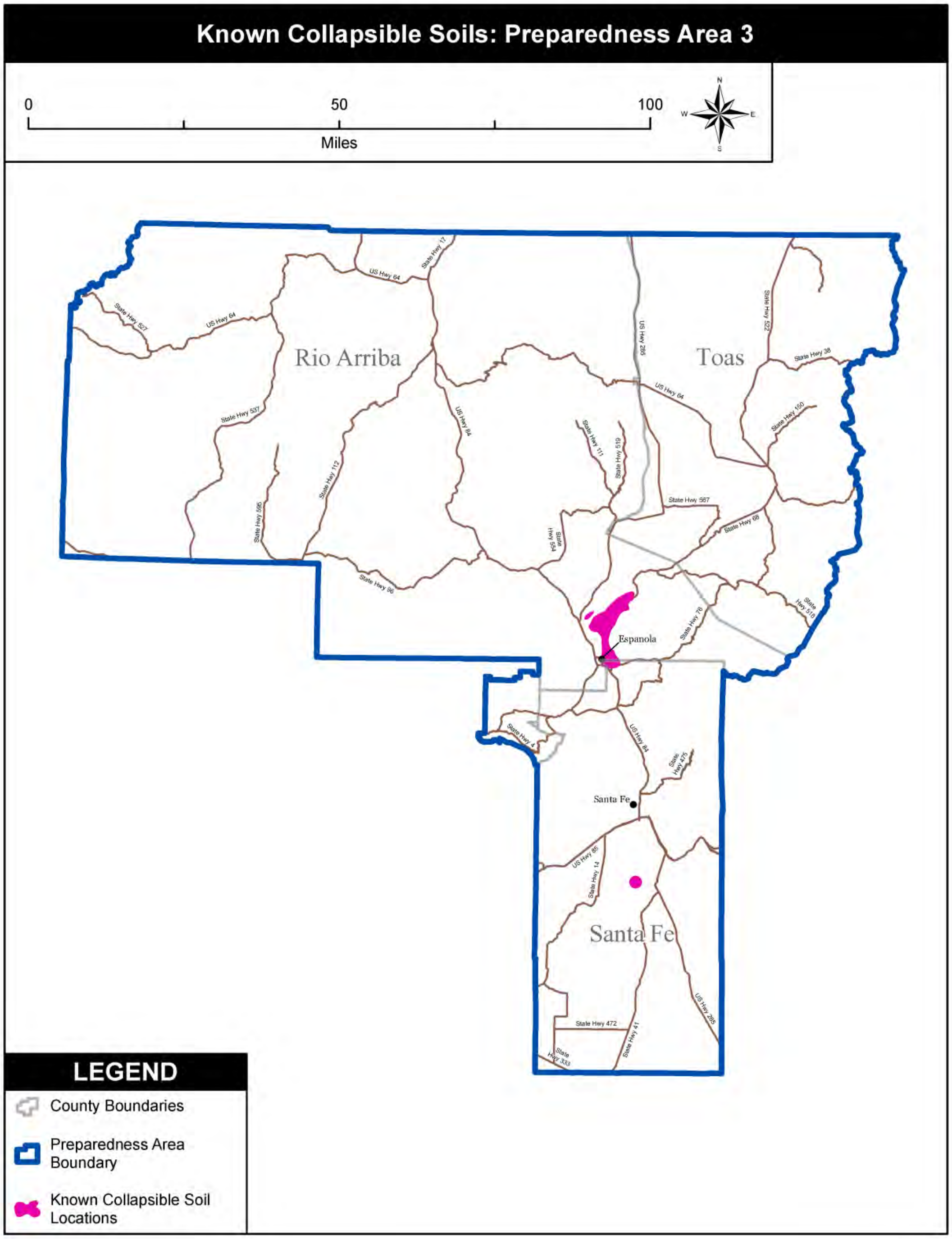
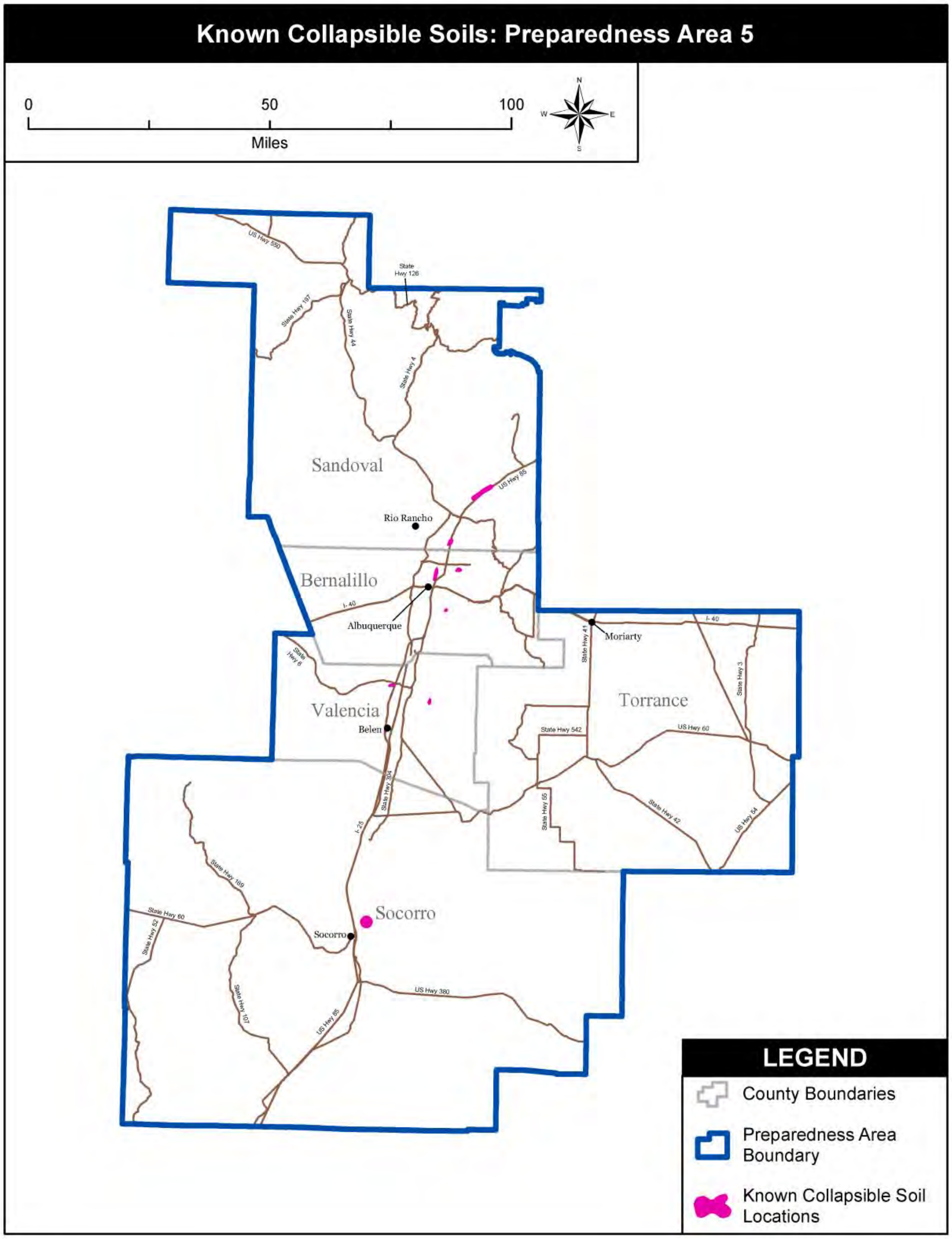


Figure 4-165 Preparedness Area 5 Known Collapsible Soils



Sub Hazards of Land Subsidence

Sinkholes — When land subsidence is isolated in a small area, it appears as sinkholes. Some areas of the State are particularly subject to sinkhole formation, such as the region between Carlsbad in Eddy County (Preparedness Area 1) north to the Santa Rosa and Vaughn area in Guadalupe County (Preparedness Area 1), as shown in Figure 4-166. General sink hole formation area supplied by Lewis Land, New Mexico Bureau of Geology and Mineral Resources. The large area north of the Capitan mountains, known as the

Hasparo Embayment, also has a high number of sinkholes. The locations of these sinkholes are controlled by the underlying bedrock type. Limestone and gypsiferous units can dissolve into karst cavities, which then collapse. Numerous sinkholes are visible from highways in the region. Highway damages have been reported from this hazard, and the potential for sinkhole formation should not be overlooked in planning highways, pipelines, and electric transmission lines. Figure 4-167 is a photograph illustrating sinkholes alongside U.S. Highway 285 near Vaughn.

Figure 4-166 Sinkhole Formation Area between Santa Rosa, NM and Carlsbad, NM 2016

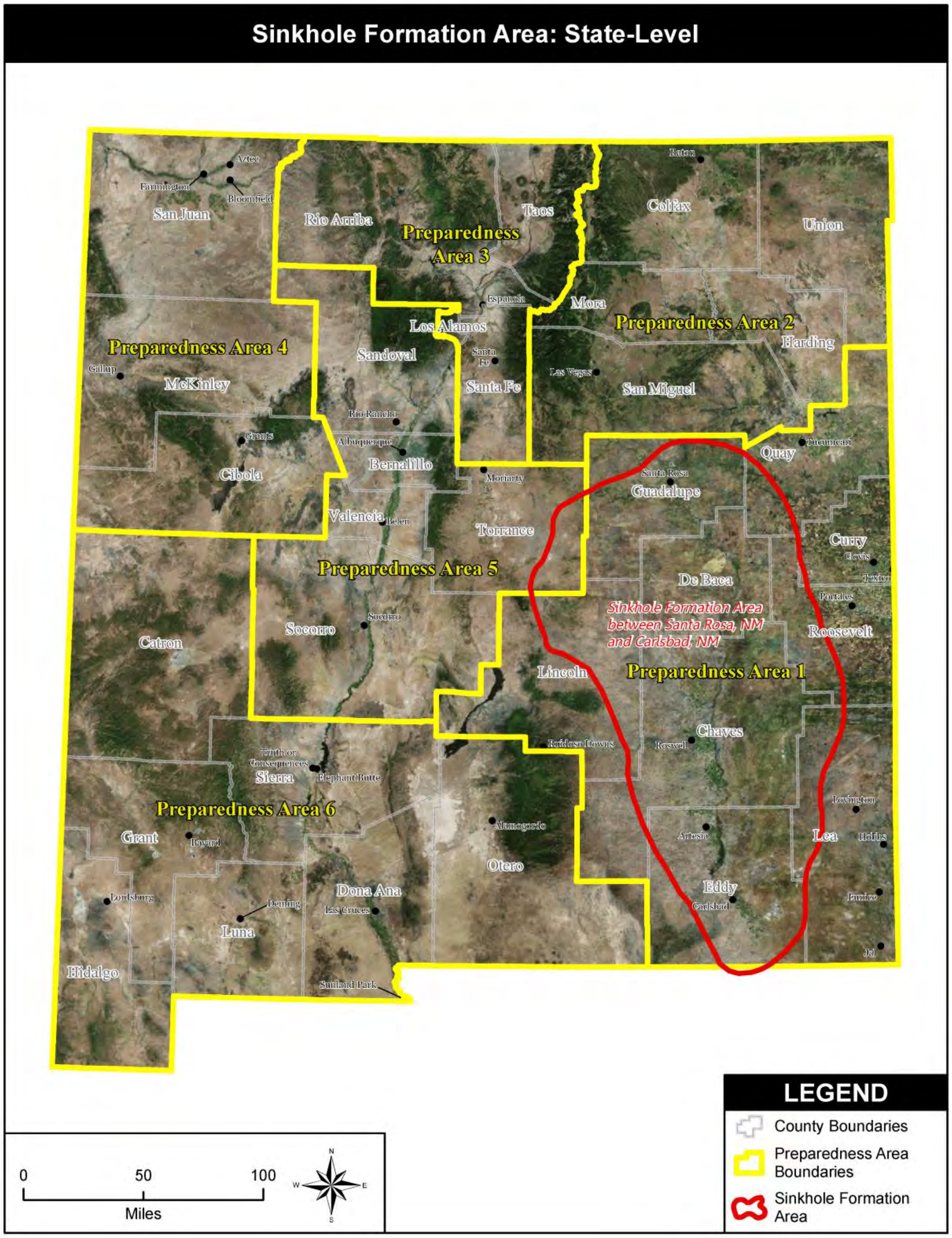


Figure 4-167 Sinkholes along US Highway 285 corridor, about 30 miles southeast of Vaughn, NM

Collapsible Soils – Another type of subsidence, collapsible soils, are soils that compact and collapse after they get wet. The soil particles are originally loosely packed combinations of clay-sized to sand-sized grains and barely touch each other before moisture soaks into the ground. As water is added to the soil in quantity and moves downward, the water wets the contacts between clay and silty or sandy soil particles and allows them to slip past each other to become more tightly packed.

Collapsible soils develop on valley margins where soil particles move from the foothills toward the valleys and are rapidly deposited. They commonly accumulate to tens of feet thick. The valley margin also protects these deposits from collapse because it is uncommon for them to be wetted extensively under natural conditions. As New Mexico's population has moved out of the well-watered and irrigated valleys with compact soils to develop the valley margins and foothills, the collapsible soils have made their presence known as the newcomers add water to the drier soils.[117]

[117] Source: http://geoinfo.nmt.edu/geoscience/hazards/collabsible.html

Compaction of Organic Soils – Wetland soils developed in marshes may lose water and compact as they become buried by other sediments. The organic matter may become peat with further compaction. Marshes along major river valleys such as the Rio Grande are known to have been buried by later floods. Another cause of organic soil compaction is cyclic drying and rewetting of organic horizons caused by groundwater level fluctuations. The organics lose volume after drying, and the overlying sediments collapse after being re-wetted. In Albuquerque's north valley, several buildings were damaged as buried organic soils were drained and compacted beneath the buildings.

New Mexico Tech (NM Tech) has constructed a 500-m resolution collapsible soils susceptibility map for the entire State of New Mexico (Figure 4-168).[118] Given the lack of required reporting of hydrocompactive subsidence events, this study chose to use an expert-driven spatial weighted average of multiple indirect proxies, or an overlay method, to estimate collapsible soil susceptibility. This included several sets of proxies: climate zone proxies derived from spatially distributed air temperate and precipitation products; landform age, style of emplacement, depositional environment, source lithology and grain size; NRCS soil map-derived parent material texture and soil taxonomic order, suborder and great group; NLCD land-use; and depth-to-water maps derived from New Mexico Office of the State Engineer Water Rights Report System database. A quality factor was assigned for each proxy based on both the reliability of the proxy and the degree of correlation of the proxy with collapsible soils. A susceptibility value for all of the proxy values was assigned through expert judgement and iterative comparison of the proxy and final susceptibility maps with known hydrocompaction incident locations.

The flanks of the Rio Grande valley and closed basins, alluvial fans, and areas with windblown sediment in the San Juan basin and along the Canadian river have high to extreme susceptibilities (Figure 4-168). Most of the remaining State has moderate susceptibilities—this is likely an overestimate to compensate for the map coarseness and the general arid conditions of the State. Wetlands and mountain uplands have low susceptibilities. The majority of the State has very good to high quality and also has most of the proxies present. Each proxy has a different correlation with known hydrocompaction incidents, but the final susceptibilities show a strong correlation (>95%) of high to extreme susceptibilities at and around known locales.

Figure 4-168 shows susceptibility for collapsible soils.[119] Redder areas are more susceptible to this hazard, while greener shades are less susceptible. Figure 4-169 through Figure 4-174 show this same data by Preparedness Area.

[118] Rinehart, A.J., Cikoski, C.T., Mansell, M.M., and Love, D.W., 2017, Collapsible soil susceptibility map for New Mexico (1:750,000) based on multiple proxies: New Mexico Bureau of Geology and Mineral Resources Open-file Report 593, 67 p. and 3 plates.

[119] Rinehart, A.J., Cikoski, C.T., Mansell, M.M., and Love, D.W., 2017, Collapsible soil susceptibility map for New Mexico (1:750,000) based on multiple proxies: New Mexico Bureau of Geology and Mineral Resources Open-file Report 593, 67 p. and 3 plates.

Figure 4-168 Susceptibility for Collapsible Soils in New Mexico

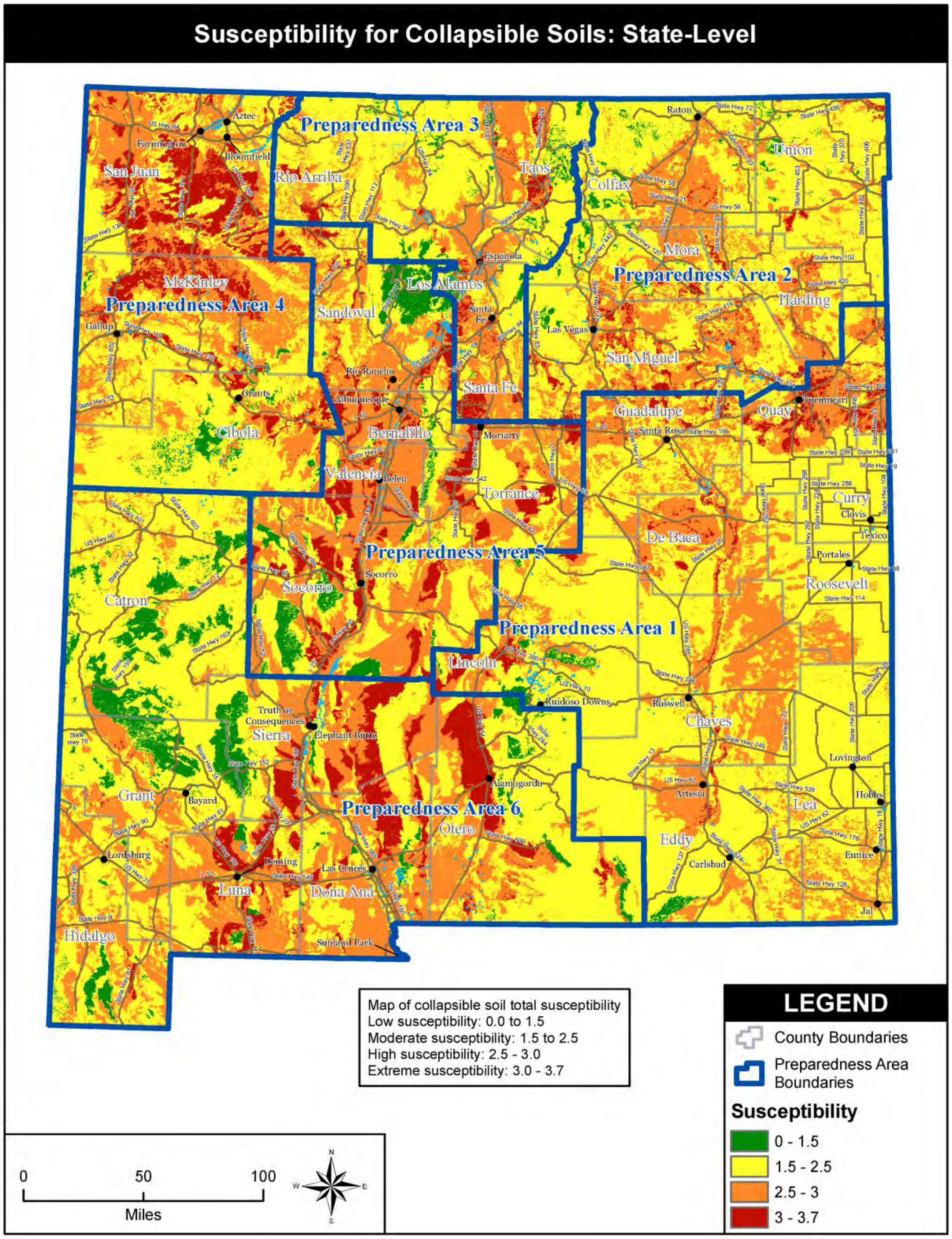


Figure 4-169 Preparedness Area 1 Susceptibility for Collapsible Soils

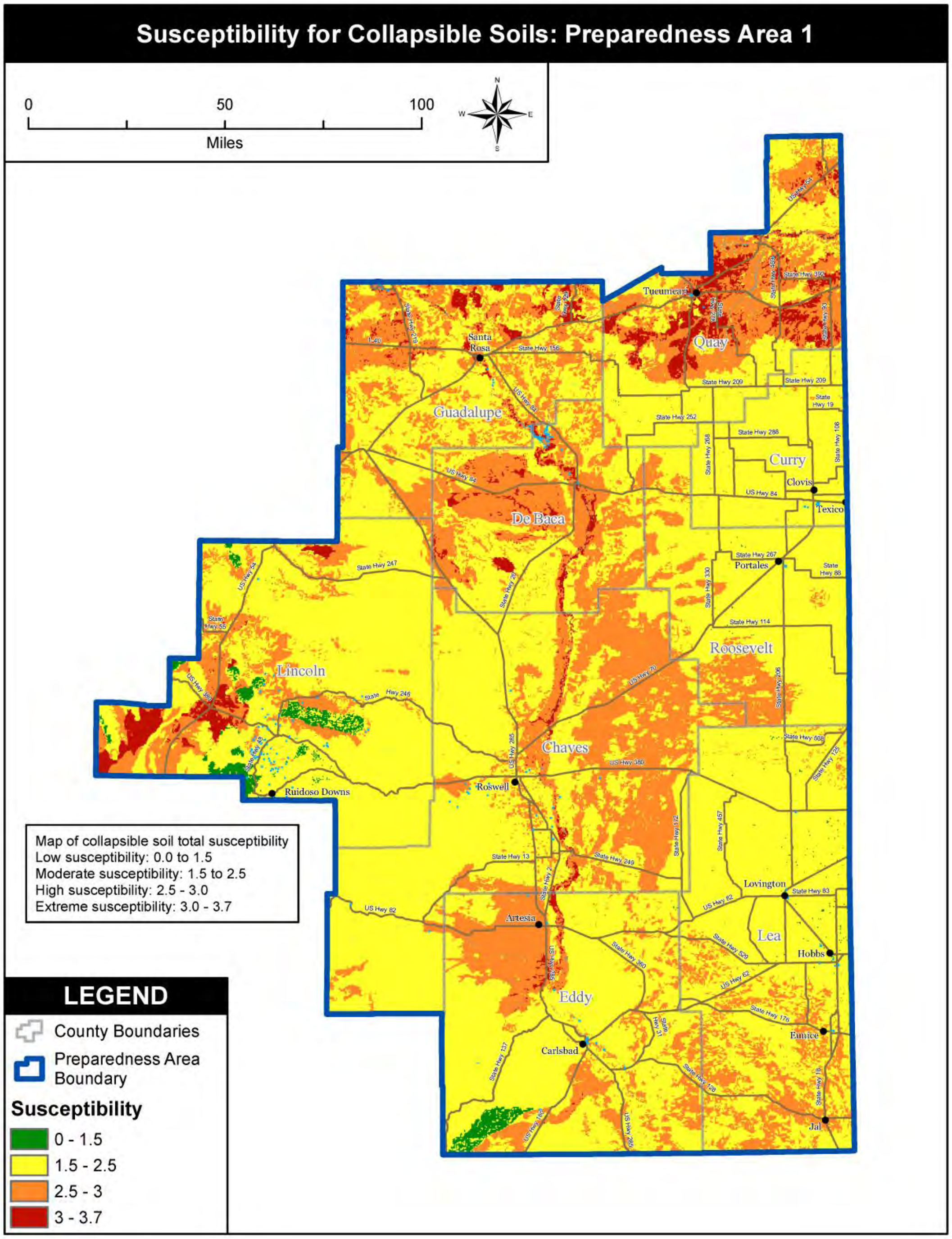


Figure 4-170 Preparedness Area 2 Susceptibility for Collapsible Soils

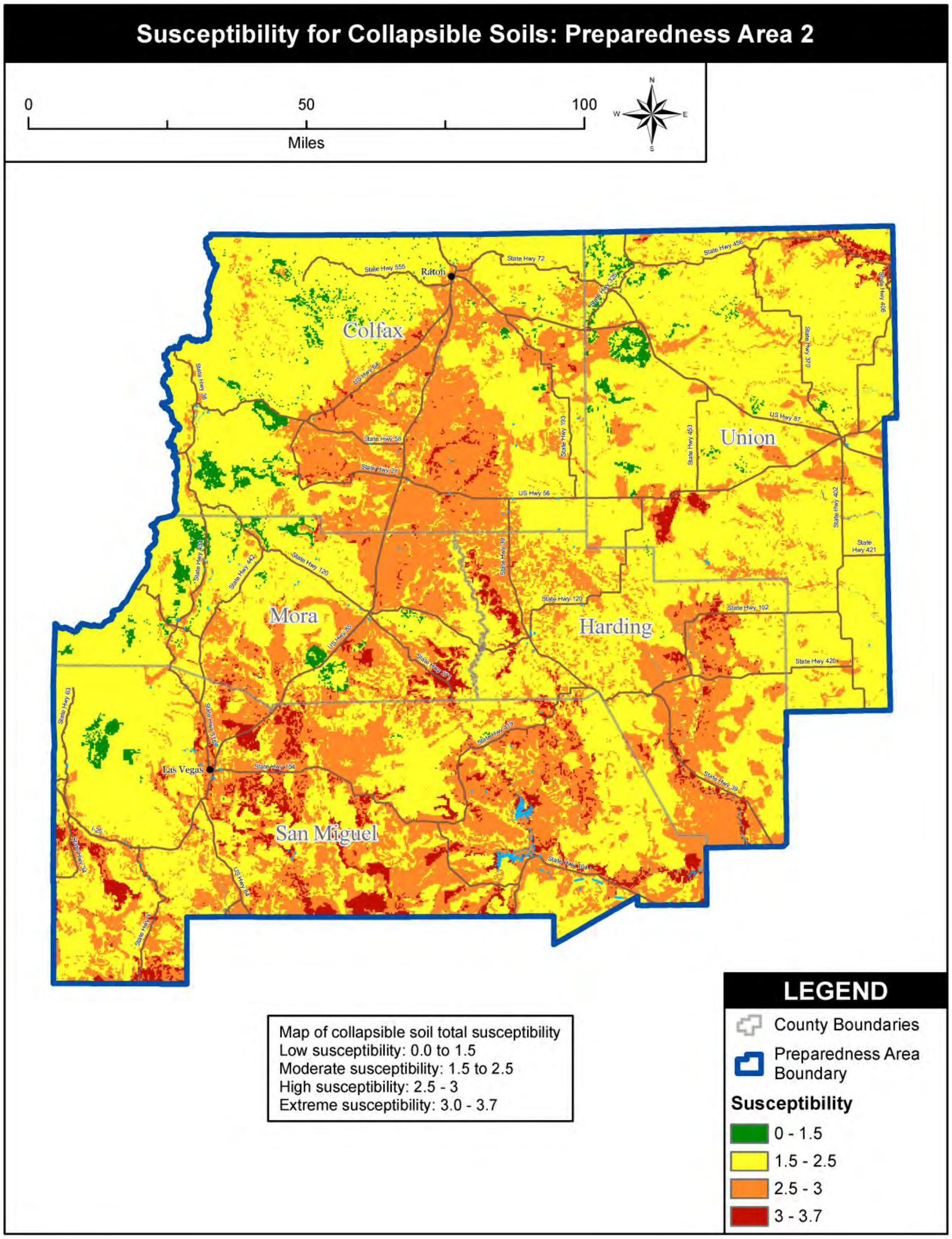


Figure 4-171 Preparedness Area 3 Susceptibility for Collapsible Soils

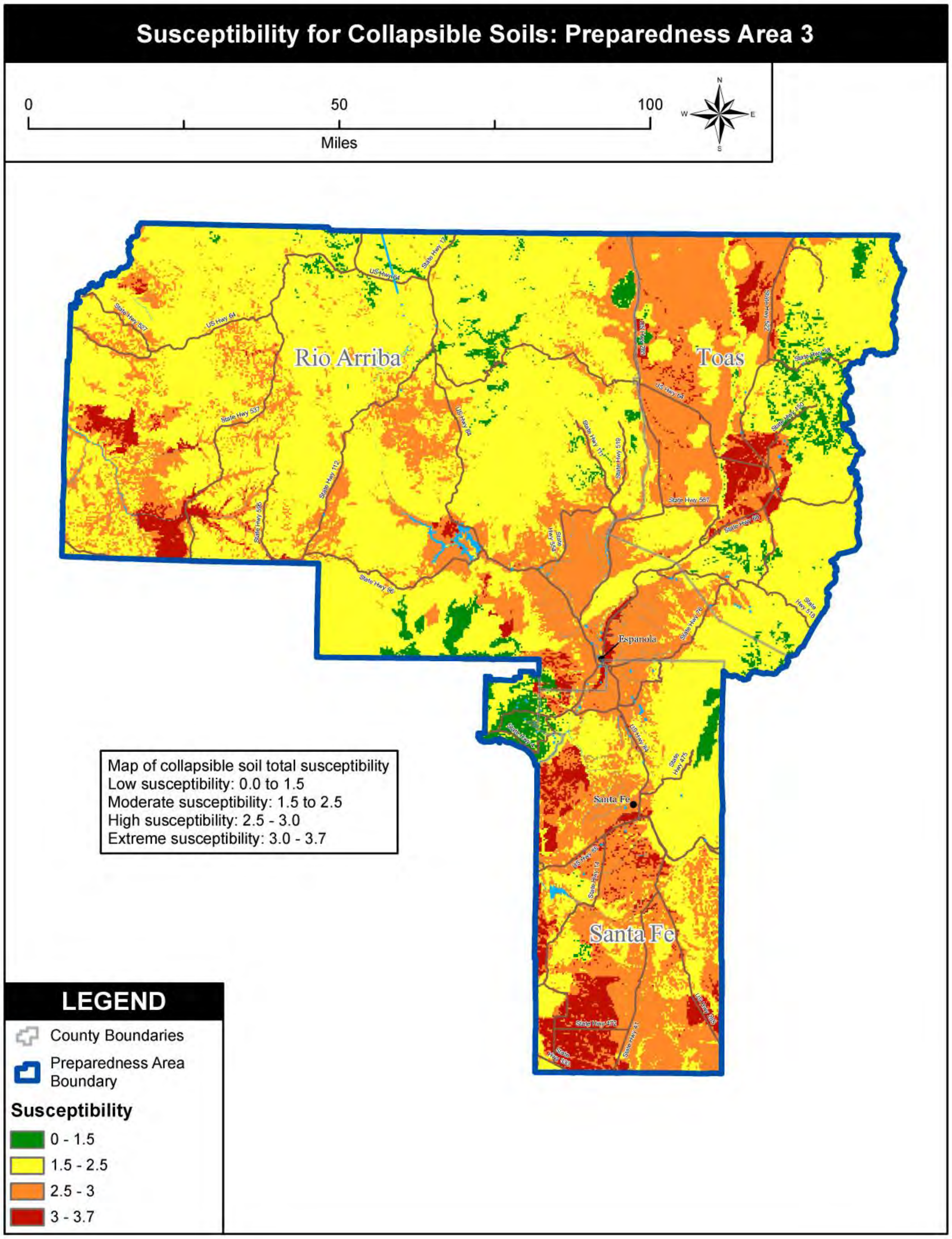


Figure 4-172 Preparedness Area 4 Susceptibility for Collapsible Soils

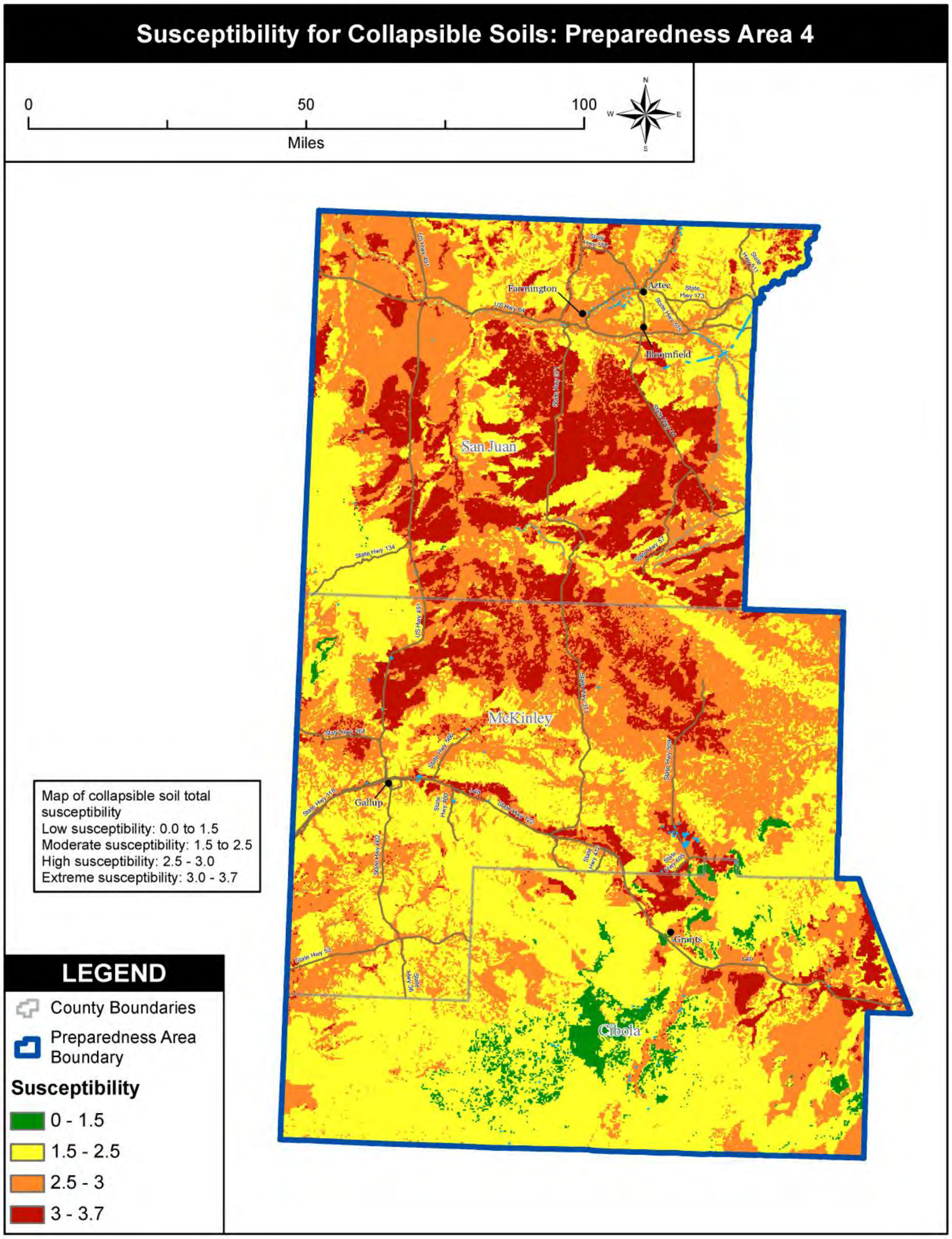


Figure 4-173 Preparedness Area 5 Susceptibility for Collapsible Soils

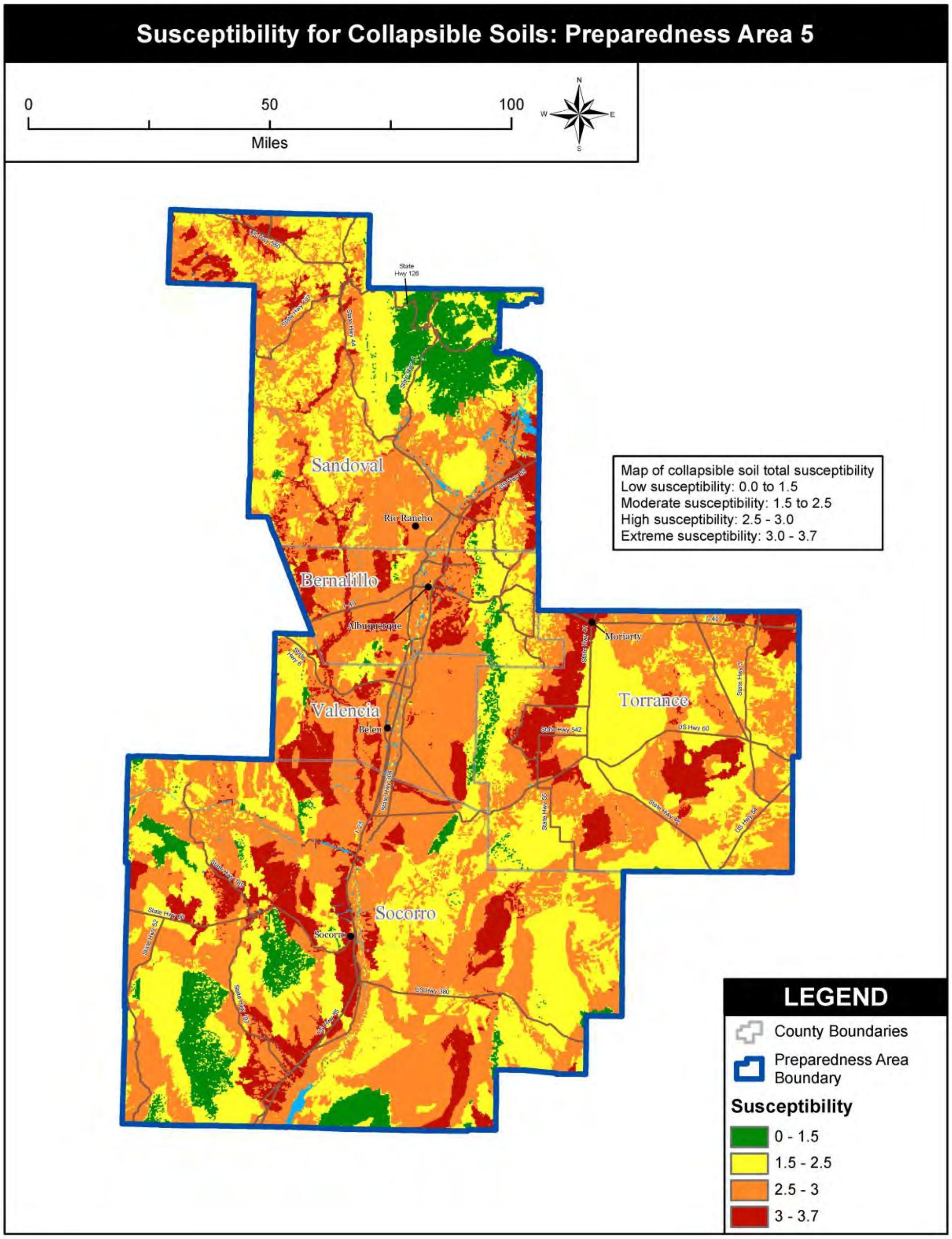
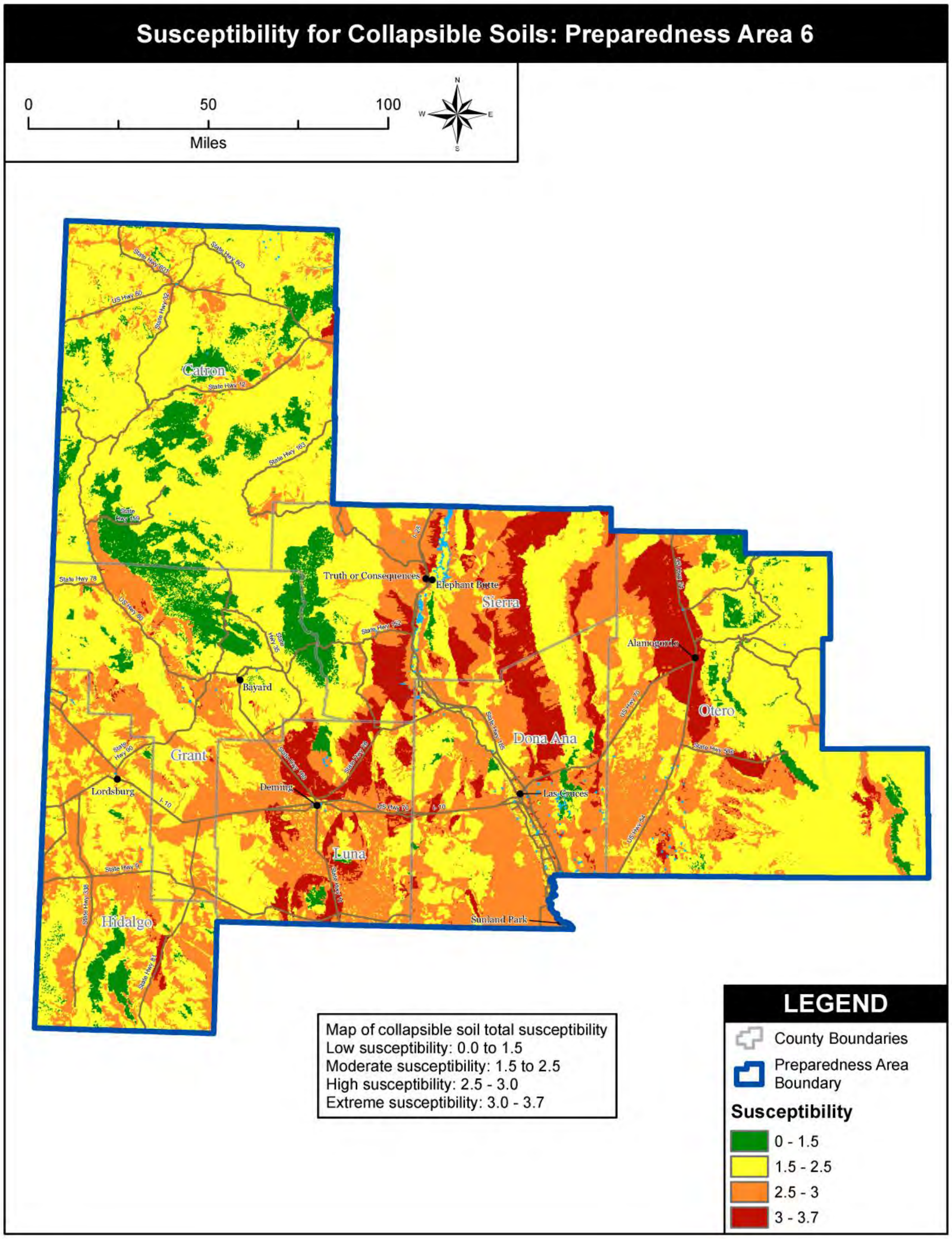


Figure 4-174 Preparedness Area 6 Susceptibility for Collapsible Soils



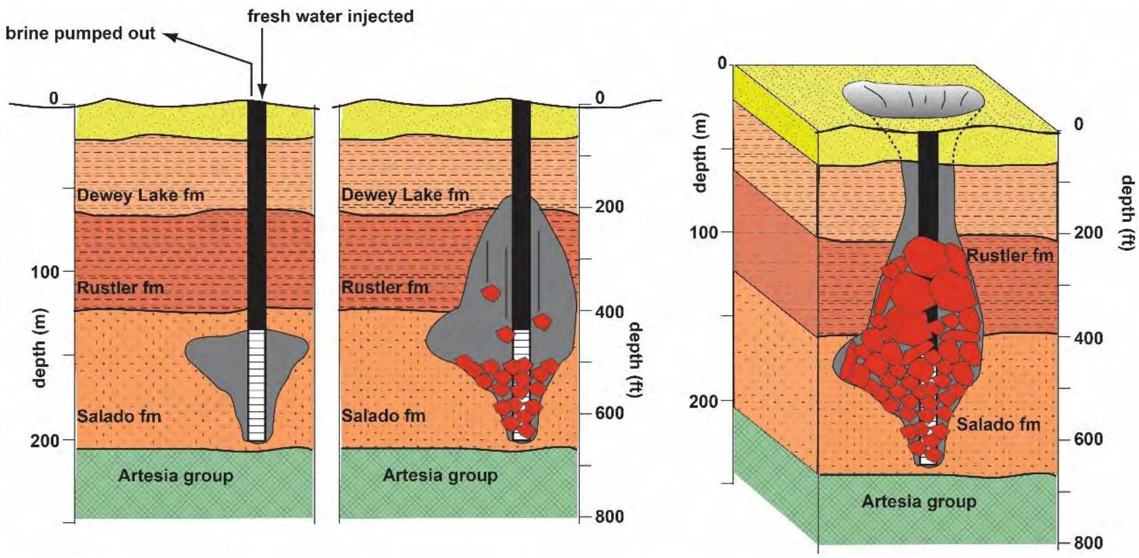
4.5.9.2 *Previous Occurrences*

Previous occurrences of land subsidence in New Mexico have been recorded, however, data on the extent of such events is extremely limited. NCDC does not provide any data on previous occurrences. One large event that has been in the news and is a concern is the collapse of two North Eddy County brine wells in the oil fields in northern Eddy County in 2008 (Figure 4-175). The operators were pumping fresh water into salt beds in the subsurface and pumping out the resulting brine for use as drilling fluid, creating an artificial cavern in the salt beds (Figure 4-176). In the aftermath of those events a third brine well was discovered at the South Y intersection in Carlsbad, sparking fears that a similar collapse might occur in that more densely populated area (Preparedness Area 1). The third brine well operation has created a large subsurface void beneath the intersection of US Highways 285 and 62-180. If a collapse occurs, it will destroy the highway intersection, several businesses, an irrigation canal, a church, and a trailer park.

Carlsbad, a city of about 30,000 residents, has declared an emergency and says that government-installed sensors should provide several hours of warning before collapse occurs, providing enough time to evacuate the area. However, such a collapse could destroy the Carlsbad Irrigation Canal, which provides water for irrigated farming south of Carlsbad, and will also disrupt oil field traffic that is integral to the economy of the area. Remediation of the brine well cavity is estimated to cost approximately $43 million. Without remediation, engineers and scientists predict that a collapse is inevitable in the next few years, with an economic impact on the community of greater than $1 billion.

Figure 4-175 JWS sinkhole in northern Eddy County, about three weeks after initial brine well collapse. Pickup truck in lower right corner for scale.

Figure 4-176 Brine Well Operation and Subsequent Sinkhole Formation



There have been issues over the past three years related to mining but this data is not available. Further research will be required to gather information related to this hazard.

Most of the land subsidence occurrences in the country have been due to sinkholes that are a subhazard of land subsidence. The most recent event in Carlsbad was directly related to the mining in the area and the U.S. Environmental Protection Agency has taken the lead due to the high amount of brine (hazardous substance). Additionally, natural sinkhole formation and collapse has been observed along roads around Carlsbad.

Land subsidence due to hydrocompactive soils has been identified and verified in a number of locations across New Mexico, affecting roads, residences, water lines and sewer lines. These include regions north of Española, on tribal lands along the Rio Grande corridor, along Interstate 25 near Algodones, in the Tanoan Communities in Albuquerque, along the western flank of the Rio Grande valley in Albuquerque, in Tijeras Canyon in Albuquerque, in subdivisions in Los Lunas, in subdivisions in western Belen, in a housing area west of Socorro, and in subdivisions north of Alamogordo. Possible hydrocompaction features have been observed along roads near the Navajo Agriculture Products Industry irrigated fields south of Farmington, but have not been verified.

4.5.9.3 *Frequency*

Local land subsidence will episodically continue as more water is pumped, or roads and buildings extend into new regions. Earth fissures at the ground surface will become more frequent and will damage infrastructure as well as individual structures, as is the situation in Carlsbad. Because a full dataset is not available on past occurrence, frequency can only be determined based on the few occurrences described here. Based on previous occurrence, it is reasonable to conclude that some form of land subsidence will occur in Preparedness Area 1.

4.5.9.4 *Probability of Occurrence*

Because full historical data is not available, the probability of experiencing future land subsidence could not be calculated. Once data is compiled, probability can be determined by dividing the number of events observed by the number of years and multiplying by 100. This would give the percent chance of the event happening in any given year. According to the New Mexico Bureau of Geology and Mineral Resources, there is a 30% chance of land subsidence occurring in any given year. This figure is based on the previous occurrence data.

4.5.9.5 *Risk Assessment*

Sinkholes are secondary hazards related to land subsidence. The most recent New Mexico sinkhole event occurred in Carlsbad (Preparedness Area 1) and was directly related to the mining in the area and the US Environmental Protection Agency has taken the lead due to the high amount of brine (hazardous substance). Land Subsidence can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. Figure 4-177 identifies impacts from Land Subsidence in New Mexico.

Figure 4-177 Impacts of Land Subsidence

Subject	Impacts
Agriculture	With any kind of indication of pending occurrence of land subsidence, agriculture should experience little to no loss long term. Short term access issues could occur.
Health and Safety of The Public	The sinkhole situation under Carlsbad is a concern. There is an anticipated health and safety hazard to the public and to responders as well as property, facilities, and infrastructure.
Health and Safety of Responders	None likely.
Continuity of Operations	None likely.
Delivery of Services	None likely.
Property, Facilities, Infrastructure	The slow nature of this type of event causes the impacts to be almost imperceptible, however damages to the built environment may occur, that can be very costly over time. Hydrocompaction deforms miles of paved highways in New Mexico over decades.
Environment	Pollution of groundwater is a possibility.
Economic Condition	The only anticipated impacts are repair costs but for both fissures and for collapsible soils, the results are catastrophic for whole subdivisions of home owners.
Public Confidence	Very little impact anticipated.

4.5.9.6 *Data Limitations*

Data needs to be collected and compiled on past occurrence of the various types of land subsidence. Once that information is collected and mapped, analysis of Preparedness Area risk can be evaluated.

4.5.9.7 *What Can Be Mitigated?*

This will be re-addressed further in the next plan update. One mitigation effort is educating communities about the effects of land subsidence and the risks mining brings to the community. For hydrocompactive soils, better building ordinances and special care for all surface and subsurface water sources is essential. This includes better testing of the subsurface before construction.

4.5.9.8 *Changing Weather Patterns*

According to the New Mexico Bureau of Geology and Mineral Resources, each form of subsidence relates to changing weather patterns differently (subsidence from sinkhole formation, from collapsible soils, and from groundwater pumping). Natural sinkhole formation may gradually increase if storm magnitude and intensity increases. More water would be focused into the sinkhole due to greater run-off, leading to greater dissolution. However, this link has not been studied. Similarly, areas with collapsible soils that already have structures built on them may be more likely to subside due to greater focused run-off if precipitation magnitude and intensity increase. New Mexico will likely see an increased incident of subsidence from groundwater withdrawal as climate changes. A warming climate, regardless of precipitation patterns, will require greater irrigation and other water use in New Mexico. This will lead to greater reliance on groundwater reserves, likely lowering groundwater levels below historical levels. Once groundwater levels drop below historical lows, the likelihood of subsidence increases greatly.

4.5.10 Severe Winter Storms

4.5.10.1 *Hazard Characteristics*

Winter storms have significant snowfall, ice, and/or freezing rain, with the quantity of precipitation variable by elevation. According to the National Weather Service, heavy snowfall is four inches or more in a 12-hour period, or six or more inches in a 24-hour period in non-mountainous areas; and 12 inches or more in a 12-hour period or 18 inches or more in a 24- hour period in mountainous areas. Winter storms vary in size and strength and include heavy snowfalls, blizzards, freezing rain, sleet, ice storms, blowing and drifting snow conditions, and extreme cold.

A variety of weather phenomena and conditions can occur during winter storms. For clarification, the following are NWS approved definitions of winter storm elements:

- Heavy snowfall - the accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.
- Blizzard - the occurrence of sustained wind speeds in excess of 35 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- Ice storm - an occurrence where rain falls from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground.
- Freezing drizzle/freezing rain - the effect of drizzle or rain freezing upon impact on objects that have a temperature of 32° F or below.
- Sleet - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. This ice does not cling to surfaces.
- Wind chill - an apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin.

A blizzard is a winter storm with considerable falling and/or blowing snow combined with sustained winds or frequent gusts of 35 mph or greater that frequently reduces visibility to less than one-quarter mile. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death. Winter storm occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents, collapsed roofs from fallen trees and limbs, heavy ice and snow loads, and downed telephone poles and lines, electrical wires, and communication towers. Such storms can also cause exceptionally high rainfall that persists for days, resulting in heavy flooding.

A severe winter storm for New Mexico as defined by the National Weather Service:

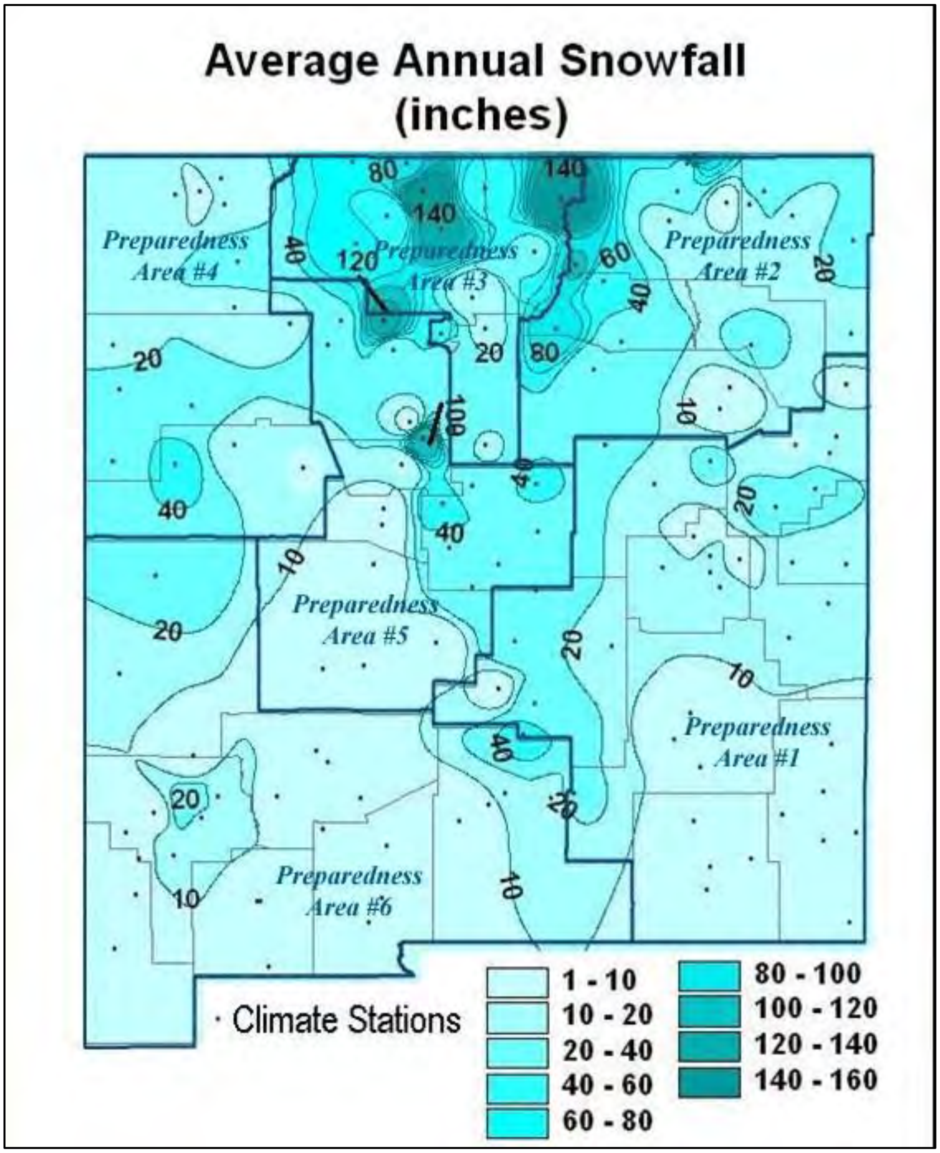
- Four to five inches of snowfall below 7,500 ft. or
- Six or more inches of snowfall above 7,500 ft. in a 12-hour period, or
- Six or more inches of snowfall below 7,500 ft. or
- Nine inches of snowfall above 7,500 ft. in a 24-hour period

Most winter precipitation in New Mexico is associated with Pacific Ocean storms as they move across the State from west to east. As the storms move inland, moisture falls on the coastal and inland mountain ranges of California, Nevada, Arizona, and Utah. If conditions are right, the remaining moisture falls on the slopes of New Mexico's high mountain chains.

Much of the precipitation that falls as snow in the mountain areas may occur as either rain or snow in the valleys. The average annual snowfall ranges from about three inches in the southern desert and southeastern plains to over 100 inches in the northern mountains. It can, on rare occasions, exceed 300 inches in the highest mountains. January is usually the coldest month, with average daytime temperatures ranging from the middle 50s in the southern and central valleys to the middle 30s in the higher elevations. Minimum temperatures below freezing are common in all sections of the State during the winter.[120] The following two maps (Figure 4-178 - Figure 4-179) depict State-wide snowfall distributions by average inches and average numbers of days with snowfall over one inch.

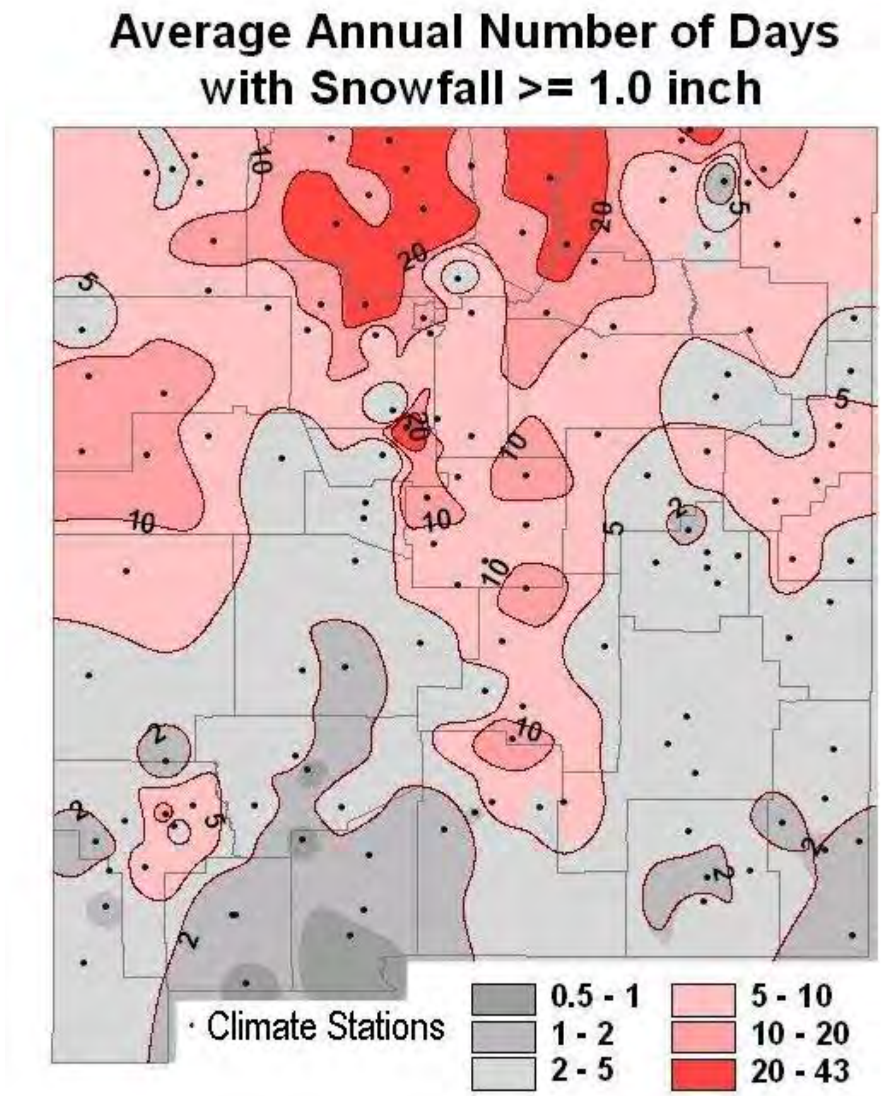
[120] Source: https://wrcc.dri.edu/Climate/narrative_nm.php

Figure 4-178 State-wide Snowfall Distributions by Preparedness Area[121]



121 Source: http://www.weather.gov/abq/prepwinterwxclimo

Figure 4-179 Statewide Average Annual Number of Days with Snowfall >= 1.0 Inch



Severe winter storms can vary in size and strength and include heavy snowstorms, blizzards, ice storms, freezing drizzle or rain, sleet, and blowing and drifting snow. Extremely cold temperatures accompanied by strong winds result in potentially lethal wind chills.

The Wind Chill is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. The Wind Chill chart (Figure 4-180) shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs.

Figure 4-180 Wind Chill Chart[122]

Wind Chill Chart

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

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Extreme cold occurs when temperatures drop below normal and wind speeds increase, as this occurs, the body is cooled at a faster rate than normal, causing the skin temperature to drop, which can lead to frostbite (when body tissues freeze) and hypothermia (abnormally low body temperature, <95°F). Extreme cold is measured by the wind chill temperature index. The index is based on heat loss from exposed skin and includes a frostbite indicator.

In New Mexico, January is the coldest month. Day-time temperatures range from the mid-50s in the southern and central valleys to the mid-30s in the north's higher elevations. Minimum temperatures below freezing are common throughout the State; however, subzero temperatures are rare, even in the mountains.[123] The lowest temperature ever officially recorded was -50 degrees at Gavilan on February 1, 1951. An unofficial low temperature of negative 57 degrees at Ciniza was reported by the press on January 13, 1963.[124]

The entire State of New Mexico experiences some form severe winter storm event. Based on the topography of the State, such as elevation and land contours, this all plays a significant part in how winter weather affects a particular area. The effects of severe winter storm events vary according to the type of hazard. Winter storms often have the effect of disrupting transportation and commerce. Injury to people and property result from heavy loads of snow and ice causing collapse of roofs of

[122] Source: http://www.nws.noaa.gov/om/cold/wind_chill.shtml
[123] Source: Western Region Climate Center http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm
[124] Source: https://wrcc.dri.edu/narratives/NEWMEXICO.htm

buildings, falling trees and telephone poles, knocking down electrical lines, and creating slippery conditions for pedestrians and vehicles.

4.5.10.2 *Previous Occurrences*

The State of New Mexico experiences severe winter storm events annually. Referencing the NCDC, New Mexico experienced a total of 370 winter storm events between January 1997 and December 2017, resulting in five deaths, $4.46 million in property damage, and $5.27 in crop damage. For the same time period, NCDC reports 48 extreme cold events resulting in one death and $1.175 million in property damage. In addition, there have been a total of 15 freezing fog events resulting in three deaths, one injury, and $50,000 in property damage. Reviewing severe winter storm events by Preparedness Area, Figure 1-4 in Appendix A briefly explains those significant winter storm events that have occurred throughout the State of New Mexico. The location of the event is identified by both the city/county and Preparedness Area. Source information is from the NCDC and data provided by local authorities.

Figure 4-181 shows State winter storm disaster information. One of the 11 State severe winter storm disasters was also a federally-declared disaster (Figure 4-182). The total Public Assistance dollar losses from Federal, State, and Local government entities and all Tribal entities was $2,393,376. The State contributed 12.5% of the total cost for this disaster. Data is not broken out by Preparedness Area. Research into locations and costs for each county for this disaster would need to be completed prior to breaking-out the figures by Preparedness Area. However, for this one disaster damage was calculated from Preparedness Areas 1, 3, 5 and 6.

Figure 4-181 State Disaster Event Information 2003 through 2017

Event Type	State Executive Order	Dollar Loss
Severe Winter Storm	2004-031	$176,513
Snow Storm	2005-012	$384,269
Snow Storm	2005-016	$906,396
Snow Storm	2006-070	$2,013,953
Snow Storm	2008-005	$1,386,815
Snow Storm	2009-001	$71,427
Snow/Wind Storm	2009-048	$54,040
Snow Storm	2010-005	$209,456
Severe Cold	2011-014	$750,000
Navajo Freeze	2013-004	$100,000
Severe Winter Storm	2013-034	$100,000
Severe Winter Storm	2015-021	$750,000
Severe Winter Storm	2016-035	$2,000,000
Total	**11**	**$8,902,869**

Figure 4-182 Federal Disaster Event Information 2003 through 2017

Event Type/Name	Event Number	Federal Share	State Share	Total Cost	State % of Total
Severe Winter Storm and Extreme Cold Temperatures	1962	$1,795,032	$299,172	$2,393,376	12.50%
Total	**1**	**$1,795,032**	**$299,172**	**$2,393,376**	

Another source of severe winter storm damage information is from the NCDC. Below is a tally of severe winter storm damage as reported by NCDC broken out by Preparedness Area (Figure 4-183). According to NCDC, State-wide property damage from winter storm damage was $4,465,000 and crop damage was $5,270,000 from 1997 through December 2017. Note the information in the table below only includes data presented by county, and does not include data presented by National Weather Service Forecast Zones.

Figure 4-183 Preparedness Areas 1 - 6 Severe Winter Storm Events (January 1997 - December 2017)

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln, Quay and Roosevelt						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Extreme Cold/Wind Chill	15	0	0	0	$0	$0
Freezing Fog	5	0	0	0	$0	$0
Heavy Snow	211	0	0	0	$100,000	$0
Winter Storm	17	0	0	0	$0	$0
Total	**238**	**0**	**0**	**0**	**$100,000**	**$0**

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

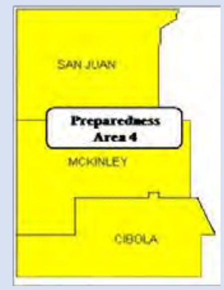
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	13	0	0	0	$0	$0
Freezing Fog	9	0	2	0	$0	$0
Heavy Snow	413	0	0	0	$205,000	$0
Winter Storm	24	0	0	0	$0	$0
Total	**459**	**0**	**0**	**0**	**$205,000**	**$0**

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	11	0	0	0	$0	$0
Freezing Fog	2	0	2	0	$0	$0
Heavy Snow	503	0	0	0	$75,000	$0
Winter Storm	8	0	0	0	0	$0
Total	**514**	**0**	**0**	**0**	**$75,000**	**$0**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	5	0	0	0	$0	$0
Freezing Fog	1	0	1	1	$50,000	$0
Heavy Snow	130	0	0	0	$50,000	$0
Winter Storm	3	0	0	0	$0	$0
Total	**139**	**0**	**1**	**0**	**$100,000**	$0



Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	8	0	0	0	$0	$0
Freezing Fog	2	0	2	0	$0	$0
Heavy Snow	276	0	2	0	$130,000	$0
Winter Storm	8	0	0	0	$0	$0
Total	**294**	**0**	**4**	**0**	**$130,000**	**$0**

Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Extreme Cold/Wind Chill	3	0	0	0	$0	$0
Freezing Fog	0	0	0	0	$0	$0
Heavy Snow	58	0	0	0	$0	$0
Winter Storm	1	0	0	0	$0	$0
Total	**62**	**0**	**0**	**0**	**$0**	**$0**

Preparedness Area 2 has suffered the highest levels of property damage. The impacts of 413 Heavy Snow events led to $205,000 worth of property damage. Preparedness Area 5 suffered the most amount of deaths with a reported four deaths due to severe winter storm events. The deaths were attributed to heavy snow (276 heavy snow events were recorded) and freezing fog. Uneven distribution of the magnitude and types of impacts winter storms have on Preparedness Areas is closely related to the capacity of the people and communities who live there.

4.5.10.3 *Frequency*

No part of the State is immune from the severe winter storms, whether extreme cold, heavy snow, ice storm, or other cold weather condition. The mountainous areas of the State, which includes all Preparedness Areas, are more likely to receive snow and cold than the plains and desert, and residents of high altitude areas are more likely to be prepared for these conditions, even if they become extreme.

4.5.10.4 *Probability of Occurrence*

To determine the probability of New Mexico experiencing severe winter storms in the future, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 1997 – December 2017 (251 months/20 years). Probability was determined by dividing the number of events observed by the number of years (20 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. Figure 4-184 provides the probability of occurrence in each Preparedness Area based on the probability formula.

Figure 4-184 Probability of Occurrence - Severe Winter Storms

Probability of Occurrence				
Preparedness Area	**Extreme Cold/Wind Chill**	**Freezing Fog**	**Heavy Snow**	**Winter Storm**
Preparedness Area 1	75%	25%	100%	85%
Preparedness Area 2	65%	45%	100%	100%

Probability of Occurrence				
Preparedness Area	**Extreme Cold/Wind Chill**	**Freezing Fog**	**Heavy Snow**	**Winter Storm**
Preparedness Area 3	55%	10%	100%	40%
Preparedness Area 4	25%	5%	100%	15%
Preparedness Area 5	40%	10%	100%	40%
Preparedness Area 6	15%	0%	100%	5%

4.5.10.5 *Risk Assessment*

Severe winter storms are difficult to predict precisely in pattern, frequency, and degree of severity. The impact from severe winter storm events (heavy snowfall, blizzard, ice storm, freezing drizzle/freezing rain, sleet, wind chill, and extreme temperatures) has been moderate with impact to widespread areas of crops and livestock depending on the time of year when it occurs. Highly vulnerable populations include those in mobile home parks, recreational vehicles, and aged or dilapidated housing, but no area is safe.

Severe winter weather is much more likely to have a serious impact on major population centers and transportation routes, most of which are not located in the high mountains. This occurred on December 24, 2011 during a severe snow storm when motorists traveling through Albuquerque, NM (Preparedness Area 5) Interstate system were stranded for up to 18 hours. The plains and desert areas (Preparedness Areas 1 and parts of Preparedness Area 6) are more susceptible to high winds that contribute to the drifting of snow, and a snow storm that would hardly be noticed in the higher altitudes could present a serious hazard to people in the lower altitudes. If a severe winter storm were to cause a power failure, as would be likely with an ice storm, the effect could be very serious anywhere in the State. Any accumulation of ice or snow on the roads is a hazardous situation and can lead to wide spread road and highway closures, that can strand motorists. Figure 4-185 outlines impacts from severe winter storm events for each Preparedness Area to consider when planning for these types of events.

Figure 4-185 Severe Winter Storm Impacts

Subject	Impacts
Agriculture	Typically, there is some advance notice to a pending cold front and potential winter storm impacts. Even with that, those impacts can be devastating to agriculture, particularly to the milk industry. The milk industry has timed inputs and outputs and closed roads can severely impact that industry.
Health and Safety of The Public	Injuries and death have resulted from winter storm events. Individuals caught outdoors can suffer frostbite, hypothermia, and death from low temperatures.
Health and Safety of Responders	Responders face the same impacts as the public.

Subject	Impacts
Continuity of Operations	Travel to key facilities and places of employment may be impossible, and those entities may not be able to function.
Delivery of Services	Facilities that are unable to be reached or if supply lines are blocked, widespread denial of services may result.
Property, Facilities, Infrastructure	Winter storms can cause ice to form on roads and bridges rendering them impassible, can accumulate on power lines and cause them to break, can cause water pipes to burst, and heavy snow can collapse roofs.
Environment	Winter storms can cause damages to trees and plants as well as to crops and animals.
Economic Condition	The negative effects to the economic condition are generally from the damages the hazard causes to infrastructure and agriculture. Individuals and businesses can suffer unanticipated expenses.
Public Confidence	Winter storms are an expected event in the State, but a slow response such as road clearing or restoration of utilities can cause an erosion of the public's confidence in the government.

4.5.10.6 *Data Limitations*

The SHMPT could not quantify vulnerability of individual structures to damage from severe winter storm events. Accurate methods to quantify potential future damages are not readily available. The amount of business lost due to winter storms and road closures has not been calculated due to the difficulty of attaining this information. The SHMPT could also not specify which critical facilities were vulnerable to severe winter storms. Subsequent versions of this Plan Update will need to incorporate and respond to these data deficiencies.

4.5.10.7 *What Can Be Mitigated?*

One important part of mitigating severe winter storm hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to severe winter storm by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending storms. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe winter storm weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation. For supporting road closure mitigation, a State regulation was added to provide safety to the public. The regulation regarding road closure is as follows:

> **66-7-11. New Mexico State Police power to close certain highways in emergencies.** Notwithstanding any rule, regulation or agreement of the NMDOT, the New Mexico State police, in cases of emergency where the condition of a State highway presents a substantial danger to vehicular travel by reason of storm, fire, accident, spillage of hazardous materials or other unusual or dangerous conditions, may close such highway to vehicular travel until the

New Mexico State Police determines otherwise. The NMDOT shall be notified of the highway closure as soon as practicable.

This regulation is broad enough to allow for closure for any type of severe winter storm event, but it is also difficult to define what constitutes “dangerous conditions.”

4.5.10.8 *Changing Weather Patterns*

At the time there has not been a definitive link between an increase or decrease in the frequency or severity of extreme cold events or significant winter storms due to long-term, changing weather patterns.

4.5.11 Thunderstorms (Including Lightning and Hail)

4.5.11.1 *Hazard Characteristics*

Thunderstorms are produced when warm moist air is overrun by dry cool air. As the warm air rises, thunderheads form and cause strong winds, lightning, hail, and heavy rains. Atmospheric instability can be caused by surface heating or by upper tropospheric (>50,000 feet) divergence. Rising air parcels can also result from airflows over mountainous areas. Generally, the former “air mass” thunderstorms form on warm-season afternoons and are not severe. The latter “dynamically-driven” thunderstorms, which generally form in association with a cold front or other regional atmospheric disturbance, can become severe, thereby producing strong winds, frequent lightning, hail, downburst winds, heavy rain, and occasional tornadoes.

All areas of the State have thunderstorms. According to the National Weather Service (NWS), the thunderstorm season in New Mexico begins over the high plains in the eastern part of the State in mid- to late April, peaks in May and June, declines in July and August, and then drops sharply in September and October. In the western part of the State, thunderstorms are infrequent during April, May, and June, increase in early July and August, and then decrease rapidly in September. Over the central mountain chain, thunderstorms occur almost daily during July and August, especially over the northwest and north central mountains.

Thunderstorms tend to have different characteristics in different regions of the State. Across the eastern plains, thunderstorms tend to be more organized, long-lived, and occasionally severe, producing large hail, high winds, and tornadoes. Thunderstorms in the western part of the State tend to be less severe on average, occasionally producing life-threatening flash floods and small hail accumulations. Most of the storms in western New Mexico are associated with the southwest monsoons, which mainly produce flash floods.

Severe thunderstorms are reported each year in nearly all New Mexico counties. The NWS definition of a severe thunderstorm is a thunderstorm with any of the following attributes: downbursts with winds of 58 miles (50 knots) per hour or greater (often with gusts of 74 miles per hour or greater), hail 0.75 of an inch in diameter or greater, or a tornado. Typical thunderstorms can be three miles wide at the base, rise to 40,000-60,000 feet into the troposphere, and contain half a million tons of condensed water.

Thunderstorm frequency is measured in terms of incidence of thunderstorm days or days on which thunderstorms are observed. Any county (or Preparedness Area) may experience 10 or more thunderstorm days per year. According to the NWS Publication, *Storm Data*, in the past 30 years New

Mexico has experienced over 50 reported events 75 mph or higher associated with thunderstorms, with a single occurrence of 115 mph winds. This means that in New Mexico winds similar to a Category One Hurricane (Saffir-Simpson Scale) are experienced on average about one day every 1.5 years.

The current online National Climatic Data Center (NCDC) database is limited in past events and only contains data from April 1955 to December 2017, as entered by NOAA's National Weather Service. Referencing this online database, NCDC reports 1,602 thunderstorm events causing three deaths, 34 injuries, $24.77 million in property damage, and $5.27 million in crop damages.[125]

New Mexico averages 25 thunderstorm events per year. Essentially, New Mexico has a 100% probability of a thunderstorm, and 5% chance of a fatality from thunderstorms every year.

Lightning is defined as a sudden and violent discharge of electricity, usually from within a thunderstorm, due to a difference in electrical charges. Lightning is a flow of electrical current from cloud to cloud or cloud to ground. Nation-wide, lightning is the cause of extensive damage to buildings and structures, death or injury to people and livestock, the cause of wildfires, and the disruption of electromagnetic transmissions. Lightning is extremely dangerous during dry lightning storms because people often remain outside, rather than taking shelter.

To the general public, lightning is often perceived as a minor hazard. However, lightning-caused damage, injuries, and deaths establish lightning as a significant hazard associated with any thunderstorm. Damage from lightning occurs four ways:

1. Electrocution or severe shock of humans and animals;
2. Vaporization of materials along the path of the lightning strike;
3. Fire caused by the high temperatures (10,000-60,000°F); and
4. A sudden power surge that can damage electrical or electronic equipment.

Large outdoor gatherings (sporting events, concerts, campgrounds, etc.) are particularly vulnerable to lightning strikes. New Mexico ranks sixth in the nation in lightning fatalities with 0.55 deaths per million people annually. The State ranks 22nd in lightning frequency overall.[126]

The current online NCDC database is limited in past events and only contains data from April 1996 as entered by NOAA's National Weather Service (NWS). According to the database as of December 2017, NCDC reports 63 lightning events causing 11 deaths, 48 injuries, $757,000 in property damage, and $600 in crop damage.

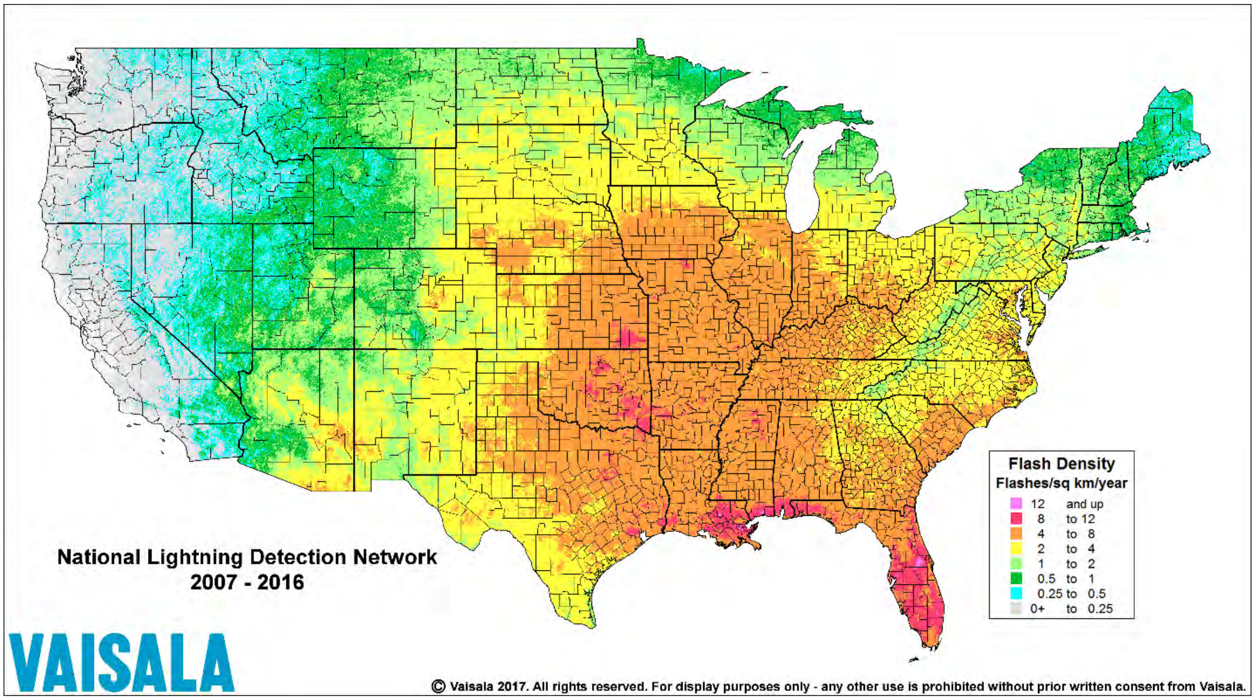
According to the National Weather Service, New Mexico suffered 93 lightning related fatalities between 1959 and 2016 (57 years)[127]. Overall, New Mexico has a 100% probability of a lightning event every year and there is a 100% chance of a lightning fatality each year. According to NWS, New Mexico experienced 727,847 lightning flashes in 2016. Between 2007 and 2016 the average number of lightning flashes totaled 762,811 per year.[128]

Recent storms monitored by NM Tech produced between 65 and 1,062 lightning flashes per minute. Additionally, lightning strikes the ground or objects on average once in every five to 10 cloud flashes.

[125] Source: http://www.ncdc.noaa.gov/stormevents/
[126] Source: http://www.lightningsafety.com/nlsi_lls/fatalities_us.html
[127] Source: http://www.lightningsafety.noaa.gov/stats/59-16_State_Ltg_Fatality+Fatality_Rate_Maps.pdf
[128] Source: http://www.lightningsafety.noaa.gov/stats/07-16_Flash_Density_State.pdf

Based on the NM Tech studies, New Mexico routinely has thunderstorms that have between 13 and 106 lightning strikes per minute. While the entire State is at risk for lightning events, some areas of the State have higher concentrations of them. Figure 4-186 shows areas of lightning flash density.

Figure 4-186 Lightning Flash Density



The Lightning Activity Level is a scale from one to six, which describes frequency and character of cloud-to- ground (cg) lightning (Figure 4-187).

Figure 4-187 Lightning Activity Level[129]

Cloud and Storm Development		Areal Coverage	Counts cg/5 min	Counts cg/15 min	Average cg/min
1	No thunderstorms.	None	-	-	-
2	Cumulus clouds are common but only a few reach the towering stage. A single thunderstorm must be confirmed in the rating area. Light rain will occasionally reach ground. Lightning is very infrequent.	<15%	1-5	1-8	<1

129 Source: http://www.crh.noaa.gov/gid/?n=fwfintro

	Cloud and Storm Development	Areal Coverage	Counts cg/5 min	Counts cg/15 min	Average cg/min
3	Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	15% to 24%	6-10	9-15	1-2
4	Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.	25% to 50%	11-15	16-25	2-3
5	Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.	>50%	>15	>25	>3
6	Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)	>15%	-	**-**	**-**

Based on the Lightning Activity scale, all Preparedness Areas consistently experience storms of LAL5 or higher, specifically during the monsoon seasons. The North American Monsoon System (NAMS) is a large-scale shift in the atmospheric circulation that results in a summertime maximum of precipitation across portions of Mexico, Arizona and New Mexico. The monsoon season, broadly defined from mid-June to late September, is actually comprised of "bursts" and "breaks," or periods of rainy and dry weather. The average onset occurs around July 3rd for the southwest corner of the State (Preparedness Area 6, around July 9th for the Middle Rio Grande valley (Preparedness Area 5), and around July 12th for the Four Corners region (Preparedness Area 4).

Hail is frozen water droplets formed inside a thunderstorm cloud. They are formed during the strong updrafts of warm air and downdrafts of cold air, when the water droplets are carried well above the freezing level to temperatures below 32 degrees F, and then the frozen droplet begins to fall, carried by cold downdrafts, and may begin to thaw as it moves into warmer air toward the bottom of the thunderstorm. This movement up and down inside the cloud, through cold then warmer temperatures, causes the droplet to add layers of ice and can become quite large, sometimes round or oval shaped and sometimes irregularly shaped, before it finally falls to the ground as hail.

Hail usually occurs during severe thunderstorms, which also produce frequent lightning, flash flooding and strong winds, with the potential of tornadoes. The hail size ranges from smaller than a pea to as large as a softball, and can be very destructive to buildings, vehicles and crops. Even small hail can cause significant damage to young and tender plants. Hail usually lasts an average of 10 to 20 minutes but may last much longer in some storms. Hail causes $1 billion in damage to crops and property each year in the U.S. The costliest hailstorm in the United States was in Denver in July 1990 with damage of $625 million.

No part of the State is immune to hailstorms. Once the summer monsoon starts, thunderstorms often develop in the afternoons and evenings. Mountainous areas usually see more storms than the plains and desert, although mountain storms tend to be less severe and produce smaller hail. In the plains and over the desert, monsoon thunderstorms sometimes reach severe levels and can produce large hail. Figure 4-188 shows hail sizes and possible damages from hail events.

According to the NWS, oversized and severe hailstorms occur most frequently in May, followed by June, July, and April. Most counties across the eastern half of the State will see large hail ranging from golf ball to softball at least six to eight times during the spring and also during the summer thunderstorm season. Smaller hail is much more frequent and common in all counties across the east. Counties in the central and western areas will see damaging hail at least twice each year. Hail the size of baseballs or softballs has been reported near Albuquerque, Santa Fe, and Las Cruces within the past three to six years. The Socorro hail storm in October 2004 caused nearly 40 million dollars in damage from baseball sized hail.[130]

The current online NCDC database is limited in past events and contains data from May 1955 to December 2017, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total of 4,195 hail events resulting in two deaths, 61 injuries, $94,019,060 in property damage and $14,250,220 in crop damage.

Figure 4-188 combines the NOAA and TORRO hailstorm intensity scales as a way of describing the size of hail based on the intensity and diameter of the hail.[131]

Figure 4-188 Combined NOAA/TORRO Hailstorm Intensity Scale

Combined NOAA/TORRO Hailstorm Intensity Scales					
	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^{2}	Description	Typical Damage Impacts
H0	Hard Hail	5	0-20	Pea	No damage
H1	Potentially Damaging	5-15	>20	Mothball	Slight general damage to plants, crops
H2	Significant	10-20	>100	Marble, grape	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	>300	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scoured

130 Source: http://www.srh.noaa.gov/abq/?n=prephazards
131 Source: Tornado and Strom Research Organization, http://www.torro.org.uk/hscale.php

Combined NOAA/TORRO Hailstorm Intensity Scales					
	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	Description	Typical Damage Impacts
H4	Severe	25-40	>500	Pigeon's Egg > Squash ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	>800	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60		Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75		Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
H8	Destructive	60-90		Large orange > Softball	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100		Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Melon	Extensive structural

4.5.11.2 *Previous Occurrences*

Thunderstorm activity in New Mexico is consistent due to seasonal meteorological patterns and local topographical conditions. The entire State is susceptible to a full range of weather conditions, including thunderstorms, lightning, and hail. All areas of State are susceptible to thunderstorm conditions, although local topography, such as elevation and land contours, plays a significant part in how weather affects a particular area. For the purpose of this report, all areas of the State are considered equally vulnerable to all types of thunderstorm activity.

The impacts of thunderstorms vary according to the types of secondary hazards they produce. Thunderstorms can cause substantial rainfall leading to localized flash flooding. Additionally, thunderstorms can cause lightning strikes that have the potential to ignite wildfires and lead to injury and death. Hailstorms are another potential result of thunderstorms and they can sometimes damage agricultural crops and cause property damage.

Figure 1-5 in Appendix A briefly explains the most significant thunderstorm events (includes lightning and hail) that have occurred in the State of New Mexico from January 1, 2006 to December 2017. The location of the events are identified by city or county and Preparedness Area. Source information is from the NCDC and data provided by local authorities.

Thunderstorm events characterized by high wind/hail events are common throughout New Mexico and occur hundreds of times each year. Analysis of the number of reported occurrences for the six Preparedness Areas from May 1955 to December 2017 by the NCDC shows a clear concentration of thunderstorm activity in Preparedness Areas 1, 2, 5 and 6. Conversely, concentrated areas of low thunderstorm occurrence were found in Preparedness Areas 3 and 4. Figure 4-189 outlines those significant thunderstorm events between 1955 and 2017 as identified in the NCDC.

Figure 4-189 Preparedness Area 1 - 6 Thunderstorm History (May 1955 – December 2017) [132]

Preparedness Area 1
Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln, Quay and Roosevelt

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	2,284	.75 – 4.25 in.	1	52	$50,042,450	$12,093,200
Heavy Rain	52	0	0	0	$2,000	$0
Lightning	14	0	5	4	$275,000	$0
Thunderstorm Wind	912	0-90 kts	3	16	$17,454,200	$5,210,500
Total	**3,262**	**-**	**9**	**72**	**$67,773,850**	**$17,303,700**

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	979	.25 – 3 in.	0	12	$5,915,600	$1,000
Heavy Rain	5	0	0	0	$0	$0
Lightning	4	0	1	3	$0	$0
Thunderstorm Wind	141	0-65 kts	0	3	$358,500	$3,000

[132] Source: http://www.ncdc.noaa.gov

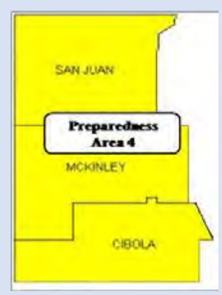
Total	**1,129**	**-**	**1**	**18**	**$6,274,100**	**$4,000**	

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

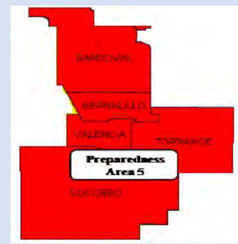
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	181	.75 – 2.5 in.	0	0	$1,260,500	$500
Heavy Rain	2	0	0	0	$0	$0
Lightning	19	0	3	9	$191,000	$100
Thunderstorm Wind	63	0 to 70 kts	0	3	$479,500	$0
Total	**265**	**-**	**3**	**12**	**$1,931,000**	**$600**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

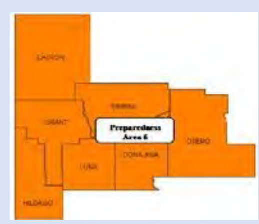
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	58	.75 – 1.75 in.	0	3	$1,000	$0
Heavy Rain	8	0	1	5	$215,000	$0
Lightning	6	0	1	4	$70,000	$0
Thunderstorm Wind	59	0 to 90 kts	0	1	$643,000	$1,000
Total	**131**	**-**	**2**	**13**	**$929,000**	**$1,000**



Preparedness Area 5 **Counties:** Bernalillo, Sandoval, Socorro, Torrance and Valencia **Pueblos:** Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Hail	350	.75-4.5 in.	0	20	$55,330,500	$300,000
Heavy Rain	21	0	0	4	$1,529,000	$0
Lightning	18	0	2	20	$220,500	$500
Thunderstorm Wind	175	0 to 87 kts	0	0	$4,412,000	$1,000
Total	**564**	**-**	**2**	**44**	**$57,492,000**	**$301,000**



Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Hail	352	.75 – 2.75 in.	1	0	$20,472,010	$727,010
Heavy Rain	38	0	0	0	$0	$0
Lightning	2	0	1	6	$1,000	$0
Thunderstorm Wind	237	0 to 100 kts	0	5	$2,333,000	$50,000
Total	**629**	**-**	**2**	**11**	**$22,806,010**	**$777,010**



4.5.11.3 *Frequency*

The entire State of New Mexico can be equally affected by thunderstorm events, hail and lightning. The State has maintained a list of past thunderstorm occurrences highlighting their vulnerabilities as medium in damage from hail and lightning strikes. Since 1955, Preparedness Area 1 recorded 2,193 hail events with over $62 Million in associated damages. Interesting to note, Preparedness Area 5 has recorded only 518 events with almost the same amount in damages (over $56 Million). This can be attributed to this area being more densely populated and having more infrastructure compared to Preparedness Area 1, which is very rural. Hail events have in the State, specifically in Preparedness Area 1, recorded hail as large as 4.25 inches in diameter or referring to Figure 4-188, anywhere from H0 to H10.

4.5.11.4 *Probability of Occurrence*

All Preparedness Areas in New Mexico experience severe thunderstorms producing high winds, large hail, deadly lightning, and heavy rains at some time during the year. During the spring, from April through June, storms are at a peak mainly in the eastern areas of the State. Storms become more numerous State-wide from July through August. Although the vulnerability is State-wide, those areas with a larger vulnerability to the effects include places where the population is concentrated and buildings have not been updated to meet current building code standards.

To determine the probability of New Mexico experiencing thunderstorm occurrences, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of May 1955 to December 2017 (751 months/62 years). Probability was determined by using the Poisson Model to analyze the rate of exceedance. The Poisson model is the most commonly used model for the occurrence of random point events in time.[133] This gives the percent chance of the event happening in any given year. In applying this formula, Preparedness Areas probabilities to the following hazards are identified in Figure 4-190. Those Preparedness Areas with the least probability of a Thunderstorm event occurring is in Preparedness Areas 3 and 4.

Figure 4-190 Probability of Occurrence (Thunderstorm Events)

Probability of Occurrence				
Preparedness Area	Hail	Heavy Rain	Lightning	Thunderstorm Wind
Preparedness Area 1	100%	84%	23%	100%
Preparedness Area 2	100%	8%	6%	100%
Preparedness Area 3	100%	3%	31%	100%
Preparedness Area 4	94%	13%	10%	95%
Preparedness Area 5	100%	34%	29%	100%
Preparedness Area 6	100%	61%	3%	100%

4.5.11.5 *Risk Assessment*

Severe weather is difficult to predict precisely in pattern, frequency, and degree of severity. The impact from thunderstorm events (thunderstorms, hail, and lightning) has been moderate, with localized flooding occurring from severe thunderstorms and minor damages from lightning and moderate to heavy damage to specific locations from hail. Highly vulnerable populations include those in mobile

[133] Source: https://pubs.usgs.gov/of/2000/ofr-00-0249/ProbModels.html

home parks, recreational vehicles, and aged or dilapidated housing, but no area is safe. Figure 4-191 identifies potential impacts from thunderstorms for the purposes of EMAP compliance.

Figure 4-191 Potential Thunderstorm Impacts

Subject	Potential Impacts
Agriculture	Agriculture operations are often times prone to damage by thunderstorm activity. Lightening cause fires, animal and human strikes, high winds and hail can ruin both livestock and crop production.
Health and Safety of the Public	The component elements of a thunderstorm (lightning and hail) can and have impacted the public in the State. Lightning strikes have caused hospitalizations and fatalities. Individuals struck by hail have also sustained injury.
Health and Safety of Responders	Similar to the impacts to the public, any responders who are out of doors at the time of a lightning strike or hailstorm have and can receive serious injuries. Responders are at a higher risk due to the fact that they are often outside during major events assisting the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or have power failures during an event.
Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or have power failures during an event.
Property, Facilities, Infrastructure	Property, facilities and infrastructure can be impacted by thunderstorm events. Lightning and the subsequent fires may destroy a facility or property. Heavy damage to roofs, windows and utilities components may be inflicted by hail.
Environment	Thunderstorms can cause crop or plant damages. Lightning caused fires may burn large areas.
Economic Condition	The overall economic condition is expected to be impacted only slightly.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

4.5.11.6 *Data Limitations*

Raw data is available dating back to 1955 for thunderstorm, lightning, and hail storm occurrence in the State. Further analysis and summary of the historical data could be accomplished for the next Mitigation Plan update.

4.5.11.7 *What Can Be Mitigated?*

One important part of mitigating thunderstorm hazards is forecasting and warning so that people can prepare. Each Preparedness Area can prepare for disruptions of utilities and transportation due to thunderstorm events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National

Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending storms. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

4.5.11.8 *Changing Weather Patterns*

At the time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of severe thunderstorm, hail or lightning events in the State of New Mexico.

4.5.12 Tornadoes

4.5.12.1 *Hazard Characteristics*

A tornado is an intense rotating column of air, extending from a thunderstorm cloud system. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 mph, but some may have winds exceeding 300 mph. The following are NWS definitions of a tornado and associated terms:

- **Tornado** – A violently rotating column of air that is touching the ground.
- **Funnel cloud** – A rapidly rotating column of air that does not touch the ground.
- **Downburst** – A strong downdraft, initiated by a thunderstorm, which induces an outburst of straight-line winds on or near the ground. They may last anywhere from a few minutes in small-scale microbursts to periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds in downbursts can reach 150 mph and therefore can result in damages similar to tornado damages.

Tornadoes are classified by the degree of damage they cause. The tornado classification, shown in Figure 4-192, is called the Fujita Scale. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.

Figure 4-192 Fujita Tornado Damage Scale[134]

Fujita Scale			
F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.

[134] Source: NOAA, http://www.spc.noaa.gov/faq/tornado/f-scale.html

Fujita Scale			
F-Scale Number	**Intensity Phrase**	**Wind Speed**	**Type of Damage**
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off framed houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

On February 1, 2007, the Fujita scale was decommissioned in favor of the more accurate Enhanced Fujita Scale, shown in Figure 4-193, which replaces it. None of the tornadoes recorded on or before January 31, 2007 will be re-categorized. Therefore, maintaining the Fujita scale will be necessary when referring to previous events.[135]

Figure 4-193 Enhanced Fujita (EF) Scale[136]

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential 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.

[135] Source: http://en.wikipedia.org/wiki/Fujita_scale
[136] Source: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
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	>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.

The **Enhanced Fujita Scale**, or **EF Scale**, is the scale for rating the strength of tornadoes in the United States estimated via the damage they cause. Implemented in place of the Fujita scale, it was used starting February 1, 2007. The scale has the same basic design as the original Fujita scale, six categories from zero to five representing increasing degrees of damage. It was revised to reflect better examinations of tornado damage surveys, so as to align wind speeds more closely with associated storm damage. The new scale takes into account how most structures are designed, and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes.

Tornadoes cause an average of 70 fatalities and 1,500 injuries in the U.S. each year. The strongest tornadoes have rotating winds of more than 250 mph and can be one mile wide and stay on the ground over 50 miles. Tornadoes may appear nearly transparent until dust and debris are picked up or a cloud forms within the funnel. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. The average forward speed is 30 mph but may vary from nearly stationary to 70 mph.[137]

Damages from tornadoes result from extreme wind pressure and windborne debris. Because tornadoes are generally associated with severe storm systems, they are often accompanied by hail, torrential rain, and intense lightning. Depending on their intensity, tornadoes can uproot trees, bring down power lines,

[137] Source: http://www.nws.noaa.gov/om/tornado/index.shtml

and destroy buildings. Flying debris is the main cause of serious injury and death. New Mexico lies along the southwestern edge of the nation's maximum frequency belt for tornadoes, often referred to as "tornado alley," which extends from the Great Plains through the central portion of the U.S. Broadly speaking, the eastern portions of New Mexico have a higher frequency of tornadoes; however, every county in the State has the potential to experience tornadoes. The publication "FEMA 320 Taking Shelter from the Storm," December 2014, presents a method where by residents can determine their tornado risk.[138] The majority of New Mexico is located in Wind Zone II while the western most portions of the state are located in Zone I. The FEMA publication recommends consideration for safe rooms in Wind Zone II while Wind Zone I is considered a matter or preference due to the limited risk.

Figure 4-194 describes the risks associated to tornadoes for determining shelter requirements.

Figure 4-194 Tornado Risk Table as of 2014[139]

		Wind Zone			
		I	II	III	IV
Tornadoes Per 3,700 Square Miles	<1	Low Risk	Low Risk	Low Risk	Moderate Risk
	1-5	Low Risk	Moderate Risk	High Risk	High Risk
	6-10	Low Risk	Moderate Risk	High Risk	High Risk
	11-15	High Risk	High Risk	High Risk	High Risk
	>15	High Risk	High Risk	High Risk	High Risk
	Low Risk		Moderate Risk		High Risk
	High-wind Shelters are a matter of homeowner preference		Shelter should be considered for protection from high winds		Shelter is the preferred method of protection from high winds

Figure 4-195 illustrates tornado activity in the United States as provided by the NOAA Storm Prediction Center Statistics.

[138] Source: https://www.fema.gov/media-library/assets/documents/2009

[139] Source: FEMA publication "FEMA 320 Taking Shelter from the Storm" https://www.fema.gov/media-library/assets/documents/2009

Figure 4-195 Recorded EF3, EF4, and EF5 Tornadoes in US from 1950 to 2013

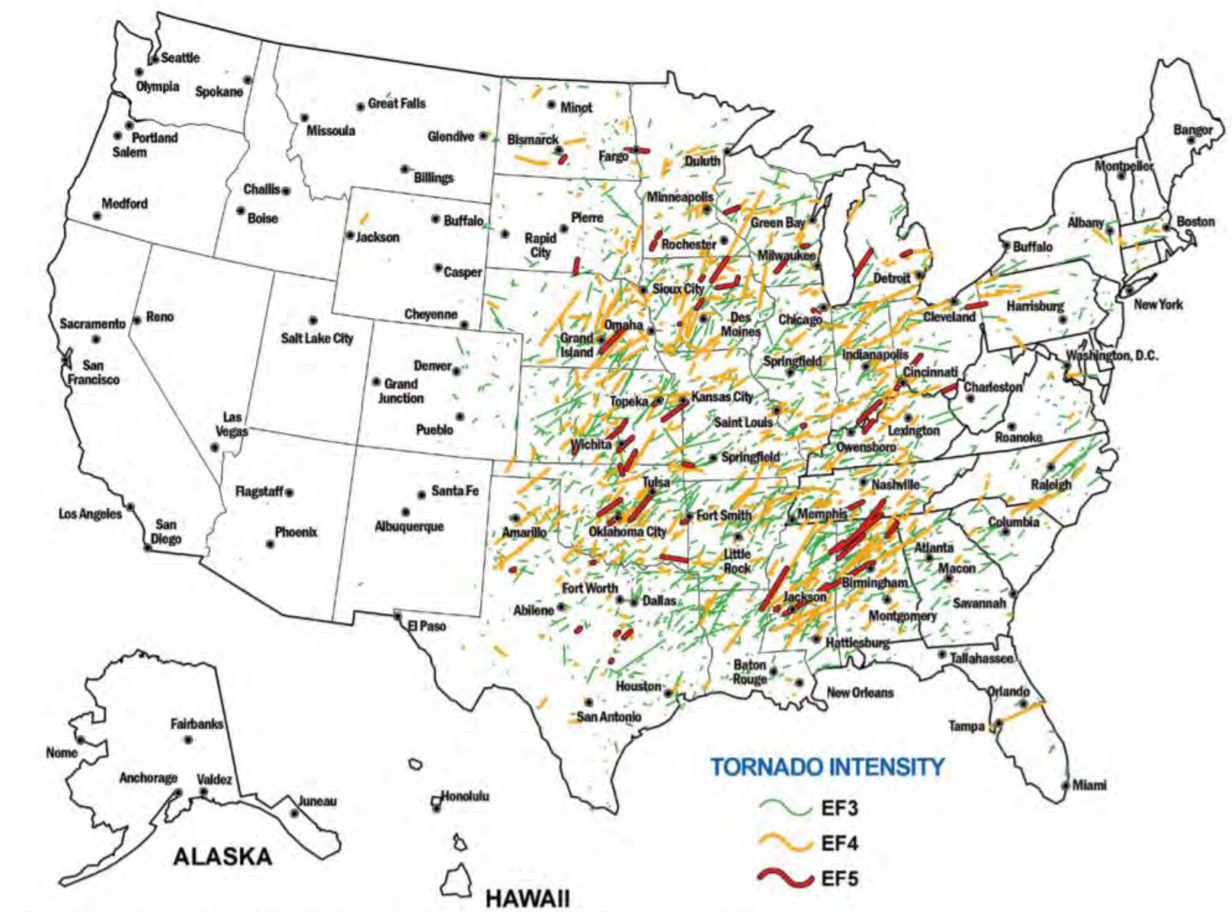


Figure 2-2: Recorded EF3, EF4, and EF5 tornadoes in the United States from 1950 to 2013

SOURCE: NOAA NATIONAL WEATHER SERVICE, STORM PREDICTION CENTER

4.5.12.2 *Previous Occurrences*

Tornadoes have been verified in most New Mexico counties. The highest risk of tornadoes is in the east during April through July, but tornadoes are possible with any thunderstorm. New Mexico averages about 10 tornadoes in a year. For example, on October 21, 2010, a tornado tracked just north of Roswell. A significant tornado outbreak occurred on May 23, 2010 across eastern Union County. [140]

New Mexico experiences mostly weak, short-lived tornadoes. Strong tornadoes, while rare, are possible and occur about once every 10 years. Seventy-five (75) percent of severe storms with tornadoes occur in eastern New Mexico and are most likely to occur between April and July. However, the latest tornado fatalities in New Mexico occurred on March 23, 2007 when two people died, one near Clovis (and 33 were injured) and one in Quay County. Another fatality occurred west of Albuquerque in October 1974 and a rare winter tornado was reported southwest of Roswell in December 1997. This shows that

[140] Source: 2013 New Mexico Hazard Mitigation Plan

tornadoes can be deadly at any time and nearly anywhere within the State, at both low and high elevations.

The current online NCDC database is limited in past events and contains data from 1950 to December 2017, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total 588 Tornado events, five deaths, 156 injured, $60,606,180 million in property damage, and $260,000 thousand in crop damage between July 1950 and December 2017.

Figure 4-196 briefly explains those significant tornado events that have occurred in the State of New Mexico. The location of the event is identified by both the city and county and Preparedness Area. Source information is from the NCDC and data provided by local authorities. Table 2.70 provides a cumulative overview of all tornado events that have occurred in all Preparedness Areas.

Figure 4-196 Significant Past Occurrences - Tornado (2006-2017)

Date	Location	Significant Event
May 09, 2017	Torrance County, Santa Fe County, Lincoln County, Mora County (Preparedness Areas 1, 2, 3, 5)	A potent upper level low pressure system moving slowly east across the desert southwest for several days combined with abundant moisture and instability on the 9th to generate a widespread, significant severe weather outbreak over central and eastern New Mexico. Isolated thunderstorms developed shortly after midnight in the area from Santa Fe to Farmington and produced quarter size hail with heavy rain and strong winds. A large area of showers and thunderstorms developed shortly after sunrise over central New Mexico and moved north across the Albuquerque and Santa Fe metro areas through the early afternoon. Several funnel clouds and large hail were reported around the Estancia Valley. A brief tornado developed near the Santa Fe airport shortly after noon with minor damage reported. A major hailstorm struck the Interstate 25 corridor near Kewa Pueblo, resulting in damage to homes and vehicles. The next wave of storms that developed over central New Mexico produced tornadoes near Carrizozo, Clines Corners, and Wagon Mound. Large hail up to the size of golf balls was also reported with these storms. More storms firing up around the Albuquerque metro area produced nickel to quarter size hail from Rio Rancho north into the Jemez Mountains. Severe thunderstorms continued to pound eastern New Mexico well into the evening hours with golf ball to hen egg size hail producing damage in areas around Roswell and Tucumcari.

Date	Location	Significant Event
August 13, 2016	Union County (Preparedness Area 2)	A back door cold front surged southwest across New Mexico and interacted with a very rich plume of monsoon moisture surging northward into the State. A strong thunderstorm around Ojo Encino produced a brief landspout tornado. This tornado captured lots of attention at a nearby baseball field. Another tornado was reported near Capulin on a distant mesa. No damage was reported from either storm. A funnel cloud was also spotted near Ocate. The most impactful thunderstorm of the day occurred along Interstate 40 near San Fidel. Several inches of penny size hail accumulated on the interstate. Brief rope tornado touched down on a distant mesa near Capulin Volcano National Monument.
July 07, 2015	Rio Arriba County, Santa Fe County, San Juan County, Torrance County (Preparedness Areas 3, 4, and 5)	Monsoon moisture firmly in place over New Mexico focused another round of very heavy rainfall and severe thunderstorms. Storms with torrential rainfall and strong winds erupted over the State. A storm that developed around Shiprock moved northeast over La Plata and produced flash flooding along U.S. 170. Law enforcement reported that 12 inches of water was flowing over the roadway. A thunderstorm that moved southeast along two colliding outflow boundaries near Edgewood produced a brief tornado. A metal barn for storing hay was tossed a quarter mile and slammed into a house where a woman was injured by flying glass. This same storm also produced quarter size hail.
October 21, 2010	Roswell, NM (Preparedness Area 1)	Tornado tracked just north of Roswell.
May 23, 2010	Union County (Preparedness Area 2)	Swarm of tornadoes tracked through Union County.
October 11, 2009	Stanley, NM (Santa Fe County) (Preparedness Area 3)	Two miles east of Stanley a tornado touched down (Santa Fe County) causing $12K in damage it registered as a F0. There were no injuries or deaths.
July 13, 2009	Tres Piedras, NM (Taos County) (Preparedness Area 3)	Two miles south of Tres Piedras a tornado touched down (Taos County) causing $10K in damage; it registered as a F0. There were no injuries or deaths.

Date	Location	Significant Event
March 23, 2007	Clovis, Logan, Lovington, Arch, Rogers, Portales, and McDonald, NM (Preparedness Area 1)	Widespread severe weather ignited over much of the eastern plains. Large hail was reported at several locations, stretching from southeast New Mexico to central Kansas. In addition, 13 tornadoes where observed across the eastern plains of New Mexico. The two tornadoes that provided the most significant damage in eastern New Mexico were located at Logan and Clovis. The Logan tornado created damage that fit within the EF0 to EF1 range on the enhanced Fujita scale. Meanwhile, the damage in Clovis was rated to fit within the EF0 to EF2 range. "The Logan tornado created an intermittent three-mile damage track. The heaviest damage was noted on the south end of 4th Street, from Lake Drive north for approximately five blocks. RVs and trailers sustained the most significant damage in the Logan area. The Clovis tornado also created an intermittent three-mile damage track, with the most significant damage noted in the southern and northern sections of the city. Preliminary, estimated maximum winds for this particular tornado ranged from 120 to 125 mph. Mobile homes were destroyed, trees knocked down, power poles snapped, and roofs of substantial buildings and homes heavily damaged or blown off. Other verified tornadoes were reported 16 miles north/northwest of Lovington, 10 miles north of McDonald, seven miles northwest of Tatum, 12 miles north of Tatum, three miles north of Crossroads, one mile south of Milnesand, two miles north of Arch, Rogers, 10 miles northeast of Portales, 10 miles east/southeast of Lakewood, and 15 miles east of Lakewood." The damages (493 structures in Clovis and 97 in Logan) two fatalities and 35 injuries, led to a State Declaration of disaster for Quay, Curry and Roosevelt counties. On April 2, 2007, the president declared disaster 1690, at that time damages were approximately $20 million. Figure 4-198 shows the Clovis tornado damage.[141]

[141] Source: http://www.srh.noaa.gov/abq/quickfeatures/March20 07/Mar23SvrWxEvent.php

Date	Location	Significant Event
June 4, 2003	Portales, NM (Preparedness Area 1)	Damage from brief tornado reported east side of Portales. A small thunderstorm that formed over south central San Miguel County at midafternoon moved eastward into northwest Quay County where it intensified. Near Tucumcari, the storm developed strong meso-cylcone radar signatures. A front continued east and northeast towards San Jon and Logan while the core of the storm headed southeast of Tucumcari. The storm then spread southward into western Curry County and continued through north central and southeast Roosevelt County with frequent reports of large hail and a number of brief tornado and funnel cloud sightings. Reported damages: $20K.
May 28, 1997	Hobbs, NM (Preparedness Area 1)	Damage occurred just west of the Hobbs City. The damage included a 15x20 ft. wooden roof taken off an old shed, parts of two other roofs damaged, an awning from a trailer destroyed, a trailer pushed 3-4 feet off its foundation, and two utility poles downed. The tornado was sighted, and a faint trail of it could be traced in the debris pattern upon inspection. Over $20K in damages were reported.
May 6, 1997	Hobbs, NM (Preparedness Area 1)	A strong meso-cyclone on the leading edge of the severe thunderstorm moving to the southeast produced a tornado on the southeast flank of the storm. Tornadoes ranged from F0 on the southern end to F1 damage in the heart of the tornado path. Damage included travel trailers overturned, mobile homes pushed from foundation and roof sections missing, and a barn was leveled. Approximately $60K in damages were reported.

Date	Location	Significant Event
July 25, 1996	Cimarron, NM (Colfax County) (Preparedness Area 2)	An F2 tornado destroyed 11 homes and seven businesses in Cimarron. Another 43 structures were damaged. Among the buildings destroyed was the Post Office, which was sliced by the air-borne frame of a mobile home. Of the five injuries, two were serious, requiring hospitalization. All injuries occurred in mobile homes or portable buildings without permanent foundations. The tornado developed as convection moved over a horizontal shear axis created by southeast surface winds and northwest winds aloft above the foothills located just northwest of Cimarron. Reported damages approached $2 million. [142]

Declared Disasters from Tornadoes

DHSEM reports one State Declared Disaster for a tornado between 2003 and 2017. This number is based on how many Executive Orders were signed by the Governor. According to DHSEM records, the total cost for the 2007 State Declared tornado was $848,660 (Figure 4-197). Research into damage amount per County has yet to be completed. However, all damage associated with this Executive Order was sustained within Preparedness Area 1. There were no Federal Disaster Declarations for Tornadoes from 2003 through 2017.

Figure 4-197 State Disaster Event Information 2003 through 2017

Event Type	State Executive Order	Dollar Loss*
Tornado	07-013	$848,660.0
Total	**1**	**$848,660.0**

Another source of tornado damage information is from the NCDC. Below is a tally of tornado damage as reported by NCDC broken out by Preparedness Area (Figure 4-199). According to NCDC, State-wide damages included $60,606,180 in property damage and $260,000 in crop damage from tornado events reported from 1950 through 2017.

[142] Source: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Figure 4-198 Clovis Tornado Damage[143]

Below, Figure 4-199 outlines significant past tornado events that have occurred in New Mexico by Preparedness Area. Magnitude has been updated to represent the Enhanced Fujita Scale.

Figure 4-199 Preparedness Area 1 - 6 Tornado History (July 1950 to December 2017)

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Tornado	29	EF0 to EF3	2	93	$54,943,170	$260,000	
Total	**29**	**EF0 to EF3**	**2**	**93**	**$54,943,170**	**$260,000**	

[143] Source: Clovis News Journal

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

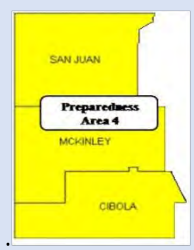
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	89	EF0 - EF3	1	51	$2,913,210	$0
Total	**89**	**EF0 - EF3**	**1**	**51**	**$2,913,210**	**$0**

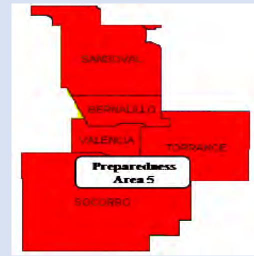
Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	28	EF1	0	1	$552,280	$0
Total	**28**	**EF1**	**0**	**1**	**$552,280**	**$0**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	11	EF0-EF2	1	3	$275,000	$0
Total	**11**	**EF0-EF2**	**1**	**3**	**$275,000**	**$0**



Preparedness Area 5 **Counties:** Bernalillo, Sandoval, Socorro, Torrance and Valencia **Pueblos:** Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Tornado	43	EF0-EF2	1	8	$831,930	$0	
Total	**43**	**EF0-EF2**	**1**	**8**	**$831,930**	**$0**	
Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Tornado	47	EF0-EF3	0	0	$1,090,590	$0	
Total	**47**	**EF0-EF3**	**0**	**0**	**$1,090,590**	**$0**	

4.5.12.3 *Frequency*

The State of New Mexico experiences some tornado activity annually, based on seasonal meteorological patterns and local topographical conditions. New Mexico's complex terrain favors the formation of numerous small landspouts, a weak and short-lived variation of the tornado similar to a dust devil. Landspouts may form without the presence of a strong thunderstorm.

The complex terrain in New Mexico, ranging from the eastern plains, to the high mountains across the northern and western regions, creates weather regimes that change quickly over relatively short distances. Highway travelers, especially truckers, hit by strong gusts of wind that can make driving hazardous. New Mexico experiences mostly weak, short-lived tornadoes. Strong tornadoes, while rare, are possible and occur about once every 10 years.

Based on the data collected by the National Weather Service – Albuquerque, tornado frequency is seen most in the May and June time frame. This is consistent with the NWS' assessment in that:

- During the spring, from April through June, storms are at a peak mainly in the eastern areas of the State. Storms become more numerous State-wide from July through August.
- Tornadoes have been verified in most New Mexico counties. The highest risk of tornadoes is in the east during April through July, but tornadoes are possible with any thunderstorm. New Mexico averages about 10 tornadoes in a year. For example, on October 21, 2010, a tornado

tracked just north of Roswell (Preparedness Area 1). A significant tornado outbreak occurred on May 23, 2010 across eastern Union County (Preparedness Area 2).

4.5.12.4 *Probability of Occurrence*

To determine the probability of each Preparedness Area experiencing future tornado occurrences, the probability or chance of occurrence was calculated based on historical data identified in the NCDC from a period of July 1950 to December 2017 (67 years). Probability was determined by dividing the number of events observed by the number of years (37 years) and multiplying by 100. This gives the percent chance of the event happening in any given year. Figure 4-200 provides the probability of each Preparedness Area experiencing a tornado event in any given year.

Figure 4-200 Probability of Occurrence – Tornado

Probability of Occurrence	
Preparedness Area	**Tornado**
Preparedness Area 1	43%
Preparedness Area 2	100%
Preparedness Area 3	42%
Preparedness Area 4	16%
Preparedness Area 5	64%
Preparedness Area 6	70%

4.5.12.5 *Risk Assessment*

Based on the assessment from data collected in Figure 4-200 above, Preparedness Areas 2, 5 and 6's risk of experiencing a tornado event in any given year is greater than those in the Preparedness Areas 1, 3, or 4. For those Preparedness Areas with the greatest risk, assessments should be taken in consideration and determine what mitigation actions are appropriate for that location. Risks for consideration include manufactured homes that are not adequately anchored are the most vulnerable structures for damage from tornado events. Other risks for consideration include:

- **Environmental Risks**: Tornadoes pose several risks to the environment. The potential for property damage and disruption of vital, natural resources as a result of a tornado is often very high and increases in proportion to the strength of the storm. Tornadoes produce winds that are strong enough to destroy whole towns. These storms can damage water treatment facilities, block roadways, and destroy animal habitats.
- **Biological Risks**: Tornadoes also pose great risks to living things. The most powerful tornadoes are capable of killing hundreds of people. People are not only killed by the strong winds, flooding and debris, but also by fires, exposure to the elements and loss of electricity. Endangered animals and plants in national parks and forests are also killed during tornadoes.

Figure 4-201 identifies potential impacts from tornadoes for the purposes of EMAP compliance.

Figure 4-201 Impacts from Tornadoes

Subject	Potential Impacts
Agriculture	Agriculture infrastructure including those types that have height such as grain silos and windmills are most vulnerable to tornados. Livestock and crop losses have been recorded in the past as well.
Health and Safety of The Public	Injuries and deaths have occurred in the State due to tornadoes. There is no reason to expect that the impacts will not continue.
Health and Safety of Responders	Responders face the same risks as the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Property, Facilities, Infrastructure	A tornado can cause anywhere from minor damage to total destruction of facilities and infrastructure depending on the size of the event. Extensive damages are anticipated.
Economic Condition	A small community can be completely destroyed by a tornado. The economic base (businesses) and individuals can lose everything, and recovery may require substantial investment.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

4.5.12.6 *Data Limitations*

The information necessary to determine the location and condition of manufactured homes and aged or dilapidated structures in areas where tornadoes have touched down was not available during the development of this mitigation plan. Consequently, the SHMPT could not quantify vulnerability of individual structures to damage from tornadoes. Maps and data of past tornado occurrence were not readily available. Numerous sources exist with conflicting information. Clarifying and source checking maps and data is an activity that can be performed for future updates of the State Mitigation Plan.

In addition, accurate methods to quantify potential future damages are not readily available. The amount of business lost due to tornado events has not been calculated due to the difficulty of attaining this information. The SHMPT could also not specify which critical facilities were vulnerable to high wind events. Once the 2010 Census data is integrated into Hazus, modeling can result in potential damage estimates. Subsequent versions of this Plan Update will need to incorporate and respond to these data deficiencies.

4.5.12.7 *What Can Be Mitigated?*

One important part of mitigating tornado hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to high wind events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending tornado events. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to tornado events. The State of New Mexico requires that all modular homes conform to local zoning and State building codes. Governing jurisdictions shall continue to regulate modular homes so that they meet the latest building code requirements, and are built with structural integrity so as to mitigate damage from potential tornado events. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

4.5.12.8 *Changing Weather Patterns*

At the time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of tornadoes in the State of New Mexico.

4.5.13 Volcanoes

4.5.13.1 *Hazard Characteristics*

A volcano is a vent through which molten rock and hot gases escape to the earth's surface. Unlike other mountains, which are pushed up from below, volcanoes are built by surface accumulation of their eruptive products (e.g., lava, pyroclastic flows and surges, and ashfall). When pressure from gases within a magma chamber becomes too great to be contained, an eruption occurs. Volcanic hazards include lava flows, pyroclastic flows and surges, ashfall, volcanic mudflows (lahars), landslides, earthquakes, and those related to gas emissions. Volcanoes produce a wide variety of hazards that can harm and kill people, destroy property, and disrupt vital transportation infrastructure. Large explosive eruptions can endanger people and property hundreds of miles away as well as affect global climate patterns.

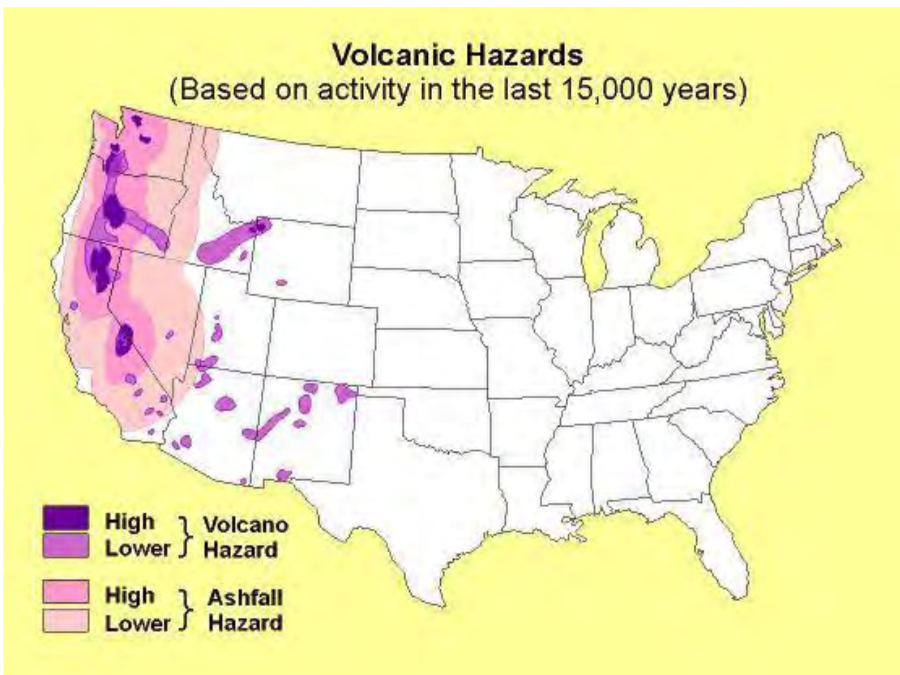
Eruption characteristics (size, style, and duration) are variable for different types of volcanoes and even for a single volcano at different times throughout its history. Eruptions are grouped into one of two categories, effusive and explosive. Effusive eruptions are relatively passive producing lava flows that commonly creep across the land at speeds of two to 10 mph. Explosive eruptions can shoot columns of gases and rock fragments tens of miles into the atmosphere, producing devastating pyroclastic flows and surges, or depositing volcanic ash hundreds of miles downwind. A single eruptive episode can include both effusive and explosive components. The eruptive styles of volcanoes in New Mexico encompass the entire severity range from dangerously explosive to passive.

Lava flows are streams of molten rock that either pour from a vent quietly or through mildly explosive lava fountains. Lava flows destroy virtually everything in their path, but most move slowly enough that people and some property can be moved out of the way. The speed at which lava moves across the ground depends on several factors, including the type of lava erupted, which influences the viscosity, the steepness of the ground, and the rate of lava production at the vent. Lava flows are typically not dangerous to human life, but are a significant fire hazard because of their intense heat. Because lava is fluid the flows typically follow topographic lows and thus detailed knowledge of the topography surrounding dormant and active volcanoes is important for hazard preparedness.

The United States is third in the world, after Japan and Indonesia, for the number of active volcanoes. Since 1980, as many as five volcanoes have erupted each year in the United States. Eruptions are most likely to occur in Hawaii and Alaska. For the Cascade Range in Washington, Oregon, and California, volcanoes erupt on the average of once or twice each century.

Figure 4-202 illustrates the volcanic hazard areas in the continental United States based on events over the last 15,000 years. Areas in purple and dark pink show regions at greater or lesser risk of local volcanic activity, including lava flows, ashfalls, lahars (volcanic mudflows), and debris avalanches. Approximately six regions in New Mexico have been classified with lower risk volcanic hazards. Areas in light pink show regions at risk of receiving five centimeters or more of ashfall from large or very large explosive eruptions, originating at the volcanic centers. These projected ashfall extents are based on observed ashfall distributions from an eruption ("large") of Mt. St. Helens that took place 3,400 years ago, and the eruption of Mt. Mazama ("very large") that formed Crater Lake, Oregon, 6,800 years ago.[144]

Figure 4-202 Volcanic Hazard areas based on events over the last 15,000 years[145]



New Mexico has one of the greatest concentrations of young, well-exposed, and un-eroded volcanoes in North America. See Figure 4-203 below. Volcanism during the last five-million-years is distributed into about 10 major volcanic fields located throughout New Mexico and numerous isolated vents (shown in red on Figure 4-203). Although somewhat challenging to determine, because younger flows commonly cover older flows, an estimated 700 volcanoes have erupted during this time period. These volcanoes reside in all Preparedness Areas (1, 2, 3, 4, 5 and 6) with a majority of volcanic concentration in Preparedness Areas 4 through 6 (Figure 4-203). Figure 4-204 shows the principal types of volcanoes based on their locations by Preparedness Area in the State. The last volcanic episode in the State

[144] Source: http://readyandsafe.mt.gov/Portals/105/Full%202013%20Mitigation%20Plan_1.pdf
[145] Source: Mullineaux, D.R. 1976. Preliminary overview map of volcanic hazards in the 48 conterminous United State: U.S. Geological Survey Miscellaneous Field Studies Map MF-786.

occurred approximately 3,900 years ago with the eruption of several cubic kilometers of basalt (McCartys lava flow of El Malpais.)

Two magma bodies have been imaged in the crust beneath New Mexico. The Socorro magma body is one of only four large mid-crustal active magma bodies in the country; the others are Long Valley (California), Three Sisters (Oregon) and Yellowstone (Wyoming). The inflation of this magma body and fluid circulation above the magma body are responsible for elevated seismic hazards in the Socorro region (see Earthquakes section). In addition to the mid-crustal Socorro Magma Body, a smaller partially crystallized magma chamber has been imaged in the shallow crust beneath the western margins of the Valles Caldera, north-central New Mexico.

Figure 4-203 Map of Volcanic Fields in New Mexico (2016)[146]

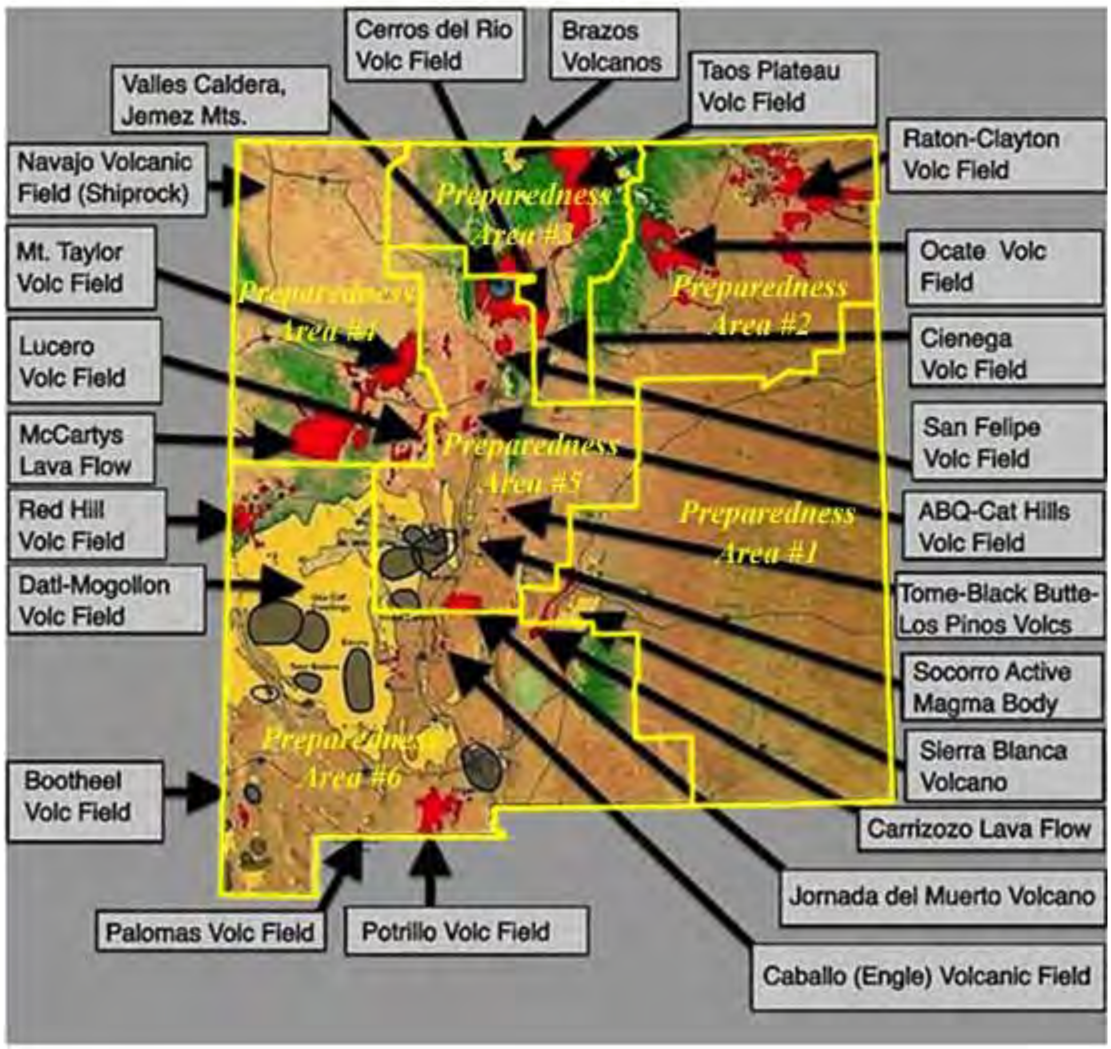


Figure 4-204 provides description of volcano types in New Mexico. The data was provided by the New Mexico Museum of Natural History and Science.[147]

[146] Source: http://nmnaturalhistory.org/online-exhibits-geoscience/volcanoes-new-mexico
[147] Source: http://nmnaturalhistory.org/online-exhibits-geoscience/volcanoes-new-mexico

Figure 4-204 Principal Types of Volcanoes in New Mexico

Large Volume		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Ashflow calderas	Mid-Tertiary (Mogollon-Gila)	Preparedness Area 5
	Valles Caldera, Jemez Volcanic Field	Preparedness Area 5
	Bootheel Volcanic Field	Preparedness Area 6
Composite volcanoes	Agua Fria	Preparedness Area 3
	Mount Taylor Necks	Preparedness Area 4
	Navajo Volcanic Field: Ship Rock	Preparedness Area 4
	Los Lunas	Preparedness Area 5
	Sierra Blanca	Preparedness Area 6
Intermediate Volume		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Scoria cone/silicic dome fields	Raton-Clayton: Capulin Volcano	Preparedness Area 2
	Taos Plateau Volcanic Field	Preparedness Area 3
	Mount Taylor Field	Preparedness Area 4
	Bandera and other El Malpais	Preparedness Area 4
	Red Hill Volcanic Fields	Preparedness Area 6
	Cerros del Rio Volcanic Field	Preparedness Area 3
	Potrillo Volcanic Field	Preparedness Area 6
	Cat Hills Volcanic Field	Preparedness Area 5
	Santa-Ana—San-Felipe	Preparedness Area 5
	Albuquerque Volcanoes	Preparedness Area 5
	Carrizozo-Broken Back Craters	Preparedness Area 1

	Lucero Volcanic Field	Preparedness Area 5
	Ocate Volcanic Field	Preparedness Area 2
	Tusas-Brazos Volcanoes	Preparedness Area 3
Small Volume		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Large lava flows	McCartys Lava Flow	Preparedness Area 4
	Carrizozo Lava Flow	Preparedness Area 1
Maars and tuff rings	Navajo Volcanic Field (Chuska Narbona Pass)	Preparedness Area 4
	Kilbourne Hole	Preparedness Area 6
	Hunts Hole, Potrillo Maar	Preparedness Area 6
	Cerros del Rio	Preparedness Area 3
	Isleta Tuff Ring	Preparedness area 5
	Elephant Butte-Engle Field	Preparedness Area 6
	Red Hill Tuff Rings	Preparedness area 6
	Zuni Salt Lake Maar	Preparedness Area 6
	Mesa Chivato	Preparedness Area 4
Small shield volcanoes	Cerro Verde	Preparedness Area 5
	Cienega Volcanic Filed	Preparedness Area 5
	San Felipe Volcano Field	Preparedness Area 5
	Jornada del Muerto Volcano	Preparedness Area 5
	Caballo (Engle) Volcanic Field	Preparedness Area 6
	Palomas Volcanic Field	Preparedness Area 6
	Navajo Volcanic Field	Preparedness Area 4
	Sierra Grande	Preparedness Area 2

	Tome-Black Butte – Los Pinos Volcanoes	Preparedness Area 5
Magma Bodies		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Active Magma Body	Socorro Magma Body	Preparedness Area 5
Possibly active magma body	Valle Caldera	Preparedness Area 5

Although there are currently no active volcanoes in New Mexico, examples of many types of volcanoes are present in the State. Figure 4-205 below includes a description of the different types of volcanoes found in the State.

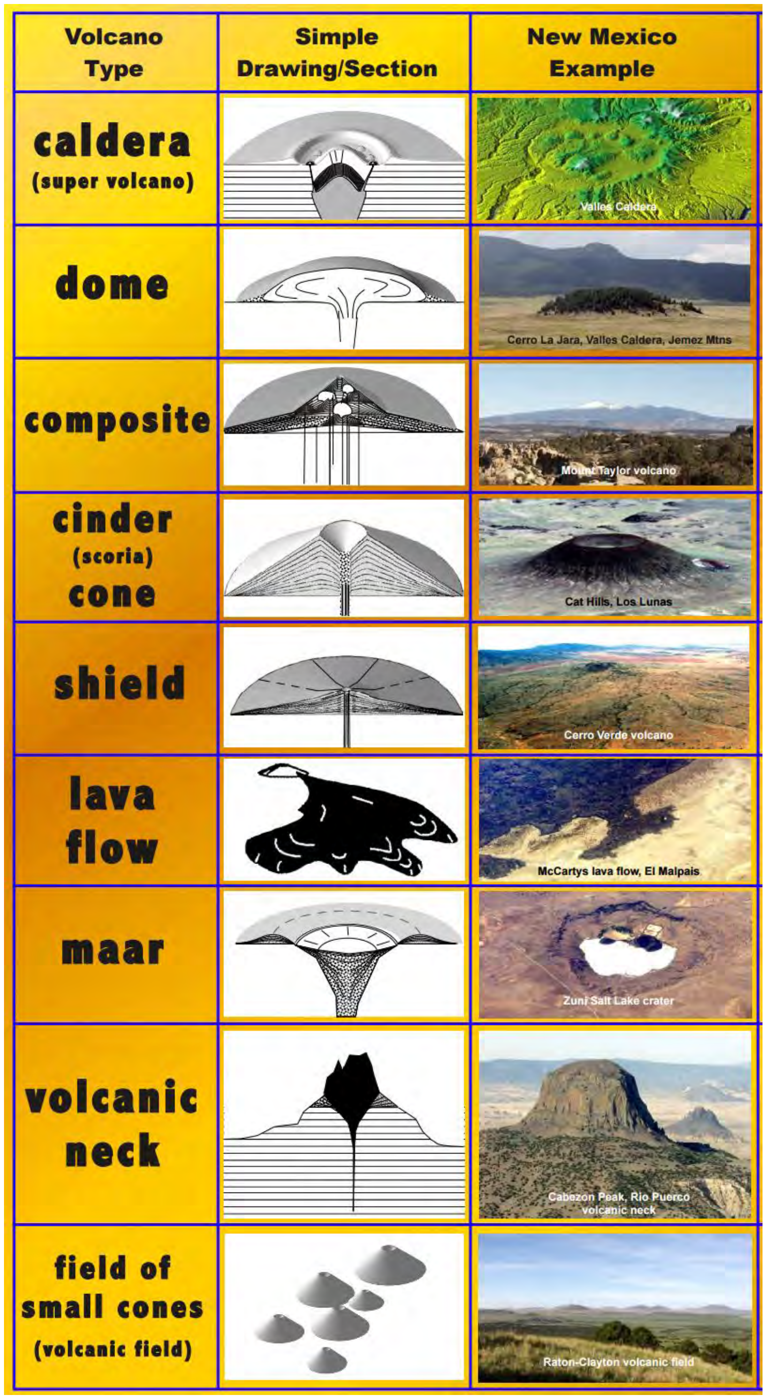
Figure 4-205 Description of Types of Volcanoes found in New Mexico

Volcano Type	Description
Calderas	The type example and one of the largest young calderas in the world (Valles Caldera) is in New Mexico. Calderas are large volume volcanoes many miles in diameter produced from the collapse of the overlying crust into an evacuating magma chamber. Smaller volume eruptions both proceed and postdate the caldera eruption for an extended time interval. Valles caldera is the type example and one of the youngest calderas in the western United States. A cluster of about 20 extinct calderas are located in southwestern NM.
Cinder Cones	There are several large concentrations of young cinder cones are in New Mexico. Cinder cones are small-volume volcanoes built from the accumulation of erupted fragmented material. Cinder cones typically erupt only once and the duration of that eruption lasts days to years. In many cases, a lava flow is associated with the eruption.
Composite Volcano	A volcano consisting of a variety of eruption materials (ash, lava, mudflows, debris flows, and volcanoclastic deposits). Built from many eruptions over time. Also known as stratovolcano. Mount Taylor is an example.
Dome	A circular mound-shaped protrusion resulting from the slow extrusion of viscous lava from a volcano. The geochemistry of lava domes can vary from basalt to rhyolite although most preserved domes tend to have high silica content. Magdalena Peak, in Socorro County is an example.
Fissure Eruptions	Good young examples of a fissure eruption (Albuquerque Volcanoes) are found in New Mexico. Fissure eruptions are typically small volume eruptions that occur along preexisting fractures in the crust. In many cases, a lava flow is associated with the eruption.

Volcano Type	Description
Lava Flows	Two of the largest young basaltic lava flows in the continental U.S. (Carrizozo and McCartys) are in New Mexico. Lava flows are highly variable, ranging in composition, volume, and flow length. Lava flows are associated with nearly every type of volcano.
Maars - Steam Explosion Craters	A number of young volcanic steam explosion craters (referred to as "maars" by geologists) occur in New Mexico. Zuni Salt Lake Crater and Kilbourne Hole Crater are two maars in New Mexico often used as type examples in textbooks. The remains of maars literally fill White Rock Canyon and they pepper the surfaces of many of the other volcanic fields, like the Mount Taylor and Potrillo fields. A significant eruption occurred from Isleta Volcano near Albuquerque. They are more abundant, better preserved, and more diversely exposed than those in the type area (Eifel district of Germany). Maar volcanoes are produced when rising magma interacts with groundwater producing a short-lived, extremely violent steam explosion that generates a shallow crater.
Shield Volcano	A large volcano with a broad summit area and low-angle sloping sides (shield shape) because the extruded products are mainly low viscosity basaltic lava flows. Jornada del Muerto Volcano in Socorro County is a good example.
Volcanic Fields	A collection of volcanoes in a particular region. Great diversity of young volcanic rock types and classic suites of volcanic rocks are present (for example, the Mount Taylor and the Raton-Clayton volcanic fields) occur in New Mexico.
Volcanic Necks	Well-exposed examples of young volcanic necks are found in New Mexico (Rio Puerco Valley).

Figure 4-206 below shows a diagram and photograph of the different types of volcanoes found in the State.

Figure 4-206 Illustration of Types of Volcanoes found in New Mexico[148]



One way to quantify the magnitude of a volcanic eruption is the Volcanic Explosivity Index (VEI), which is proportional to the logarithm of ejecta volume (See Figure 4-207):

[148] Source: http://new.nmnaturalhistory.org/assets/files/Curators/Crumpler/NM_Volc_Types_v4.2.pdf

Figure 4-207 Volcanic Explosivity Index - December 2016[149]

Volcanic Explosivity Index				
VEI	**Description**	**Plume**	**Ejecta volume**	**Frequency**
0	Non-explosive	< 100 m	> 1000 m^3	daily
1	Gentle	100-1000 m	> 10,000 m^3	daily
2	Explosive	1-5 km	> 1,000,000 m^3	weekly
3	Severe	3-15 km	> 10,000,000 m^3	yearly
4	Cataclysmic	10-25 km	> 0.1 km^3	≥ 10 yrs.
5	Paroxysmal	> 25 km	> 1 km^3	≥ 50 yrs.
6	Colossal	> 25 km	> 10 km^3	≥ 100 yrs.
7	Super-colossal	> 25 km	> 100 km^3	≥ 1000 yrs.
8	Mega-colossal	> 25 km	> 1,000 km^3	≥ 10,000 yrs.

With respect to volcanic activity, New Mexico has one of the largest number, largest range of ages, largest diversity of types, largest range of preservation, and some of the best types of examples in North America. The question remains as to how likely it is that an eruption will actually occur in New Mexico in the near future, and what type of eruption this might be. There have been more than 700 volcanic eruptions in New Mexico in the last five million years. At least three eruptions have occurred in the last 10,000 years.

Prior to an eruption, magma (molten rock) migrates into a magma chamber, or reservoir, beneath a volcano. As magma moves toward the surface, it (1) releases gases such as water, sulfur dioxide and carbon dioxide, (2) produces small earthquakes, and (3) causes subtle swelling above the magma chamber and on the flanks of the volcano. Scientists can watch for these warning signs by monitoring gases emitted by the volcano, determining the location, size and migration of small earthquakes under the volcano by using seismographs, and measuring changes on the slopes or inflation of the volcano using tiltmeters and geodetic methods especially permanent and temporarily deployed GPS receivers.[150]

4.5.13.2 *Probability of Occurrence*

To date, there are few estimates of future occurrence of volcanic eruptions in New Mexico in recent history. Volcanism in New Mexico is not "extinct," but is dormant**.** As stated previously, the last volcanic episode in the State occurred approximately 3,900 years ago. Based on past occurrence of volcanism in the State (Figure 4-208), it can be crudely estimated that there is roughly a 1% chance that some type of volcanic eruption could occur somewhere in New Mexico in the next 100 years, and a 10% chance that an eruption will occur in the next 1,000 years. Due to this extremely low probability of occurrence (0.1% chance in 10 years), this hazard will not be discussed in further detail. If circumstances warrant, future versions of the plan will elaborate.

[149] Source: https://volcanoes.usgs.gov/vsc/glossary/vei.html
[150] Source: http://geoinfo.nmt.edu/faq/volcanoes/home.html#when with modification by Richard Aster, Chair of the Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology

Figure 4-208 New Mexico Volcanic Activity by Preparedness Area[151]

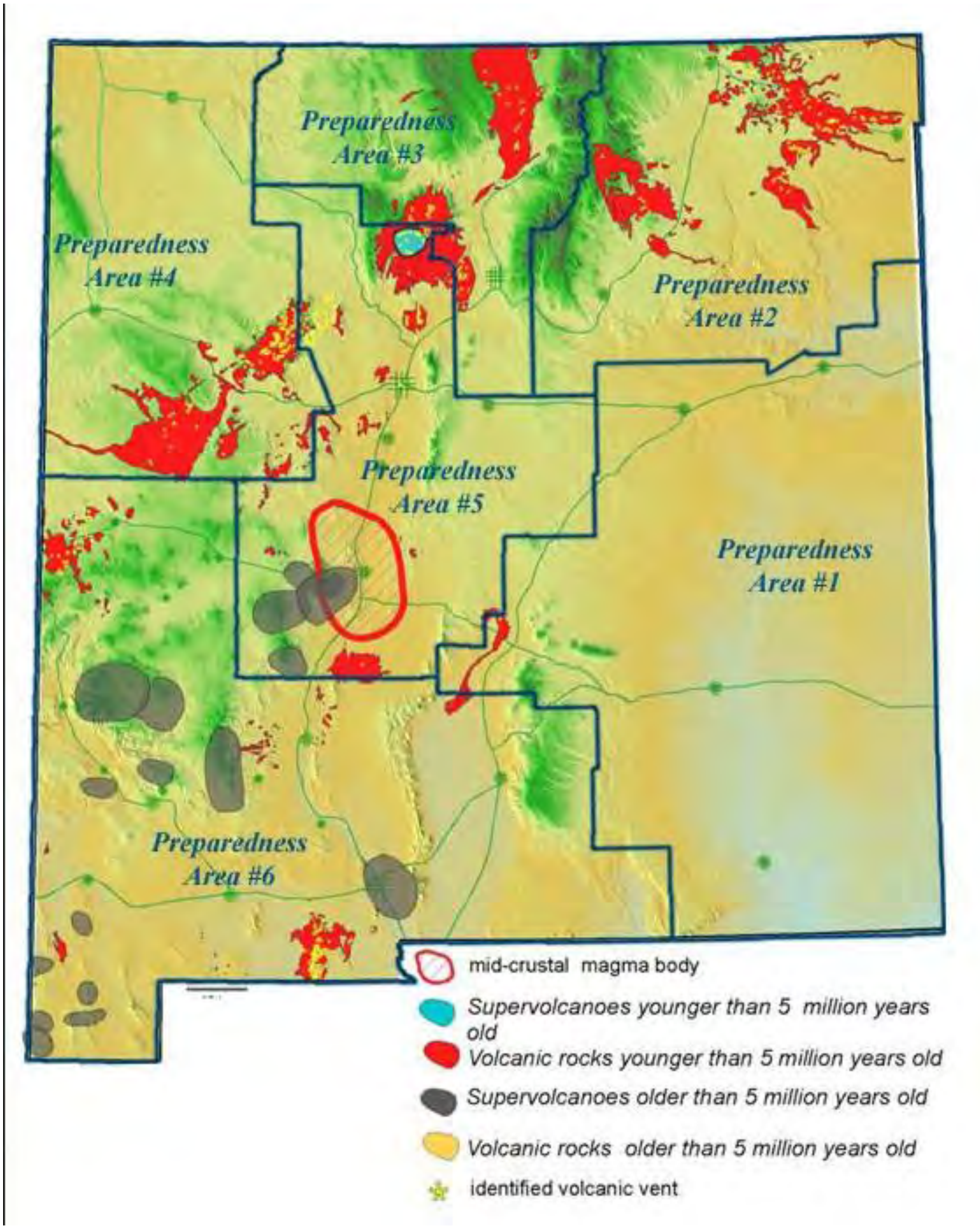


Figure 4-209 identifies potential impacts from a volcanic eruption for the purposes of EMAP compliance.

151 Source: http://nmnaturalhistory.org/sci_volcanoes.html

Figure 4-209 Potential Impacts from Volcanic Eruptions

Subject	Potential Impacts
Agriculture	Agriculture infrastructure, supplying utilities, crops and livestock would be completely devastated in proximity to a volcanic type eruption. While that may seem impossible, some of the most fertile livestock grazing areas are in location of prior volcanic activity.
Health and Safety of The Public	Severe injuries even death possible for individuals in or near the impact areas. Health issues may persist for extended durations after the eruption has stopped (e.g., redistribution of ash from winds).
Health and Safety of Responders	Same impacts as the public.
Continuity of Operations	In the event of a large event operations may be severely hampered; absenteeism expected to rise, severe impacts to facilities.
Delivery of Services	With a large area of damages or large numbers or absentees service delivery may be severely impacted.
Property, Facilities, Infrastructure	Most everything in the path of a volcanic eruption would be destroyed.
Environment	Severe damages anticipated to large areas, depending on the type of eruption.
Economic Condition	If the community is severely impacted, the public may be forced to evacuate effectively shutting down the local economy for an extended period. In addition to local economies, ash clouds could disrupt distant economies particularly those tied to aviation.
Public Confidence	Volcanic eruption is potentially the most devastating natural event for the State. Similarly to other large scale catastrophic events (Katrina, Rita, and Wilma) the public may lose all confidence in the government, if warnings are not issued in anticipation to the event or if response is slow.

4.5.13.3 *Data Limitations*

Due to the prolonged inactivity of the volcanic fields in New Mexico, there is a low probability of eruption in the foreseeable future. Field studies tend to focus on understanding the circumstances of previous events, rather than focusing on predicting future events. The current level of seismic monitoring in the State is limited, but may provide some level of precursory warning of an impending eruption. However, this cannot be assured at this time.

4.5.13.4 *What Can Be Mitigated?*

Mitigation options for volcano eruptions should address the lack of detailed, hazard-specific information at the State and Local jurisdiction level. A possible mitigation action may be to assist in conducting mapping and delineation of areas vulnerable to volcano eruption in and around the State. Currently, the database for volcanism in the State is relatively robust as it relates to age and rock type, two factors useful to assessing the level of risk. However, data pertaining to the styles of eruption, longevity, and scope of their influences depending on type of products, including gases, is poorly constrained. Additional focus on these data areas going forward is important to a better understanding of the risk present. Providing education about possible eruption scenarios, volcano alert system, and the aviation color code warning systems is another possible mitigation action item.

4.5.13.5 *Changing Weather Patterns*

At this time there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of volcanic activity in the State of New Mexico.

4.5.14 Wildland/Wildland – Urban Interface Fire

4.5.14.1 *Hazard Characteristics*

A wildfire means a fire burning uncontrolled on lands covered wholly or in part by timber, brush, grass, grain or other inflammable vegetation. This is increasing the size of the wildland-urban interface (WUI), defined as the area where structures and other human development meet or intermingle with undeveloped wildland.

Topography, fuel, and weather are the three main factors that influence the behavior of a wildfire. Topography can direct the course of a fire. Depressions, such as canyons, funnel air and act as chimneys, intensifying the fire, causing a faster rate of spread. Saddles on ridge tops draw fires and steep slopes can double the rate of spread, due to the close proximity of fuel (vegetation). The rate of spread is generally stated in chains per hour, feet per minute, or meters per minute.

Fuel type, continuity of fuel, and the moisture content of the fuel all affect wildfire behavior. Continuity of fuel applies both horizontally across the landscape and vertically, from the ground surface up to tree crowns via the understory. Weather can have a profound influence on wildfires. Wind can direct the course of a fire and increase the rate of spread. High temperatures and low humidity can intensify fire, while low temperatures and high humidity can greatly limit the potential of a fire.

Wildland fire is a general term describing any non-structure fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

a. Wildfires – Unplanned ignitions or prescribed fires that are declared wildfires; and

b. Prescribed Fires - Planned ignitions.

A wildland fire may be concurrently managed for one or more objectives, and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of various governmental jurisdictions having different missions and objectives. Management response to wildland fire on State and private land is laid out in the NM EMNRD Forestry Division Fire Policy and Procedures Manual. The Division is responsible for suppression of wildland fires on non-Federal, non-Municipal and non-Tribal lands.

Management response on Federal land is based on objectives established in the applicable Land/ Resource Management Plan and/or the Fire Management Plan. Initial action on human-caused wildfire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

Management response on municipal lands is the responsibility of municipal and/or county fire departments.

Management response on Tribal lands is the responsibility of BIA and/or Tribal fire departments and/or County fire departments.

Prescribed fires are planned fires ignited by land managers to accomplish specific natural resource improvement objectives.

The term, "wildland-urban interface" (WUI) refers to areas where structures and other human developments meet or intermingle with wildland vegetation. WUI fires are a particular concern because they pose risks to human lives, property, structures, and critical infrastructure more directly than the other types of wildland fires.

Every fire season, catastrophic losses occur as a result of wildfire in WUI areas in the western United States. Homes are lost, businesses are destroyed, community infrastructure is damaged, and most tragically, lives are lost. Precautionary action taken before a wildfire strikes often makes the difference between saving and losing a structure. Creating defensible space and reducing the ignitability of homes, businesses, and other structures are important components in wildfire hazard reduction. The Firewise Communities Network explains the basics of defensible space and the home ignition zone on the Fire Adapted Communities website: http://www.firewise.org/wildfire-preparedness/be-firewise/home-and-landscape/defensible-space.aspx?sso=964a1cae-4b28-4cbd-9769-7027bc160427.

WUI studies suggest that the intense radiant heat of a wildfire is unlikely to ignite a structure that is more than 30 feet away as long as there is no direct flame impingement. Studies of home survivability indicate that homes with noncombustible roofs and a minimum of 30 feet of defensible space have an 85-percent survival rate (Cohen and Saveland 1997). Conversely, homes with wood shake roofs and less than 30 feet of defensible space have a 15 percent survival rate. The National Fire Protection Associations Standard NFPA 1144 provides a methodology for assessing wildland fire ignition hazards around existing structures, residential developments, and subdivisions and improved property or planned property improvement that will be located in a wildland/urban interface area, and provides minimum requirements for new construction to reduce the potential of structure ignition from wildland fires. See http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1144.

Wildfires may also lead to mudslides, floods, and debris flows in areas where the fire removes the vegetative covering along slopes or burns hot enough to create hydrophobic soils (heat damaged soils that resist water penetration).

Wildfires can occur at any time of day and during any month of the year, but the peak fire season in New Mexico is normally from March through July. The length of the fire season and the peak months vary appreciably from year to year. Land use, vegetation, amount of combustible materials present, and weather conditions such as wind, low humidity, and lack of precipitation are the chief factors in determining the number of fires and acreage burned. Generally, fires are more likely when vegetation is dry from a winter with little snow and/or a spring and summer with sparse rainfall, especially if wet antecedent conditions produced an abundance of fine fuels.

Wildfires have potential to cause significant injury, death, and damage to property. The potential for property damage from fire increases each year as more properties are developed on forested land and increased numbers of people use these areas and adjacent wildland. Fires can have a serious negative impact on the economy of an affected area, especially the logging, recreation, and tourism industries, upon which many counties depend. Major costs associated with wildfires may include the salvage and removal of downed timber and debris, the restoration of the burned area, replacement of lost infrastructure like fencing, transmission lines and communication towers, and preparation for or recovery from post-fire flooding. Additionally, agricultural production and food processing systems are highly vulnerable to the effects of wildfire.

The indirect effects of wildfires can also be catastrophic. Large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may become hydrophobic (lose its capability to absorb moisture and support life). Post-fire impacts may include widespread soil erosion and sedimentation leading to physical degradation of waterways, harm to aquatic life, degraded water quality, and increased risk of flooding and debris flows. Lands stripped of vegetation by wildfires are also subject to increased landslide hazards. Smoke from wildfire threatens air quality and can affect both human and livestock production and health. The New Mexico Environment Department's Smoke Management Program maintains a web page with information and resources for protecting public health. See https://www.env.nm.gov/air-quality/smp/.

Wildfire has greater consequences in some ecosystems than in others. In New Mexico, the interactions between forests, water, and fire are complex and sensitive to disturbance. High elevation forested watersheds produce most of the perennial flow in New Mexico's rivers and recharge underground aquifers. High severity fires in these watersheds can have negative impacts on downstream water supplies.

The Rio Grande, the second largest river in the southwestern United States, features a substantial bosque, or riverside cottonwood forest, which extends some 200 miles through New Mexico, from Santa Fe south to the Bosque del Apache National Wildlife Refuge. The Bosque of the Rio Grande is one of the largest continuous cottonwood gallery forests in the world. This riparian forest ecosystem consists largely of cottonwoods, willows, salt cedar, and other native and invasive species. When these areas are stressed by drought, as has happened in recent years, they become tinderboxes. While increased rainfall over the past three years has reduced the drought conditions throughout the bosque, conditions in this ecosystem continue to be affected by the extensive drought conditions in the last decade. The increase in fuels coupled with invasive species in recent years have contributed to the elevated risk of wildfire in the Rio Grande bosque and other riparian forests throughout New Mexico. The appearance of Tamarisk leaf beetle adds another, albeit poorly understood, wildfire risk factor in areas with significant populations of salt cedar.

Land Ownership

Wildfires that occur in New Mexico affect lands of various ownership types including State, private, Tribal and/or Federal lands. Diverse and complex landownership presents many different challenges when dealing with wildfires.

The majority of the land acreage in New Mexico is privately owned (44%). Approximately 34% of the land is Federally owned. Responsibility for stewardship and management of the forests and woodlands in New Mexico falls primarily to Federal agencies and about 43% of the State's acreage is managed by

Federal agencies. New Mexico's forest land area totals 24.7 million acres. Forest lands comprise 32% of the State's land area. New Mexico's forests blanket a wide variety of environments from the mesquite and juniper woodlands in the southern deserts and steppes, to the timber forests in the southern Rocky Mountains. Privately owned forest land covers 10.7 million acres, or 43% of New Mexico's total forest land area. About 32% of New Mexico's total forest land area, or 7.9 million acres, is administered by the USDA Forest Service.[152] Approximately 9% of forest and woodlands are under state ownership, while Native American tribes own 15%.

The State Forestry Division does not own and manage forest land within New Mexico, but works with partners to promote healthy, sustainable forests in New Mexico through its various programs, encouraging sustainable economic growth while protecting and enhancing watershed health and community safety. The Forestry Division provides technical and financial assistance to State, private, non-Federal public and Tribal landowners and land managers. In recent years, State Forestry has also partnered with the US Forest Service and other agencies to enhance forest management in important watersheds located on Federal lands through the Division's Watershed Restoration Initiative.

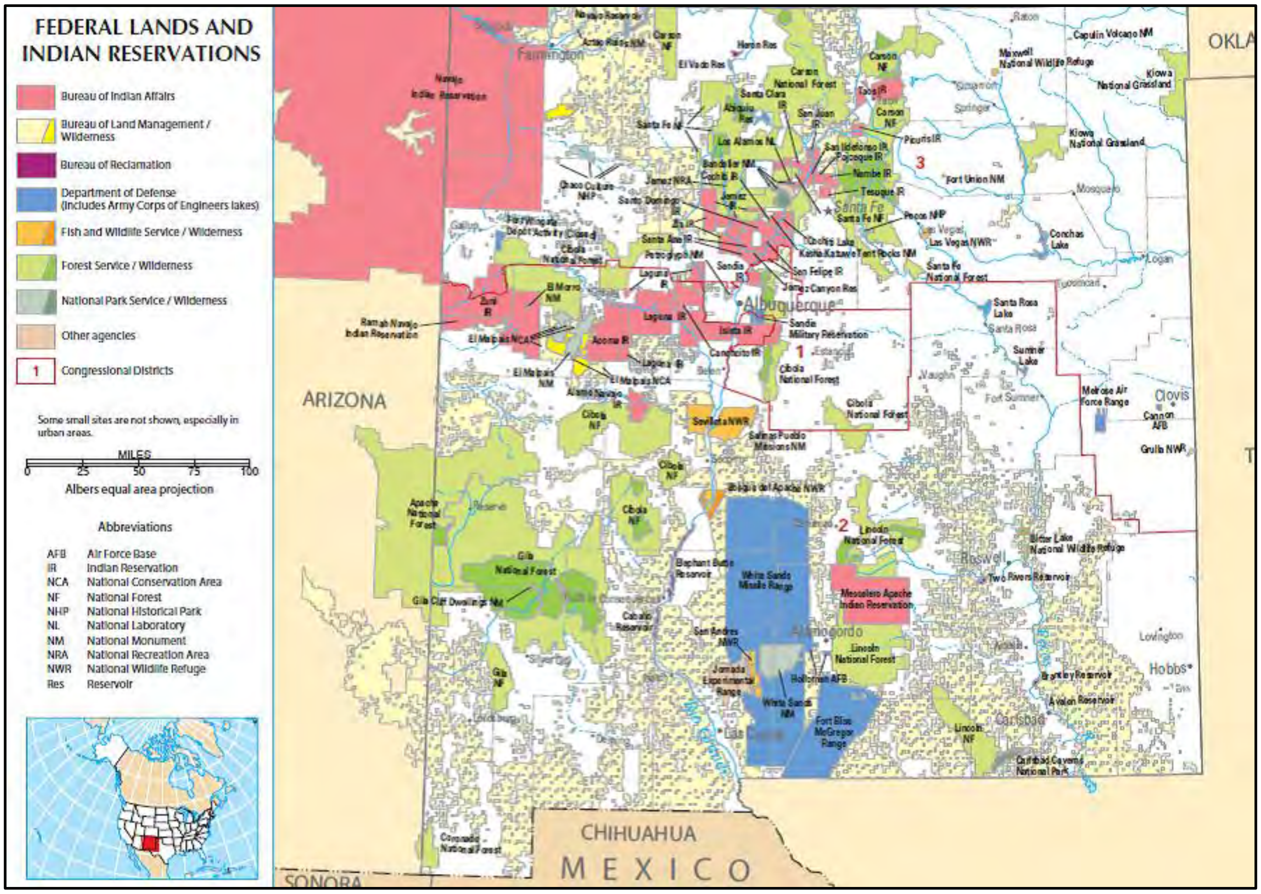
The chart below (Figure 4-210) shows land ownership in total acres, forest acres and woodland acres. Percent of total acres, forest acres and woodland acres is also presented. Figure 4-211 shows a map of Federal lands (by Bureau) and Indian Reservations.

Figure 4-210 Land Ownership in New Mexico

Ownership	Area (acres)	% of NM	Forest (acres)	Woodland (acres)	% of NM Forest
Federal					
Bureau of Land Management	13,481,000	17	97,800	2,161,100	10
Department of Defense	2,552,000	3	7,000	156,700	1
Bureau of Reclamation	54,500	<1	0	0	0
Fish and Wildlife Service	383,000	<1	1,500	42,600	0
National Park Service	379,000	<1	11,000	42,600	0
Forest Service	9,223,000	12	4,811,600	2,785,500	35
Other Federal	237,000	<1			0
Federal, Total	**26,309,500**	34	4,928,900	5,188,500	46
State	**9,171,000**	12	150,500	1,326,700	7
Private	**34,157,000**	44	1,654,800	5,617,600	33
Tribal	**8,178,000**	10	802,700	2,284,600	14
Local	**3,000**	<1	0	0	0
TOTAL	**77,818,500**	**100**	7,536,900	14,417,400	100

[152] Source: Goeking, Sara A.; Menlove, Jim. 2017. New Mexico's forest resources, 2008–2014. Resour. Bull. RMRS-RB-24. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 68 p. https://www.fs.usda.gov/treesearch/pubs/55293

Figure 4-211 Federal Lands and Indian Reservations in New Mexico[153]



Natural vs. Human-caused Wildfire

The only natural cause of wildfire in New Mexico is lightning; however, human carelessness and arson account for the larger portion of all wildfires in the State. Figure 4-212 below is based on State Forestry Division figures for fires on State and private land from 2015 to 2017. Please note that Figure 4-212 is based on State and private land only. Fires on Federal land are reported separately and shown in Figure 4-213.[154]

Figure 4-212 Fires on State and private land (2015-2017)

	Human Caused Fires				Lightning Caused Fires			
Year	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Acres	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Total
2015	211	68.5%	9,959	81%	97	31.5%	2,293	19%
2016	351	58%	80,035	63%	271	42%	47,186	37%

[153] Source: USGS Federal Lands and Indian Reservations, https://nationalmap.gov/small_scale/printable/fedlands.html#list
[154] Source: http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html

	Human Caused Fires				Lightning Caused Fires			
Year	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Acres	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Total
2017	228	70%	18,186	57%	98	30%	13,599	43%

Fires on Federal land are tallied separately. Below is a list of human-caused and lightning caused fires for 2015 and 2016 for the Federal land management agencies in New Mexico. These figures are taken from the Southwest Coordination Center.

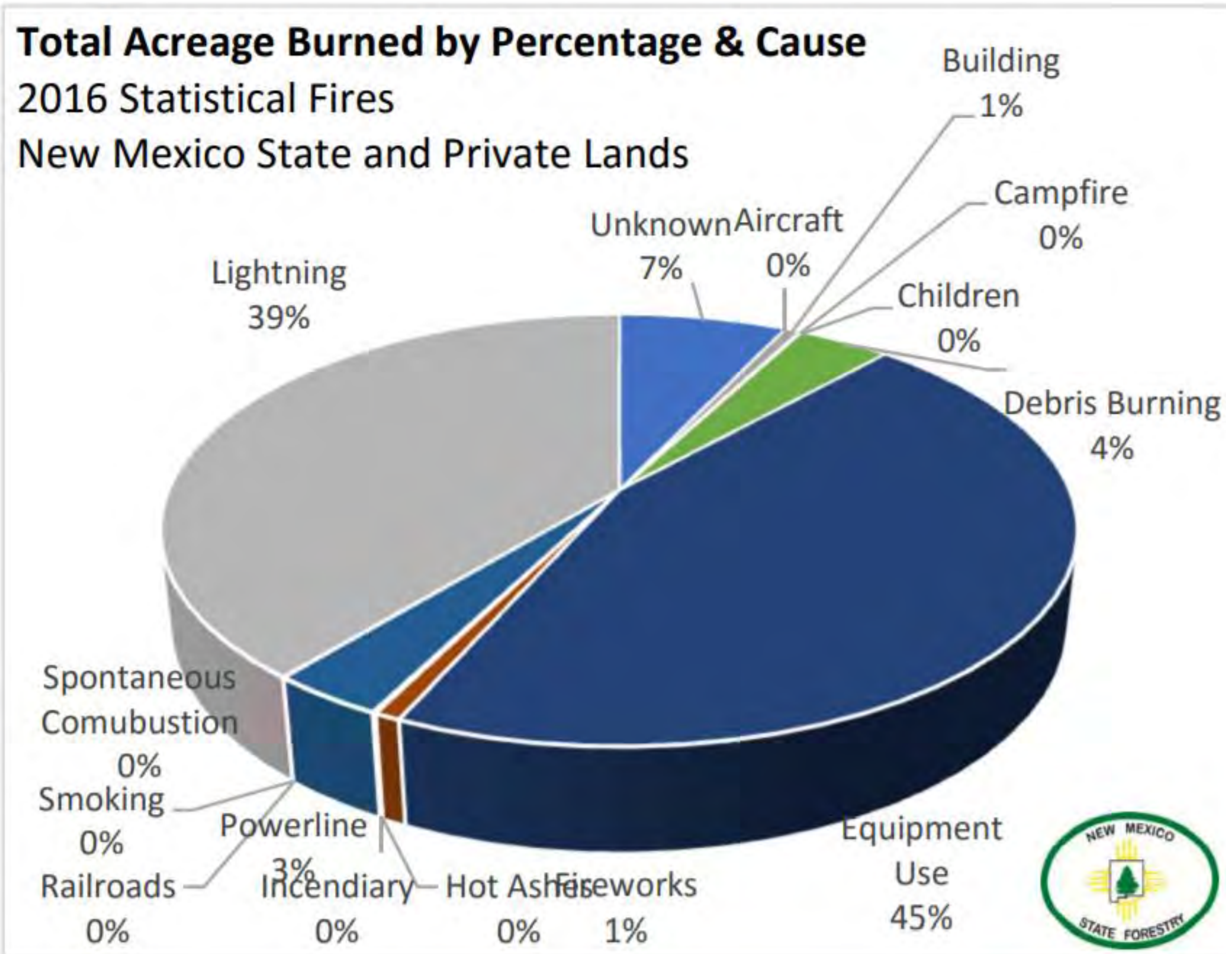
Figure 4-213 Fires on Federal Land (2015-2016)

Agency	Human Caused Fires				Lightning Caused Fires			
	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Acres	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Total
BIA 2015	79	65%	339	18 %	41	35%	1,535	82 %
BIA 2016	142	70%	1,446	84%	62	30%	272	16%
BLM	53	49%	2488	56 %	56	51%	1928	44%
BLM	40	34%	5689	81%	78	60%	1311	19%
USFW	2	100%	1	100%	0	0%	0	0%
USFW	2	29%	0	0%	5	71%	713	100%
NPS 2015	1	10%	0	0%	9	90%	1	100%
NPS 2016	2	85%	.003%	-	11	15%	309	99.996%
USFS	63	28%	183	<.01%	166	72	27980	99.9%
USFS 2016	112	30%	19554	20%	259	70%	80553	80%
Federal 2- year	496		29,701		687		114,602	
State 2- year	557		82,081		368		47,447	
Average per year	527	53%	55,891	41%	528	47%	81,025	59%

For general comparative purposes only, the State and private land fire data was collapsed with the Federal fire data. A total of 3,251 fires burned on Federal, State, and private land in 2015 and 2016. Of that number, 1,716 (53%) were human-caused and 1,535 (47%) were lightning caused. A total of 1,493,720 acres burned on Federal, State, and private land in 2015 and 2016. Of that number, 828,682 acres (55%) were human-caused and 665,038 acres (45%) were lightning caused. From these figures, we can generalize that more fires and more acres are burned from human-caused fires than lightning.

The pie charts below show the causes of fires on State and private land by acreage and cause (Figure 4-214). Based on statistical information about fire cause and number, the trend has been that human-caused fires start more fires and burn more acreage than natural caused fires. This trend provides mitigation opportunity for education and outreach to reduce the number and acreage of fires in the State.

Figure 4-214 New Mexico Acres Burned by Cause – 2016[155]



Firefighters use several methods to express fire potential. Some of the indicators are:

Relative Humidity (RH): the ratio of the amount of moisture in the air to the amount of moisture necessary to saturate the air at the same temperature and pressure. Relative humidity is expressed in percent. RH is measured directly by automated weather stations or manually by wet and dry bulb readings taken with a psychrometer and applying the National Weather Service, psychrometric tables applicable to the elevations where the reading were taken.

Fuel moisture: Fuel moistures are measured for live Herbaceous (annual and perennial), Woody (shrubs, branches and foliage) fuels, and Dry (dead) fuels. These are calculated values representing approximate moisture content of the fuel. Fuel moisture levels are measured in 1, 10, 100 and 100-hour increments.

[155] Source: http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html

The Lower Atmosphere Stability Index or Haines Index: is computed from the morning (12Zulu) soundings from Radiosonde Observation (RAOB) stations across North America. It is used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire. It is calculated by combining the stability and moisture content of the lower atmosphere into a number that correlates well with large fire growth. The stability term is determined by the temperature difference between two atmospheric layers; the moisture term is determined by the temperature and dew point difference. This index has been shown to correlate with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior. Haines Indexes range from two to six for indicating potential for large fire growth:

1. Very Low Potential (Moist Stable Lower Atmosphere)
2. Very Low Potential
3. Low Potential
4. Moderate Potential
5. High Potential (Dry Unstable Lower Atmosphere)

Keetch-Byram Drought Index (KBDI): used to measure the effects of seasonal drought on fire potential. The actual numeric value of the index is an estimate of the amount of precipitation (in 100ths of inches) needed to bring soil back to saturation (a value of zero being saturated). The index, as shown in Figure 4-215, describes the top eight inches of soil profile. Therefore, the maximum KBDI value is 800 (eight inches), the amount of precipitation needed to bring the soil back to saturation. The index's relationship to fire is that as the index values increase, the vegetation is subjected to greater stress because of moisture deficiency. At higher values, living plants die and become fuel, and the duff/litter layer becomes more susceptible to fire.

Figure 4-215 Keetch-Byram Drought Index Fire Rating System

Keetch-Byram Drought Index Fire Rating System	
0 – 200	Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
200 – 400	Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possible through the night.
400 – 600	Fire Intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
600-800	Fires will burn to mineral soils. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.

The Energy Release Component (ERC): the estimated potential available energy released per unit area in the flaming front of a fire. The day-to-day variations of the ERC are caused by changes in the moisture contents of the various fuel classes, including the 1,000-hour time lag class. The ERC is derived from predictions of the rate of heat release per unit area during flaming combustion and the duration of flaming.

The Ignition Component: a number that relates the probability that a fire will result if a firebrand is introduced into a fine fuel complex. The ignition component can range from zero, when conditions are cool and damp, to 100 on days when the weather is dry and windy. Theoretically, on a day when the ignition component registers a 60, approximately 60% of all firebrands that encounter wildland fuels will require suppression action.

The Spread Component: a numerical value derived from a mathematical model that integrates the effects of wind and slope with fuel bed and fuel particle properties to compute the forward rate of spread at the head of the fire. Output is in units of feet per minute. A Spread Component of 31 indicates a worst-case, forward rate of spread of approximately 31 feet per minute. The inputs required in to calculate the SC are wind speed, slope, fine fuel moisture (including the effects of green herbaceous plants), and the moisture content of the foliage and twigs of living, woody plants. Since the characteristics through which the fire is burning are so basic in determining the forward rate of spread of the fire front, a unique SC table is required for each fuel type.[156]

Another is the International Fire Code Institute susceptibility index (Figure 4-216), which combines slope and fuel levels:

Figure 4-216 Wildfire Susceptibility Matrix

FEMA/IFCI Wildfire Susceptibility Matrix									
Fuel Class	Critical Fire Weather Frequency								
	<1 day per year			2-7 days per year			8+ days per year		
	Slope %			Slope %			Slope %		
	<40	41-	61+	<40	41-	61+	<40	41-	61+
Light	M	M	M	M	M	M	M	M	H
Medium	M	M	H	H	H	H	E	E	E
Heavy	H	H	H	H	E	E	E	E	E
Note: M = Medium, H = High, E = Extreme. Source: International Fire Code Institute, January 2000									

All these indicators are taken into account when determining the fire danger for a specific area. These indicators can change daily, which is why the Fire Danger Rating System (Figure 4-217) was created. It is a method of conveying in a simple way the relative danger level to the public. Note that the National Wildfire Coordinating Group announced that the National Fire Danger Rating System 2016 (NFDRS2016) will replace the existing 1978 and 1988 NFDRS models by May 2020. Additional information can be found at https://www.nwcg.gov/sites/default/files/memos/eb-m-18-001.pdf

[156] Source: https://www.nps.gov/fire/wildland-fire/learning-center/fire-in-depth/understanding-fire-danger.cfm

Figure 4-217 Fire Danger Rating System[157]

Fire Danger Rating System		
Rating	**basic description**	**detailed description**
CLASS 1: Low Danger (L) COLOR CODE: **Green**	Fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: **Blue**	Fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: **Yellow**	Fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: **Orange**	Fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.

157 Source: https://www.wfas.net/index.php/fire-danger-rating-fire-potential--danger-32

Fire Danger Rating System		
Rating	basic description	detailed description
CLASS 5: Extreme (E) COLOR CODE: **Red**	Fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Wildland Fire Readiness Levels

The State Forestry Division's Fire Policy and Procedures established the Wildland Fire Readiness Levels as a method for dictating the overall preparedness levels for the Division. District Foresters and District Fire Management Officers shall assess the following criteria in determining readiness levels:

- Current and long-range forecasted weather;
- Current and forecasted fire behavior;
- Current and trend of five-day average energy release component (ERC);
- Comparison of current and trend of the seasonal ERC chart;
- Southwest Area preparedness levels; and
- Individual agency or district fire activity.

Because of the extreme geographical and topographical differences in the State, the Division's districts may be at different levels of fire readiness throughout the year. District Foresters and District Fire Management Officers shall determine fire readiness levels for their respective districts as determined by the following criteria and notify the State Fire Management Officer of the situation.

FIRE READINESS LEVEL 1:

- Most areas have low fire danger.
- Fire activity is light (occasional A, B, and C class fires) and all wildland fires are of short duration, usually lasting only one burning period.
- Moisture content in light fuels is high and heavy fuels are moist.
- State resources and interagency dispatch center cooperators are capable of handling fire incidents with minimum staffing levels.
- Initial attack forces are suppressing wildland fires.
- There is little or no commitment of State resources besides volunteer fire departments.
- ERC-5 day mean average is consistently below 30.

FIRE READINESS LEVEL 2:

- Fire danger is moderate.
- Class A, B, and C fires may occur and the potential exists for escapes to become larger but only have a potential duration of two burning periods.
- Heavy fuels are drying; frontal system winds increase the potential for rapid fire spread over a 36 to 48 hour period.
- State and volunteer fire department resources with limited assistance from the individual dispatch centers are capable of handling the situation.
- Fire department cooperators provide initial attack.
- High wind warnings and "Red Flag" alerts the National Weather Service issues are indicators that the districts may need additional resources.
- ERC-5-day mean average is consistently between 30 and 45.

FIRE READINESS LEVEL 3:

- Generally, all agencies are experiencing high fire danger.
- Numerous A, B, and C class fires, with a high potential for wildland fires to become Class D or larger in size, that may require additional resources.
- Light fuels are cured and heavy fuels are rapidly drying.
- Fires are escaping initial attack on a consistent basis and require extended attack support.
- The initial attack dispatch centers are requesting additional resources to increase initial attack capabilities.
- Federal cooperators provide critical initial attack and extended attack support during fire suppression.
- FEMA Fire Suppression Grants apply to urban/interface fires. The State Forester initiates FEMA Presidential Emergency Declaration requests.
- ERC-5 day mean average is consistently between 45 and 60.

FIRE READINESS LEVEL 4:

- Division and cooperating agencies are experiencing very high or greater fire danger.
- Numerous A, B, C, and D class fires that have the potential to exhaust dispatch area, State, Southwest Area, and national resources are common within the region.
- Division personnel implement and enforce fire restrictions.
- The Division may have Type 1 and Type 2 Incident Management Teams committed to incidents under this readiness level within the State.
- ERC-5 day mean average is consistently between 60 and 80.

FIRE READINESS LEVEL 5:

- All criteria for Fire Readiness Level 4 plus the following additional criteria are met:
- Fire danger is extreme throughout the State and region.
- Several dispatch centers and agencies are experiencing major fires and national resources are exhausted.
- Air resources are in short supply.
- Fire restrictions require closures.
- EOC is activated.
- Area Command has been implemented.

- High potential for catastrophic fires exists.
- Extreme fire behavior, scarce resources, and extremely unsafe working conditions for fire fighters hinder efforts of Type 1 and 2 Incident Management Teams.
- A multi-agency Coordination (MAC) Group is allocating resources to high priority fires.
- ERC-5 day average is consistently at or above 80.

4.5.14.2 *Previous Occurrences*

Figure 1-6 in Appendix A shows previous occurrences of wildland and WUI fires in New Mexico.

Declared Disasters from Wildfire

DHSEM reports 36 State Declared Disasters for wildfire between 2003 and 2017. This number is based on how many Executive Orders were signed by the Governor for wildfire. These events are described in Figure 4-218.

Figure 4-218 State Disaster Event Information 2003 through 2016

Event Type	State Executive Order	Dollar Loss*
Fire Preparedness	2006-009	$6,662.00
Wildfire	2008-018	$375,032.00
Wildfire	2011-040	$200,000.00
Wildfire	2011-047	$200,000.00
Wildfire	2011-053	$750,000.00
Wildfire	2011-061	$100,000.00
Wildfire	2012-007	$750,000.00
Wildfire	2012-014	$500,000.00
Wildfire	2012-015	$750,000.00
Wildfire	2012-037	$750,000.00
Wildfire	2013-008	$750,000.00
Wildfire	2013-010	$500,000.00
Wildfire	2015-003	$750,000.00
Wildfire	2015-014	$750,000.00
Wildfire	2015-015	$750,000.00
Wildfire	2016-03	$750,000.00
Wildfire	2016-05	$750,000.00
Wildfire	2016-08	$750,000.00

Event Type	State Executive Order	Dollar Loss*
Wildfire	2016-09	$750,000.00
Wildfire	2016-07	$750,000.00
Wildfire	2016-010	$750,000.00
Wildfire	2016-011	$750,000.00
Wildfire	2016-012	$750,000.00
Wildfire	2016-013	$750,000.00
Wildfire	2016-015	$750,000.00
Wildfire	2016-018	$750,000.00
Wildfire	2016-020	$750,000.00
Wildfire	2016-021	$750,000.00
Wildfire	2016-022	$750,000.00
Wildfire	2016-023	$750,000.00
Wildfire	2016-024	$750,000.00
Wildfire	2016-026	$750,000.00
Wildfire	2016-029	$750,000.00
Wildfire	2016-030	$750,000.00
Wildfire	2016-031	$750,000.00
Wildfire	2016-032	$750,000.00
Wildfire	2018-17	$750,000.00
Total*	**37**	**$24,381,694.00**
*The total does not reflect all costs for Executive Orders still being tallied.		

There were 34 Fire Management Assistance Grants at the Federal level between 2003 and 2018 (Figure 4-219). DHSEM either did not contribute to the total cost or contributed 25%. The total Public Assistance dollar losses from Federal, DHSEM, local government entities, and Tribal entities is still being calculated for some of the events as shown in Figure 4-219. Concentrations of intense fire seasons are evidenced since 2000. This could be due to rainy growing season, low snow pack and low precipitation. Extreme drought and impaired forest health conditions also influence the number, frequency and severity of fires. For 2000 there were 7 federal fire emergencies, for 2002 there were 9, 2006 had 5 and 2011 with 8.

Figure 4-219 Federal Disaster Event Information 2003 through 2018

~~(* means costs are still being tallied)~~

Name/date	Event Number	Federal Share	State (DHSEM) Share	Total Cost	State % of Total
Rio Grande Fire Complex - 2000	FSA-2295	$228,394	N/A	N/A	N/A
Cree Fire - 2000	FSA-2296	$867,787	N/A	N/A	N/A
New Mexico Fire - 2000	EM-3154	$4,385,734	N/A	N/A	N/A
New Mexico Wildfire – 2000	DR-1329	$5,652,344	N/A	N/A	N/A
Scott-Able Fire - 2000	FSA-2297	$650,088	N/A	N/A	N/A
Viveash Fire - 2000	FSA-2304	$587,627	N/A	N/A	N/A
La Cueva Fire - 2000	FSA-2310	$261,449	N/A	N/A	N/A
Trap and Skeet Fire - 2001	FSA-2364	N/A	N/A	N/A	N/A
Kokopelli Fire Complex - 2002	FSA-2398	$739,292	N/A	N/A	N/A
Penasco Fire - 2002	FSA-2402	$2,505,601	N/A	N/A	N/A
Dalton Fire - 2002	FSA-2404	$298,474	N/A	N/A	N/A
Borrego Fire - 2002	FSA-2408	$958,865	N/A	N/A	N/A
Turkey Fire - 2002	FSA-2414	$561,239	N/A	N/A	N/A
Ponil Fire - 2002	FSA-2416	$6,435,257	N/A	N/A	N/A
Cerro Pelado Fire - 2002	FSA-2415	$558,523	N/A	N/A	N/A
Roybal Fire Complex - 2002	FSA-2424	$513,493	N/A	N/A	N/A
Lakes Fire Complex - 2002	FSA-2459	$116,022	N/A	N/A	N/A
Atrisco Fire - 2003	2472	$1,749,609	$583,203	$2,332,812	25%
Walker Fire -	2467	$76,176	$25,392	$101,568	25%
Peppin Fire - 2004	2518	$283,186	$94,395	$377,581	25%
Bernardo Fire - 2004	2522	$238,140	$79,380	$317,520	25%
Casa Fire - 2006	2631	$262,647	$87,549	$350,196	25%
Southeast NM Fire - 2006	2600	$107,390	$35,797	$143,187	25%
Ojo Feliz Fire - 2006	2636	$2,406,369	$802,123	$3,208,492	25%
Malpais Fire - 2006	2644	$113,353	$37,784	$151,137	25%
Rivera Mesa Fire - 2006	2647	$2,718,248	$906,083	$3,624,331	25%
Belen Fire - 2007	2682	$89,839	$29,946	$119,785	25%
Ojo Peak Fire - 2007	2741	$17,400	$5,800	$23,200	25%
Trigo Fire - 2008	2762	$2,175,243	$725,081	$2,900,324	25%
Big Springs Fire - 2008	2777	$406,862	$135,621	$542,483	25%
Buckwood Fire - 2009	2818	$339,716		$452,955	0%
Cabezon Fire - 2010	2842	$55,680	$0	$74,239	0%
Rio Fire - 2010	2843	$55,983		$74,645	0%
Quail Ridge Fire - 2011	2866	$267,934	$89,311	$357,245	25%
White Fire - 2011	2880	$124,694	$41,565	$166,259	25%
Tire Fire - 2011	2897	$75,184	$25,061	$100,245	25%
Wallow Fire - 2011	2917	$515,274	$171,758	$687,033	25%
Track Fire - 2011	2918	$4,300,099	$1,433,366	$5,733,465	25%
Los Conchas Fire - 2011	2933	$1,640,181	$546,727	$2,186,909	25%
Little Lewis Fire - 2011	2934	$75,494	$25,165	$100,659	25%

Name/date	Event Number	Federal Share	State (DHSEM) Share	Total Cost	State % of Total
Donaldson Fire - 2011	2935	$3,173,062	$1,057,687	$4,230,749	25%
Whitewater/Baldy Complex Fire - 2012	2978	$181,858	$60,619	$242,477	25%
Little Bear - 2012	2979	$3,726,827	$1,242,276	$4,969,103	25%
Blanco Fire - 2012	2981	$156,229	$52,076	$208,305	25%
Romero Fire - 2012	2982	$24,924	$8,308	$33,232	25%
Tres Lagunas Fire - 2013	5026	$2,515,375	$838,458	$3,353,833	25%
Dog Head Fire - 2016	5127	$6,567,398.90	$1,091,062.95	$7,658,461.85	25%
Timberon Fire - 2016	5134	$816,799.69	$1,104,575.71	$1,921,375.40	25%
El Cajete Fire - 2017	5184	To be determined			
Ute Park Fire - 2018	5239	To be determined			
Soldier Canyon Fire - 2018	5240	To be determined			
Totals	**34 FMAGs**	**$35,257,175**	**$11,336,169**	**$46,743,806**	
Fire Suppression Authorization = 15					
Emergency Declarations = 1					
Major Disaster Declarations = 1					

https://www.fema.gov/disasters/state-tribal-government/0/NM

Figure 4-220 shows a map of State-wide wildfire perimeters (including county boundaries) between 2000 and 2016.

Figure 4-220 State-wide Wildfire Perimeters 2000 - 2016)

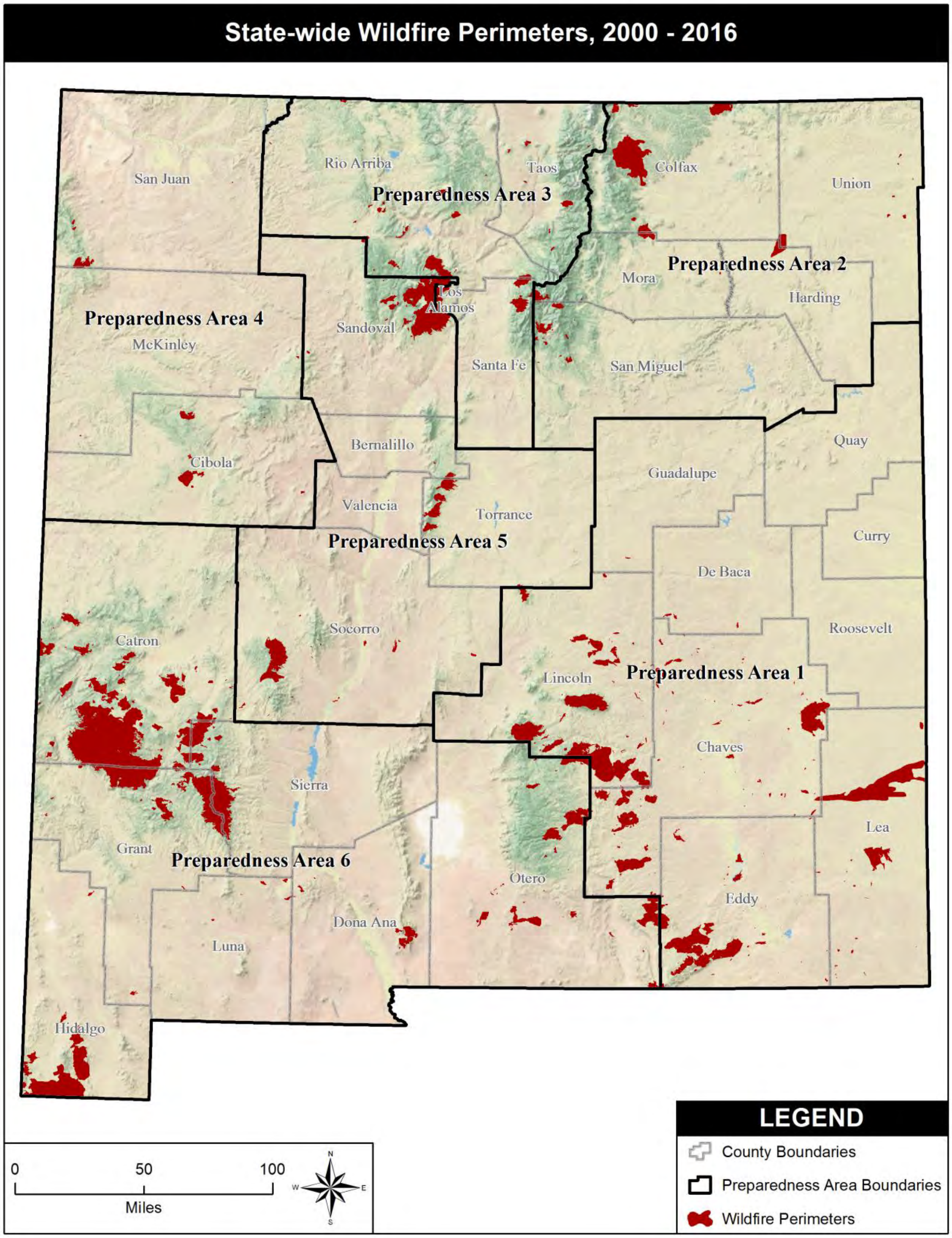


Figure 4-222 to Figure 4-227 show maps of wildfire perimeters in each of the six State Preparedness Areas. The following table (Figure 4-221) summarizes the number of wildfires and acreage for each Preparedness Area. Preparedness Area 6 has experienced the most number of acres burned and wildfire events, followed by Preparedness Area 1. The largest wildfire was the Whitewater Baldy Complex in Preparedness Area 6, burning 297,801 acres. The second largest wildfire burned was the Las Conchas in Preparedness Areas 3 and 5, burning 156,593 acres.

Figure 4-221 Summary of Wildfires and Acreage by Preparedness Area

Preparedness Area	Number of Fires	Number of Acres
1	387	3,173,611
2	34	251,273
3	59	757,569
4	35	77,526
5	77	1,328,400
6	607	24,882,180
Total	**1,199**	**30,470,560**

Figure 4-222 Preparedness Area 1 Wildfire Perimeters, 2000 - 2016

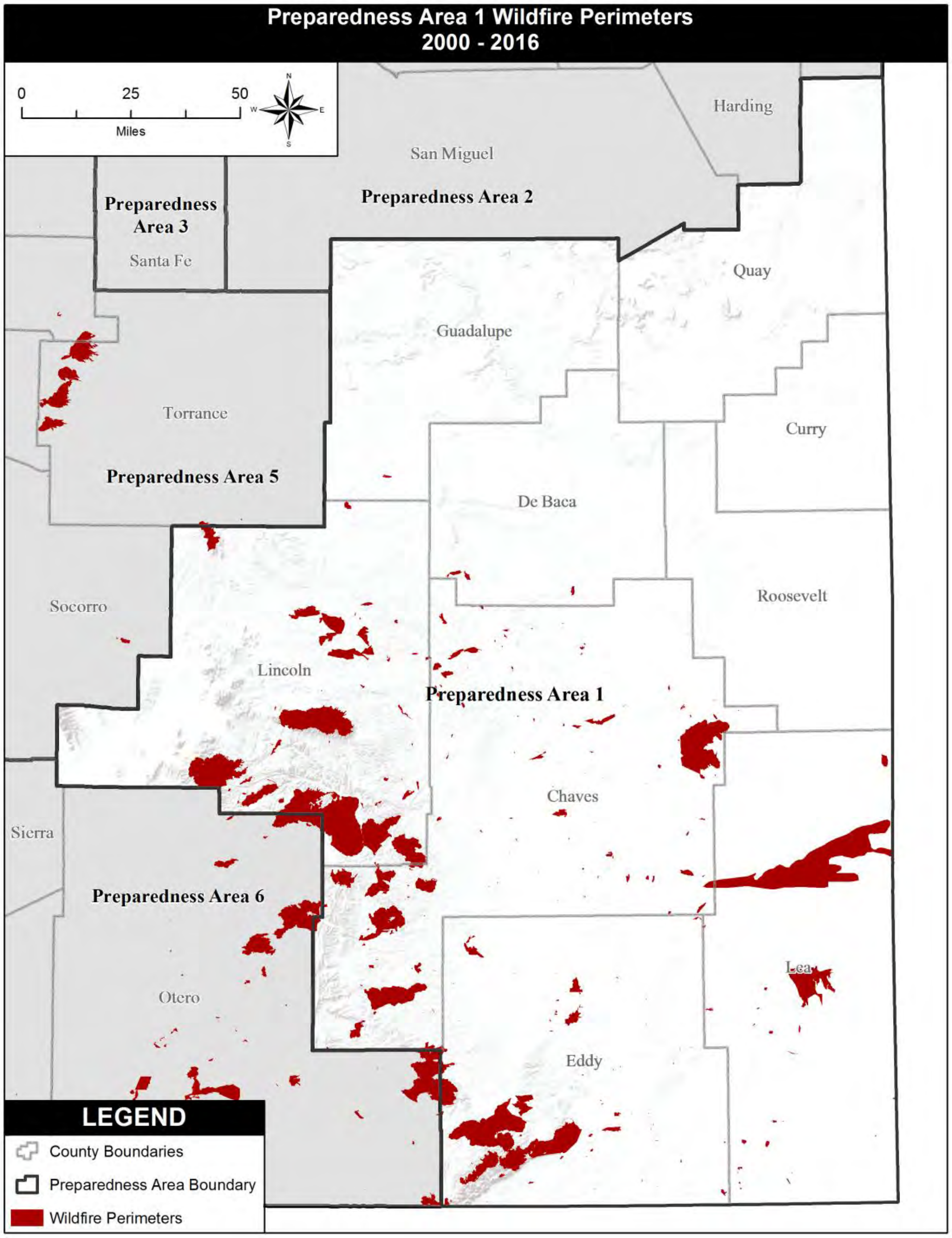


Figure 4-223 Preparedness Area 2 Wildfire Perimeters, 2000 - 2016

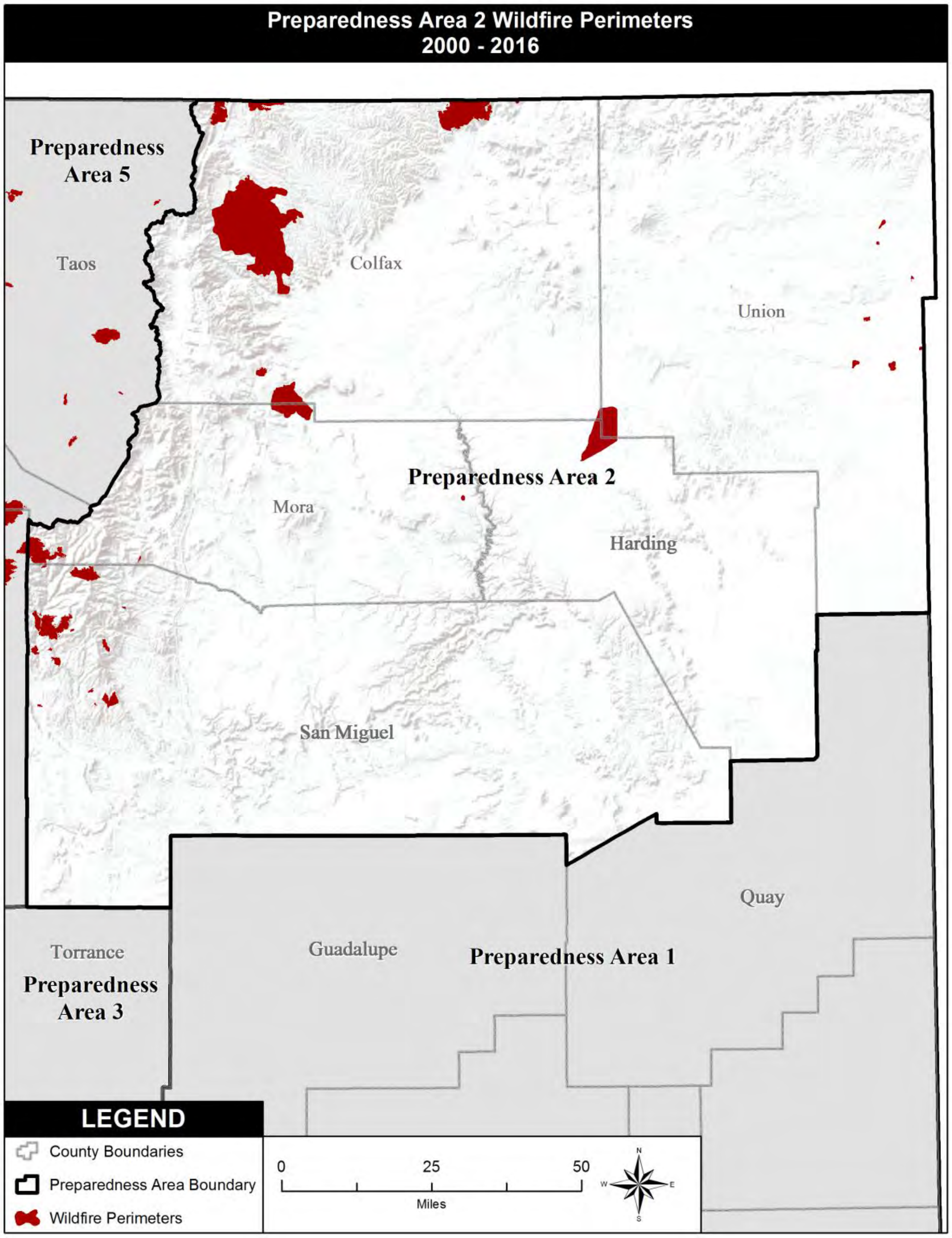


Figure 4-224 Preparedness Area 3 Wildfire Perimeters, 2000 - 2016

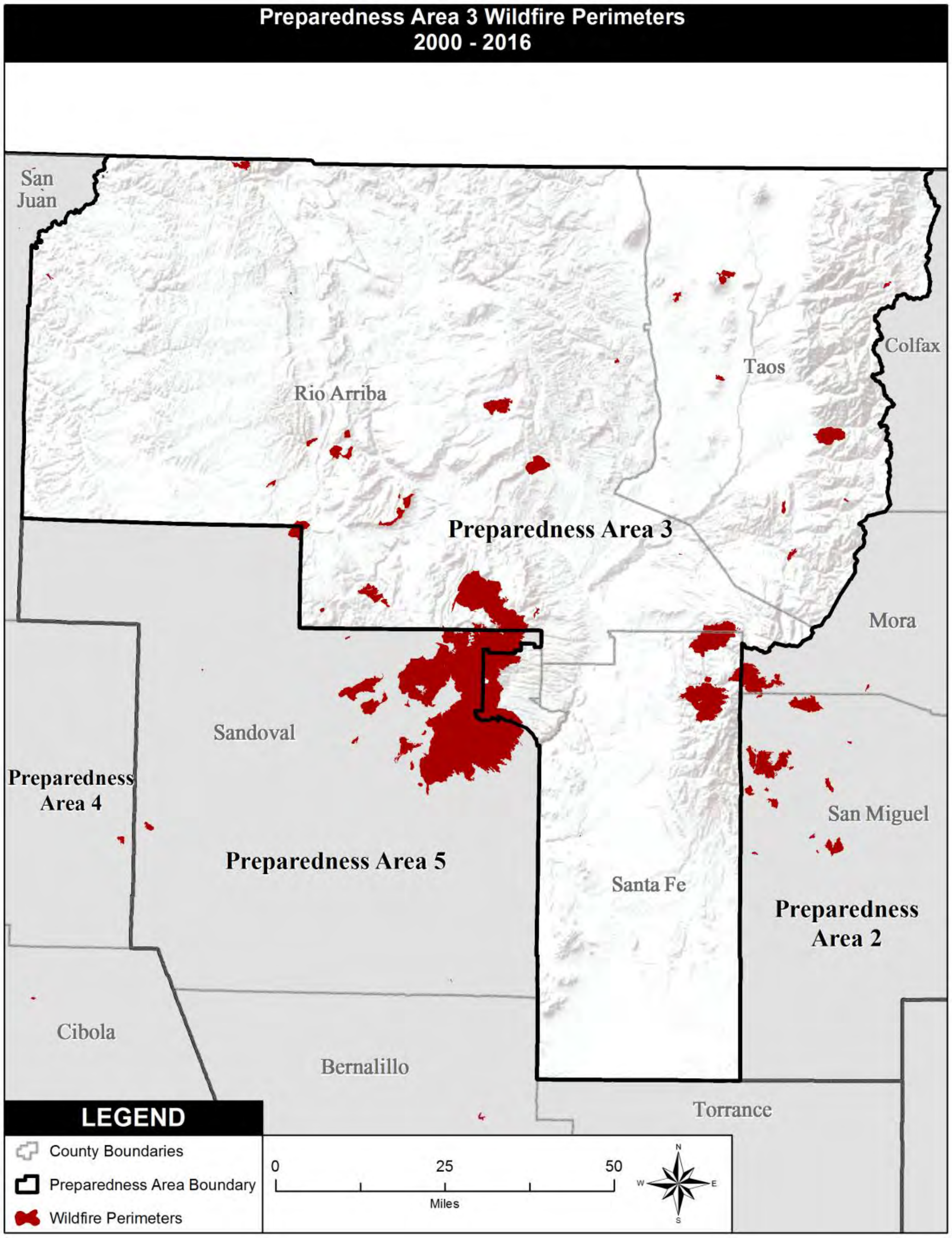


Figure 4-225 Preparedness Area 4 Wildfire Perimeters, 2000 - 2016

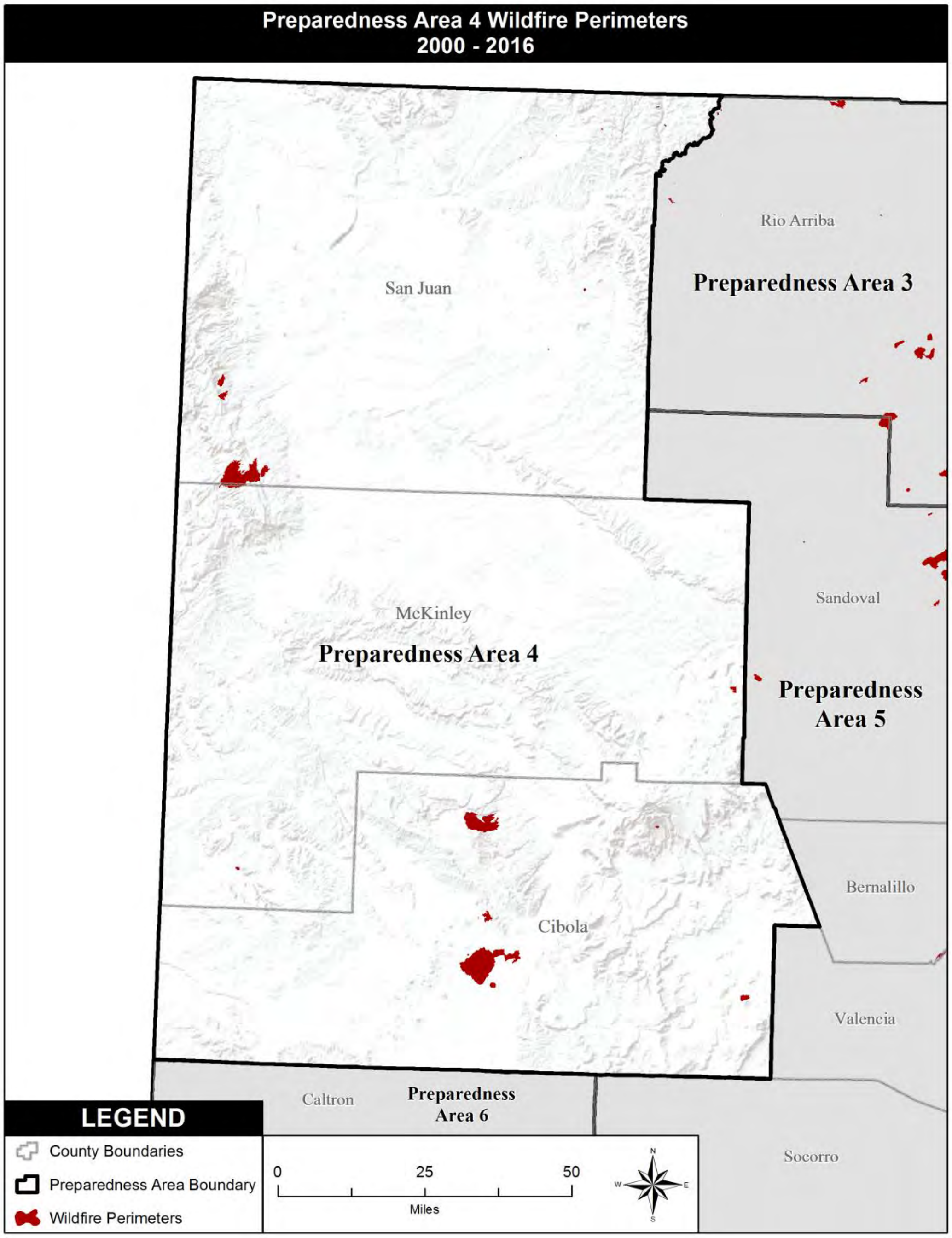


Figure 4-226 Preparedness Area 5 Wildfire Perimeters, 2000 - 2016

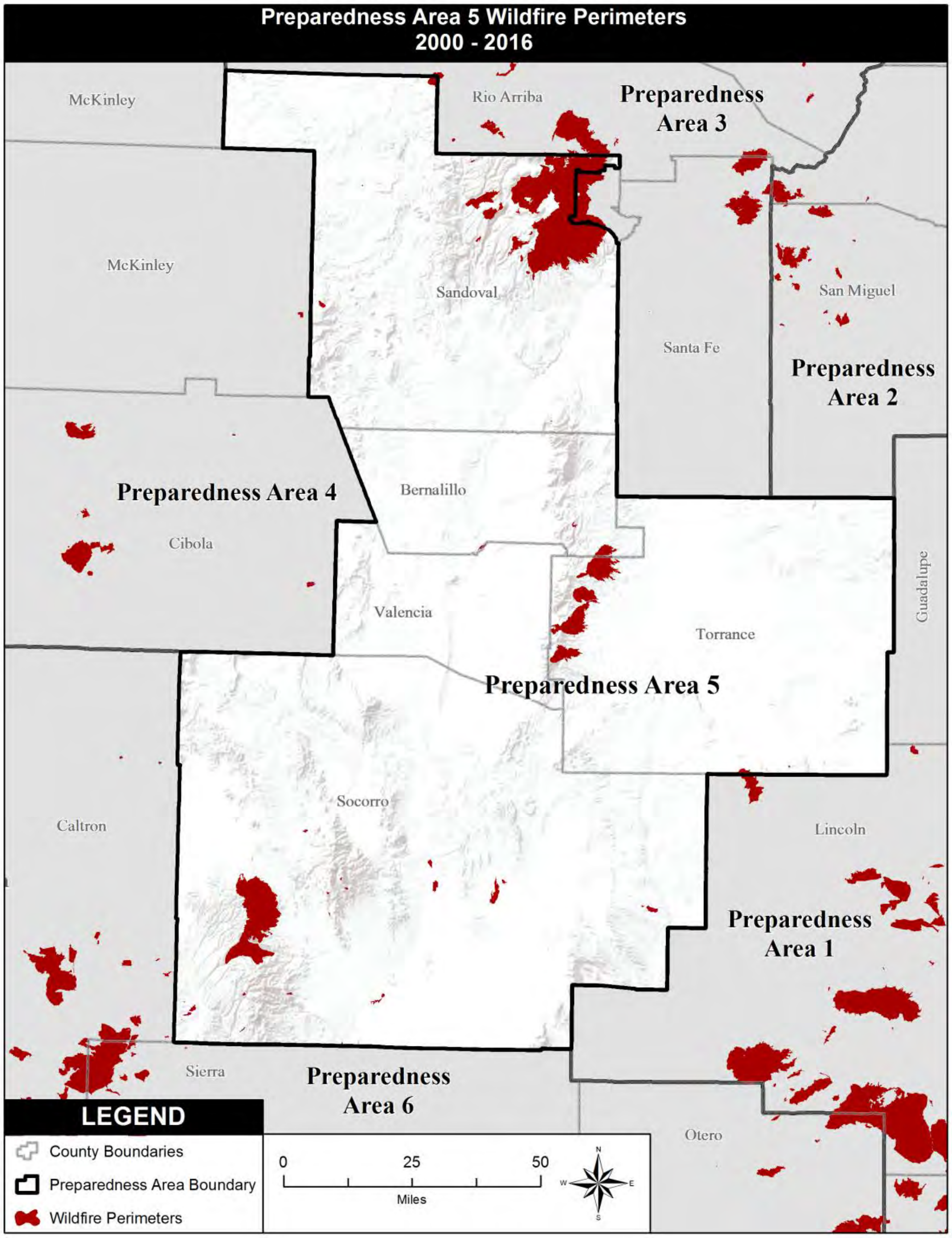
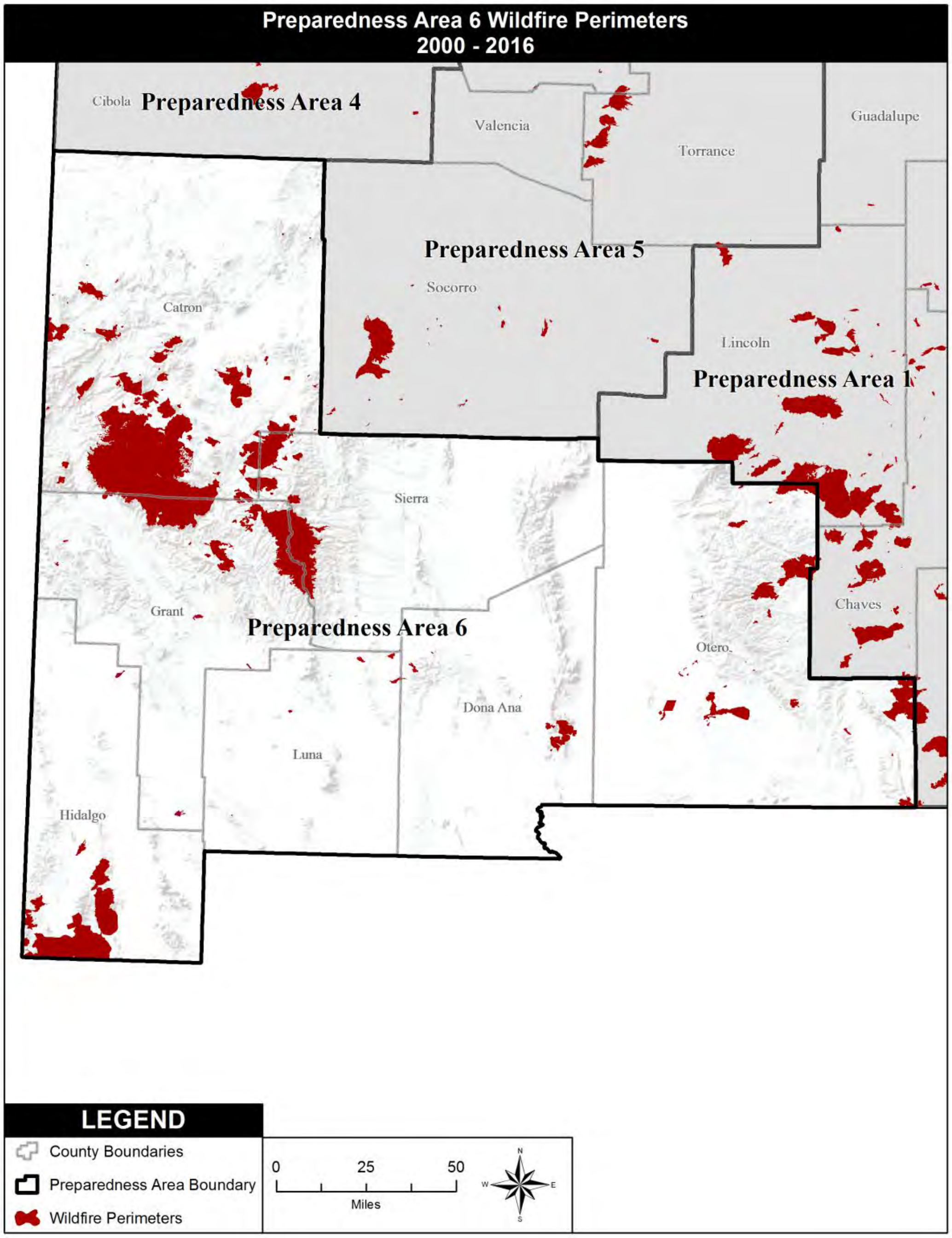


Figure 4-227 Preparedness Area 6 Wildfire Perimeters, 2000 - 2016



4.5.14.3 *Frequency*

Figure 4-228 and Figure 4-229 identify 20+ years of statistical data for the number of fires and acres burned State-wide. From 1997 to 2016, 12,829 fires have burned 2,730,583 acres State-wide. The average results in 641 wildland fires each year that burn an average of 136,529 acres per year. The number of wildland fires and acres burned vary widely from year to year depending on fuel and weather conditions.

The data presented here reflects State Forestry Division data. The State Forestry Division keeps records on a State-wide and not county-wide basis. Therefore, wildfire data is not presented by Preparedness Area (as reported for other hazards in this Plan). It is unclear which specific acreage is included in the Southwest Coordination Center or the National Data Climatic Center figures. Therefore, only the State Forestry Division data is presented in the Mitigation Plan.

Figure 4-228 20-Year New Mexico Fire History[158]

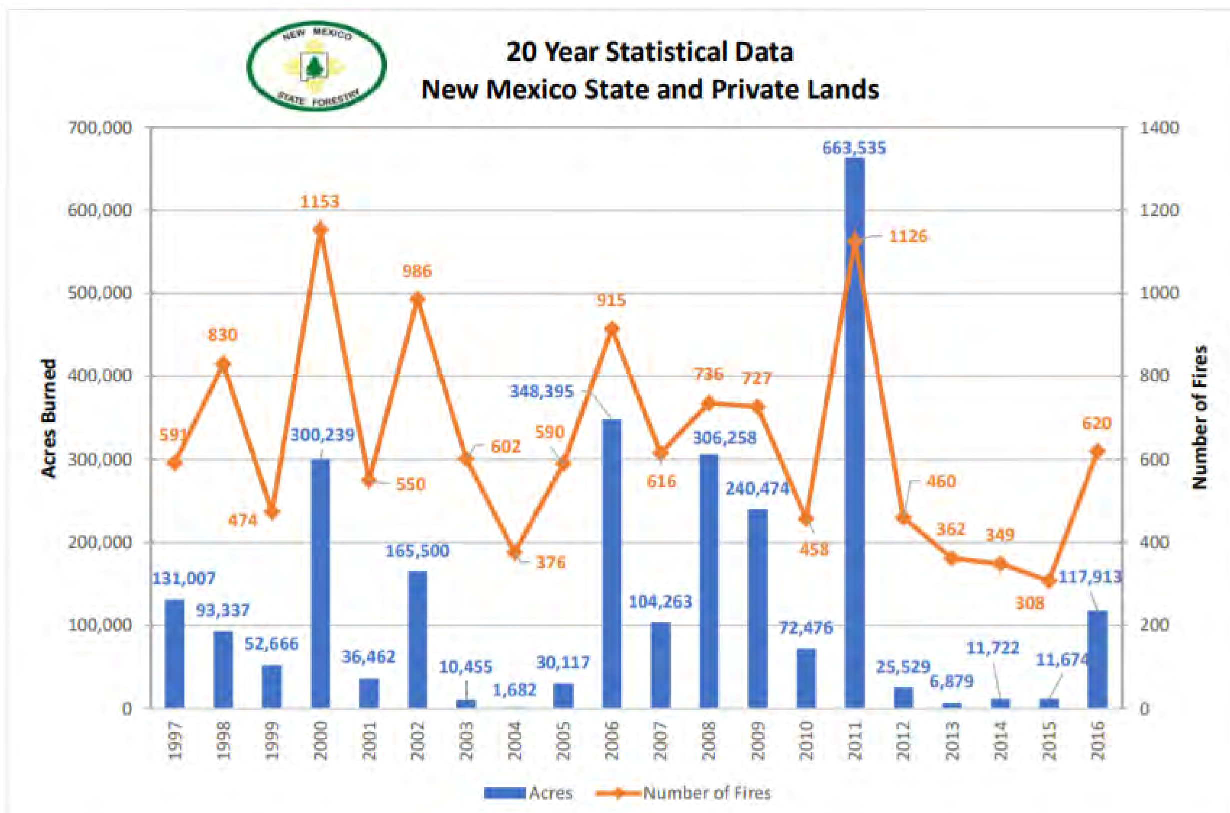


Figure 4-229 Historical Fire Data (1992 – 2016) [159]

25 Year Historical Fire Data (1992-2016)		
Date	**Number of Fires**	**Number of Acres**
1992	571	64,082
1993	1,193	200,184

[158] Source: http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html
[159] Source: Adapted from 20-year Statistical Data Chart from State Forestry Division, and National Interagency Fire Center, http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html

25 Year Historical Fire Data (1992-2016)		
Date	**Number of Fires**	**Number of Acres**
1994	1,210	247,987
1995	642	47,051
1996	929	93,083
1997	600	132,228
1998	847	102,983
1999	475	54,849
2000	1,153	386,000
2001	568	41,014
2002	843	227,244
2003	594	21,546
2004	383	2,188
2005	586	36,166
2006	924	451,443
2007	614	104,634
2008	736	373,388
2009	727	338,783
2010	458	82,057
2011	1,021	756,249
2012	711	528,368
2013	1,064	221,951
2014	728	23,440
2015	696	44,104
2016	620	117,913
Total	**18,893**	**4,698,935**
Average	**859**	**213,588**

Figure 4-230 and Figure 4-231 identify the cost of suppression from 2006 to 2016. During this time frame, $93,980,852 has been spent on suppression State-wide. The average annual cost for suppression is $8,543,714.

Figure 4-230 10 Year Historical Cost of Fire Suppression[160]

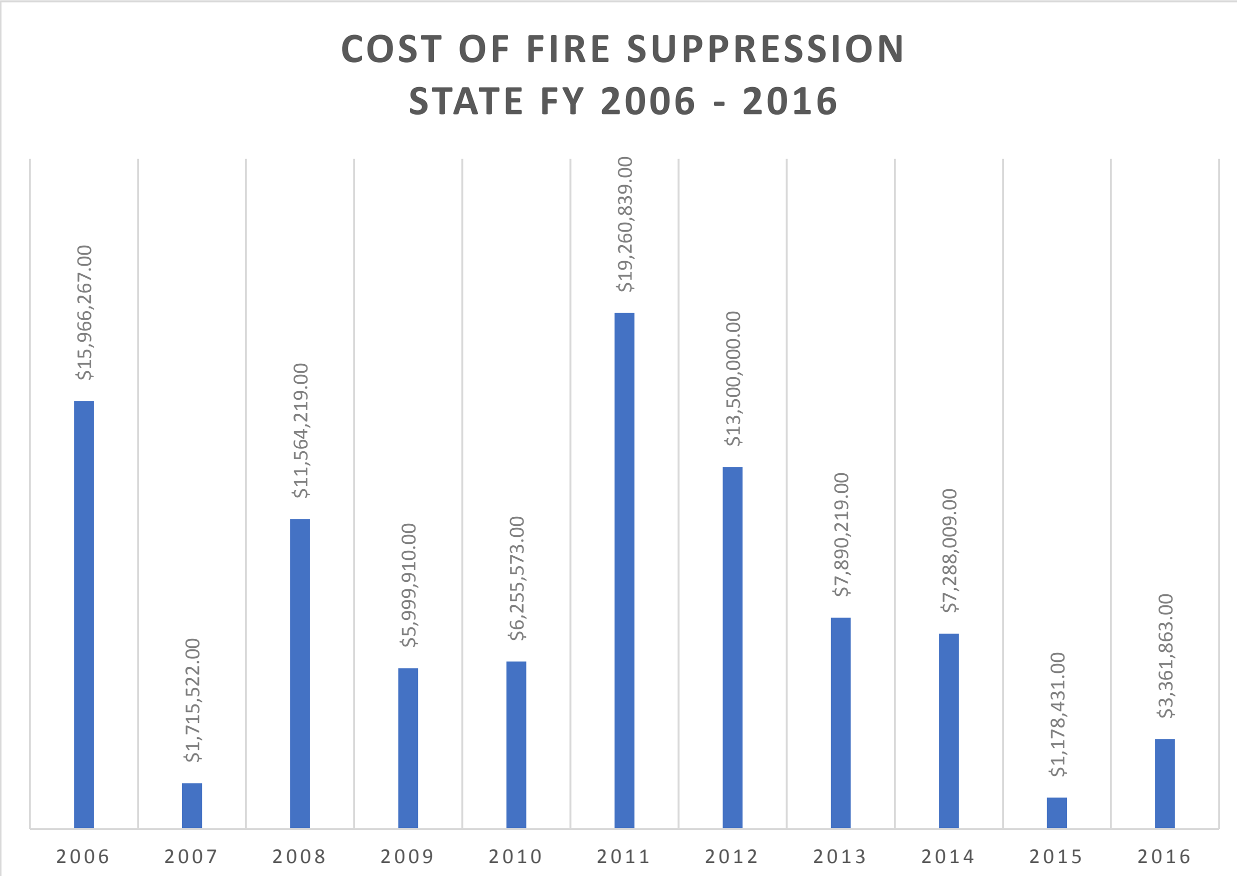


Figure 4-231 Historical Fire Suppression Costs (2006-2016) [161]

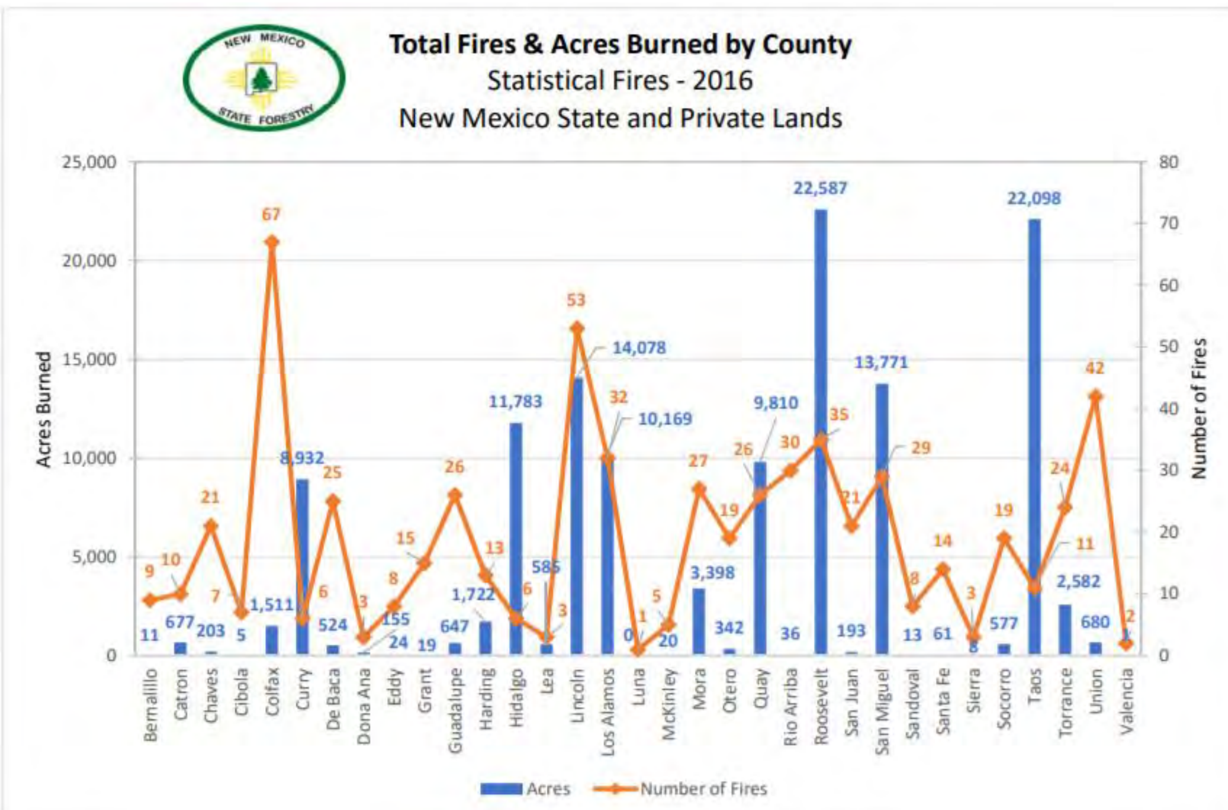
10 Year Historical Fire Suppression Cost	
Date	**Cost**
2006	$15,966,267.00
2007	$1,715,522.00
2008	$11,564,219.00
2009	$5,999,910.00
2010	$6,255,573.00
2011	$19,260,839.00
2012	$13,500,000.00
2013	$7,890,219.00
2014	$7,288,009.00
2015	$1,178,431.00
2016	$3,361,863.00

[160] Source: ENMRD, NM State Forestry Division
[161] Adapted from Cost of Fire Suppression Chart from State Forestry Division

10 Year Historical Fire Suppression Cost	
Date	**Cost**
Total	**$129,980,852.00**
Average	**$11,816,441.00**

Additional information is available from New Mexico Forestry Division on the number of fires and acres burned on State and private land organized by county; see Figure 4-232 below for the 2016 data.

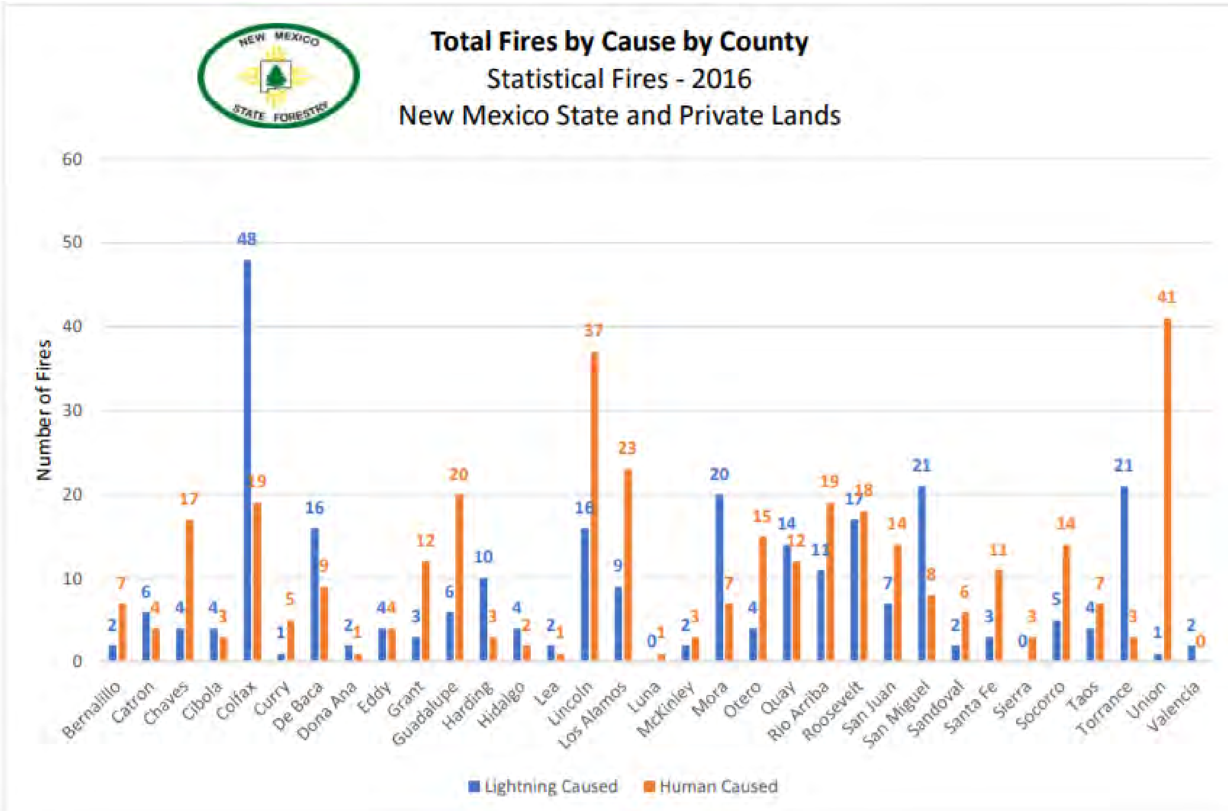
Figure 4-232 Total Statistical Fires and Acres Burned by County for 2016[162]



Information is also available for the cause of fire organized by county; see Figure 4-233 below for the 2016 data. If this same data were available for several years, trends by county and Preparedness Area could be generalized.

162 Source: http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html

Figure 4-233 Total Statistical Fires and Acres Burned by Cause by County for 2016[163]



163 Source: http://www.emnrd.State.nm.us/SFD/FireMgt/Historical.html

Figure 4-234 Track Fire, Raton (top and bottom), Little Lewis Fire, Cloudcroft (center)[164]

4.5.14.4 *Probability of Occurrence*

The threat of wildland-urban interface fires continues to be the number one natural hazard facing the State. Each Preparedness Area has experienced the effects of wildfire. The annual probability of a large fire event is 100%. There are hundreds of communities that are embedded in or surrounded by flammable vegetation, or have their major routes of egress surrounded by flammable vegetation. This greatly increases the amount of people and infrastructure that are exposed to wildfire risks. With drought conditions persisting and more people locating their residences in the wildland-urban interface,

[164] Source: Communities at Risk Assessment 2011, New Mexico Forestry Division.

it seems inevitable that all Preparedness Areas will become more susceptible to fires occurring with increased consequences to the population, property, and natural resources.

4.5.14.5 *Risk Assessment*

Wildland fire poses a significant threat to the citizens, structures, infrastructure, and natural resources within New Mexico. Figure 4-235 shows the Wildland Urban Interface (WUI) State-wide in New Mexico on a map, and the following Figure 4-236 through Figure 4-241 show the WUI in each Preparedness Area.

Figure 4-235 Statewide WUI in New Mexico

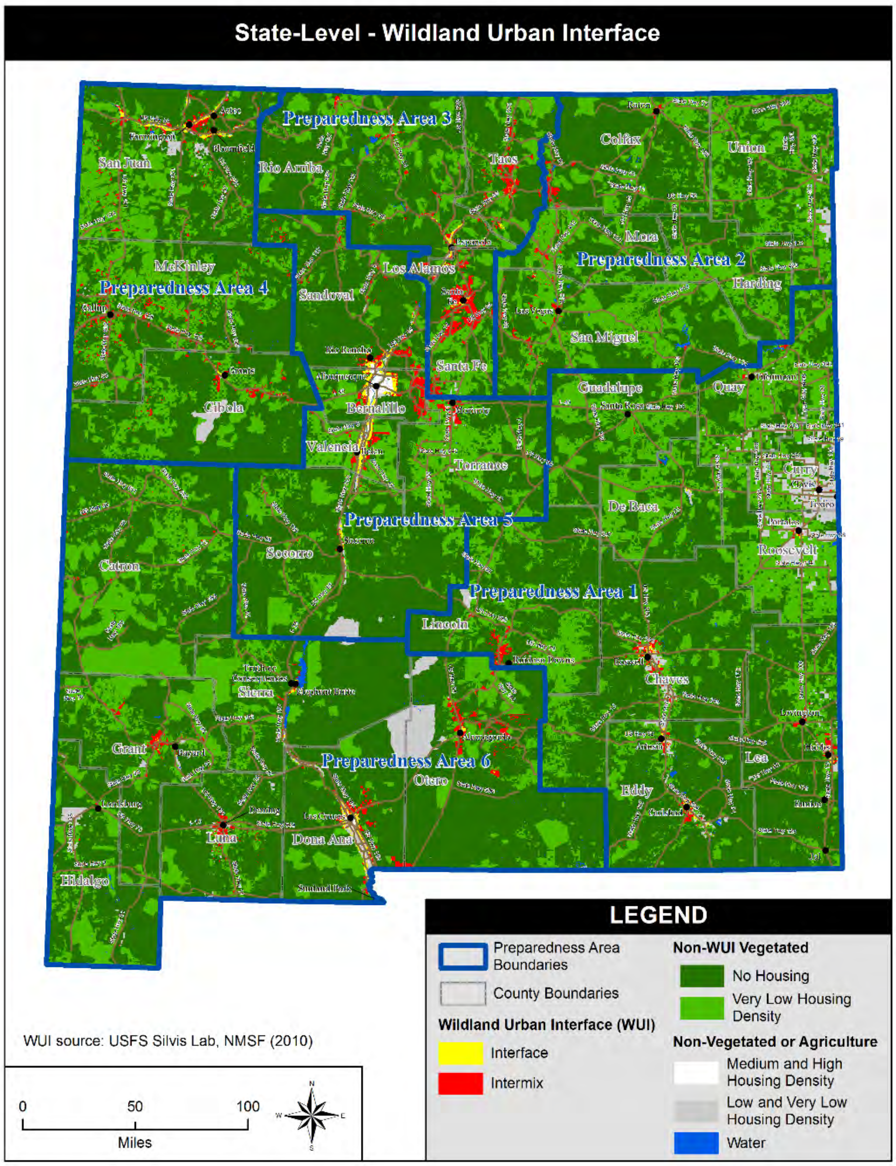


Figure 4-236 Preparedness Area 1 WUI

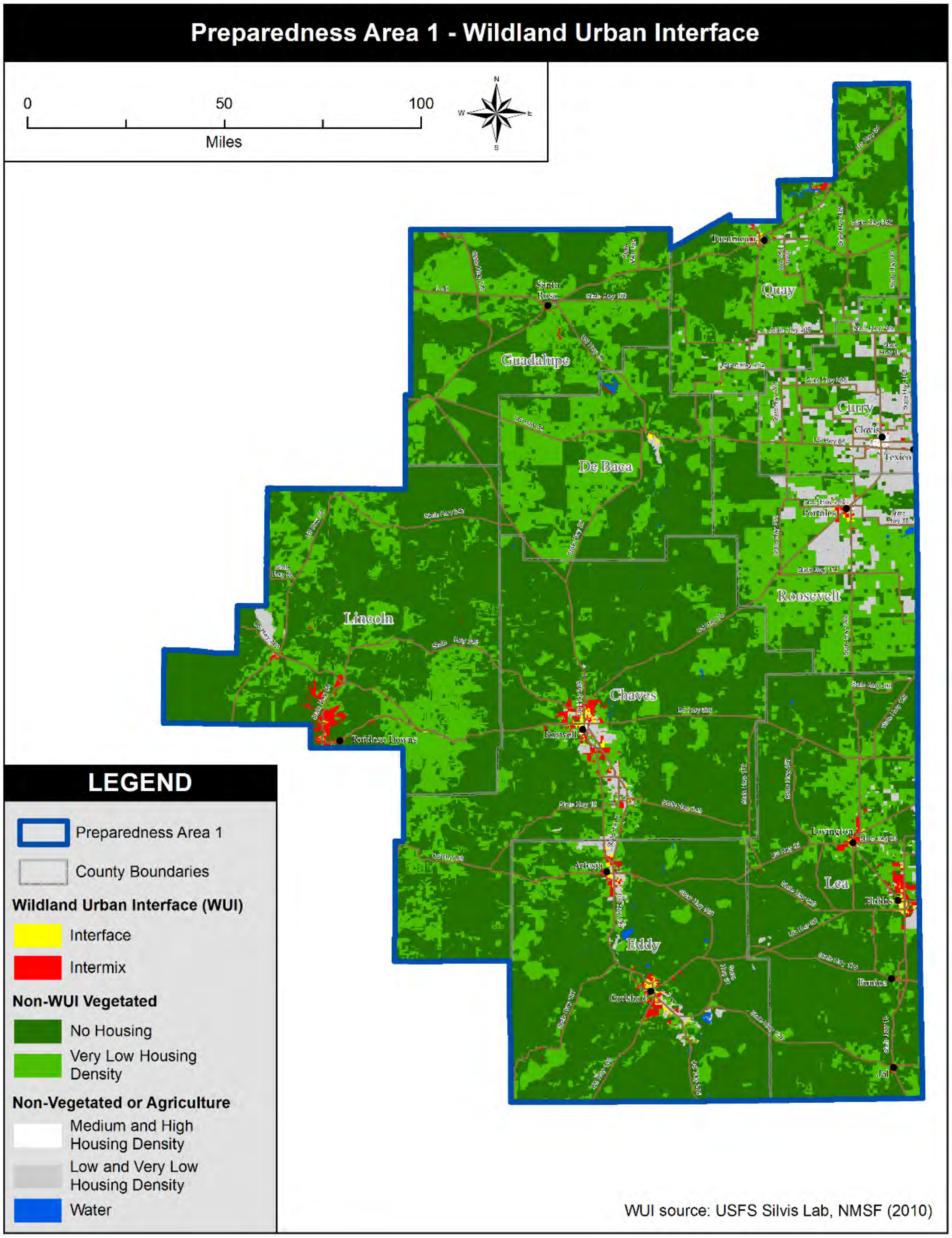


Figure 4-237 Preparedness Area 2 WUI

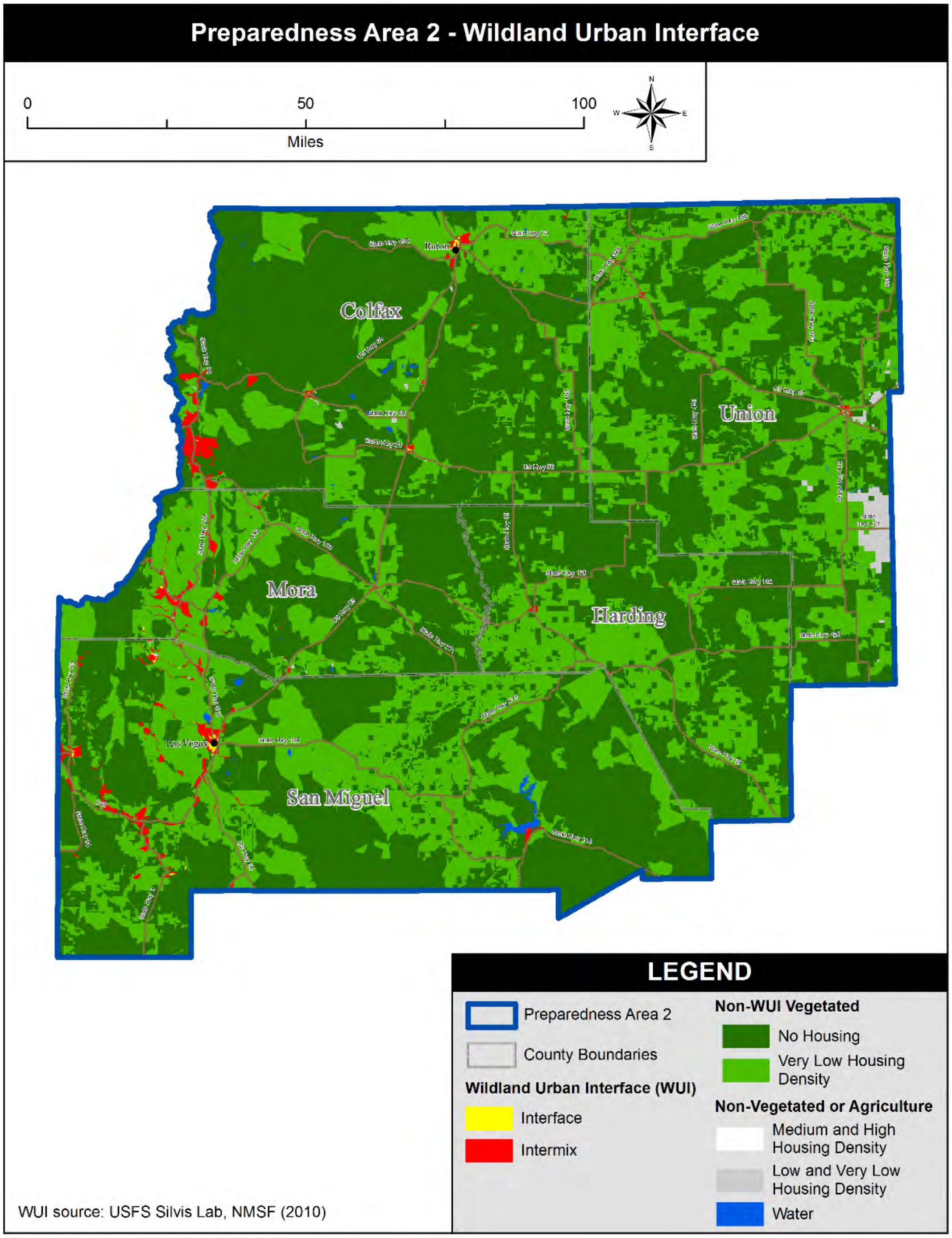


Figure 4-238 Preparedness Area 3 WUI

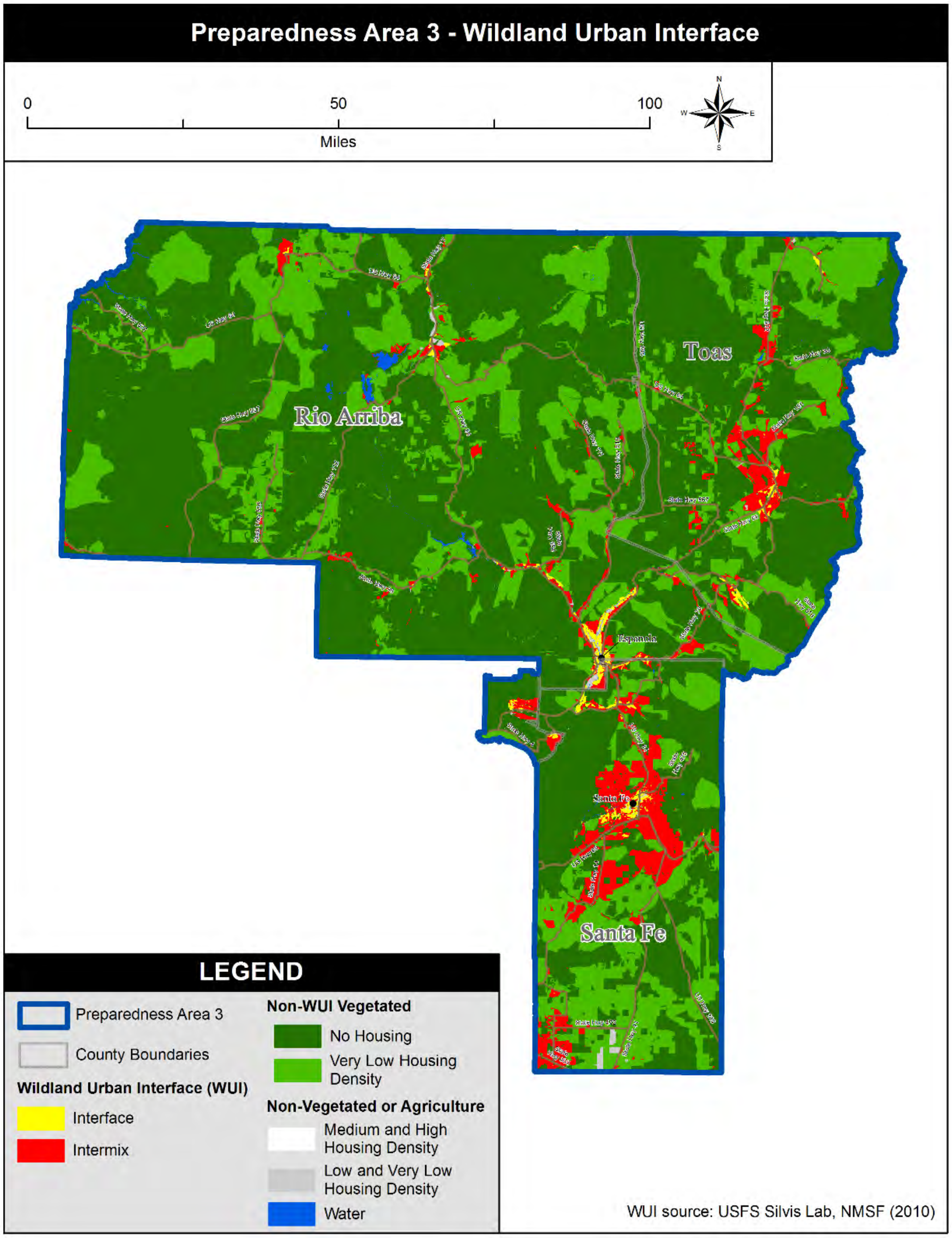


Figure 4-239 Preparedness Area 4 WUI

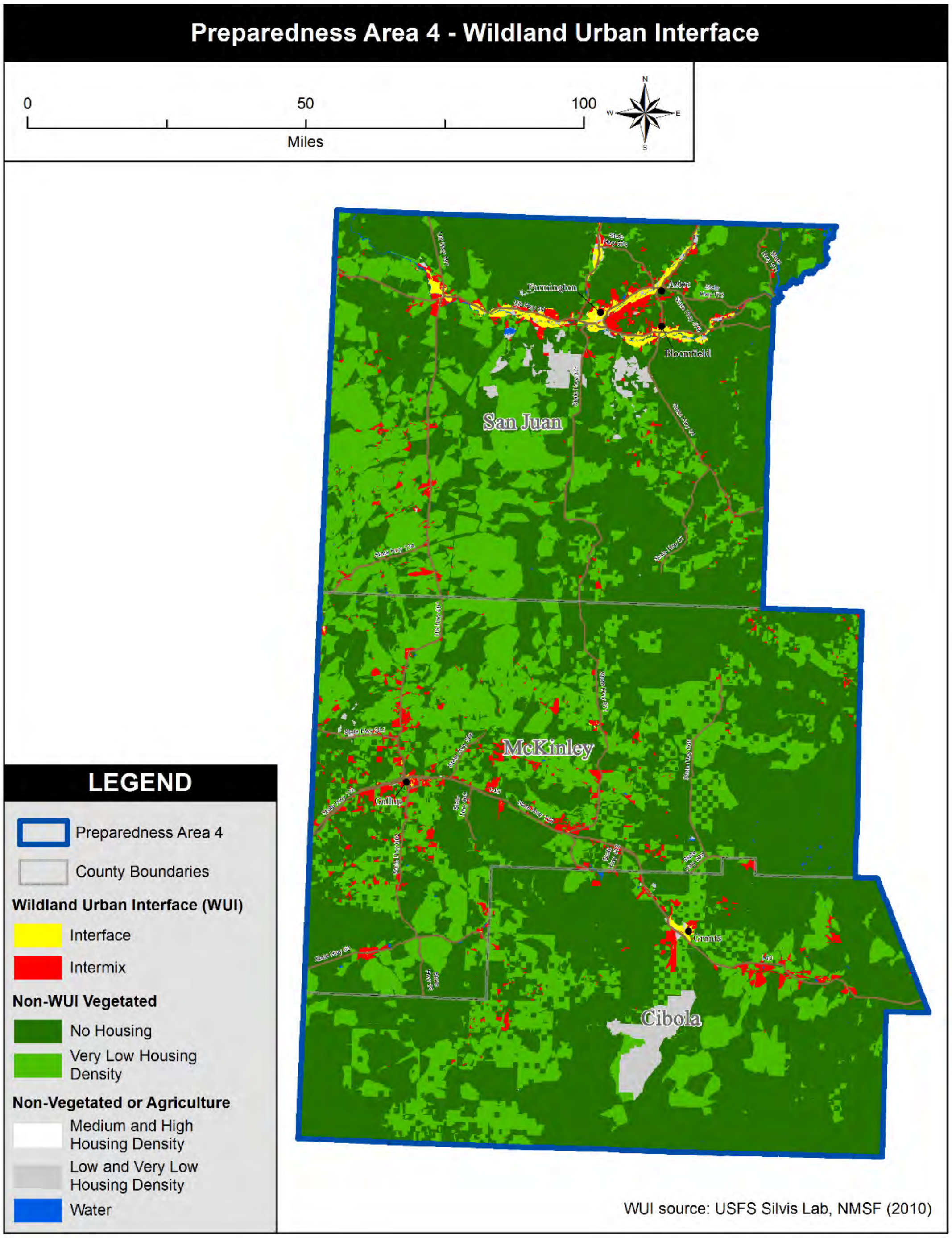


Figure 4-240 Preparedness Area 5 WUI

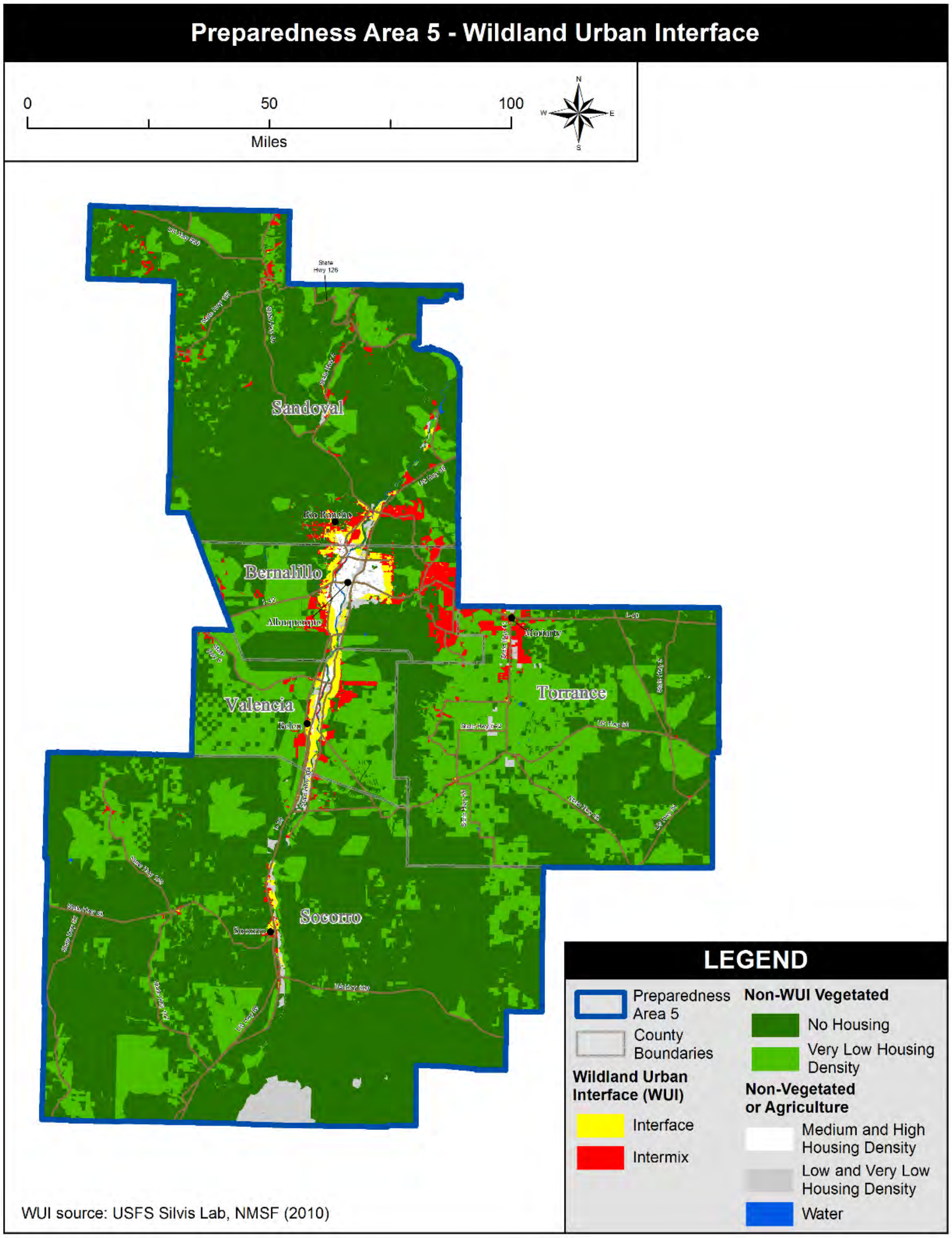
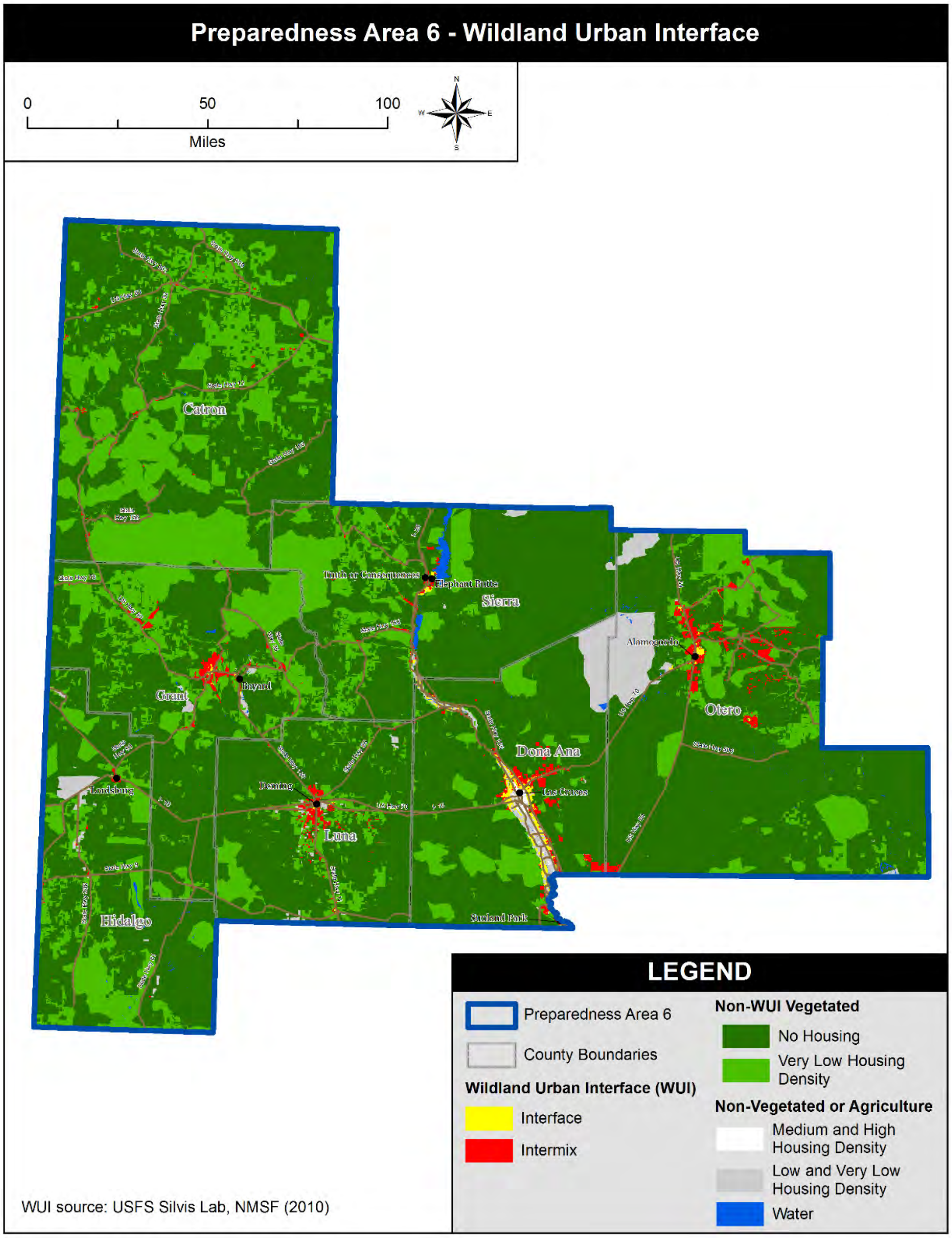


Figure 4-241 Preparedness Area 6 WUI



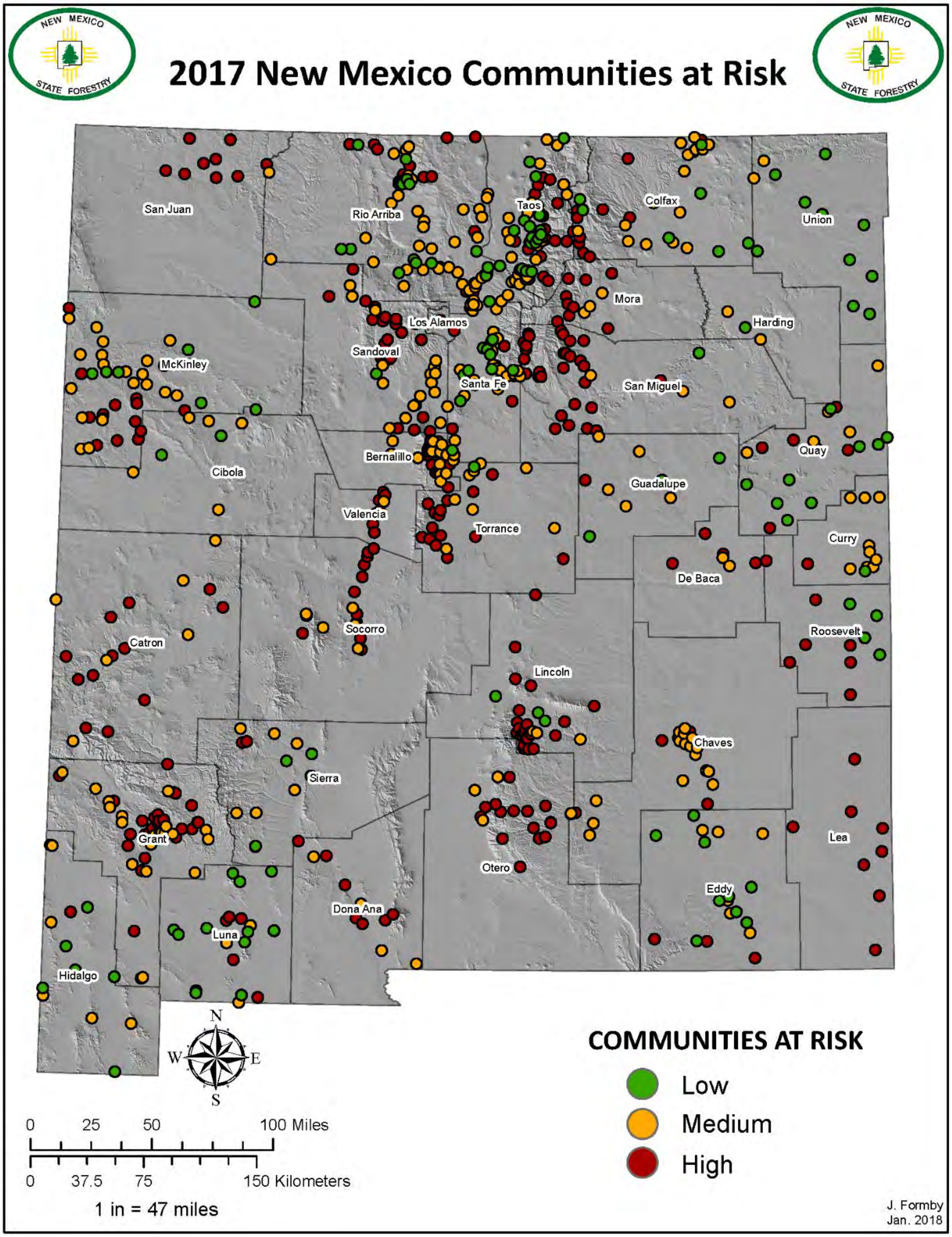
In 2016, the New Mexico Forestry Division updated the Community at Risk Assessment Plan, which ranks communities and Tribal areas by how vulnerable they are to wildland-urban interface fires.[165]

- The vulnerability criteria used to rank the communities include:
- Proximity of vegetation types to homes
- Availability of water
- Ease of evacuation
- Topography – ridge, valley, slope, and exposure
- Types of fuel (vegetation type)
- Number and size of previous fires
- Direction of prevailing and local winds in each community
- Ability of community/subdivision to protect homes

Currently, there are 58 Community Wildfire Protection Plans (CWPPs) in the State. These 58 CWPPs identify 746 communities at risk from wildland fire. Of the 746 communities, 366 are listed as high risk, 289 are listed as moderate risk and 131 are listed as low risk from wildland fire.[166] Figure 4-243 is a map showing the communities covered by a CWPP. A full listing of communities and their level of wildfire risk is shown in Figure 4-242 and can be found in the current Community at Risk Assessment Plan at nmforestry.com.

[165] Source: The Plan can be found by visiting the following link:
http://www.emnrd.state.nm.us/SFD/FireMgt/documents/2016_CAR_PlanRevision12.13.16..pdf
[166] 2017 Communities At Risk Assessment Plan:
http://www.emnrd.state.nm.us/SFD/FireMgt/documents/2017_CAR_PlanRevision12.13.17_REVISEDFINAL.pdf

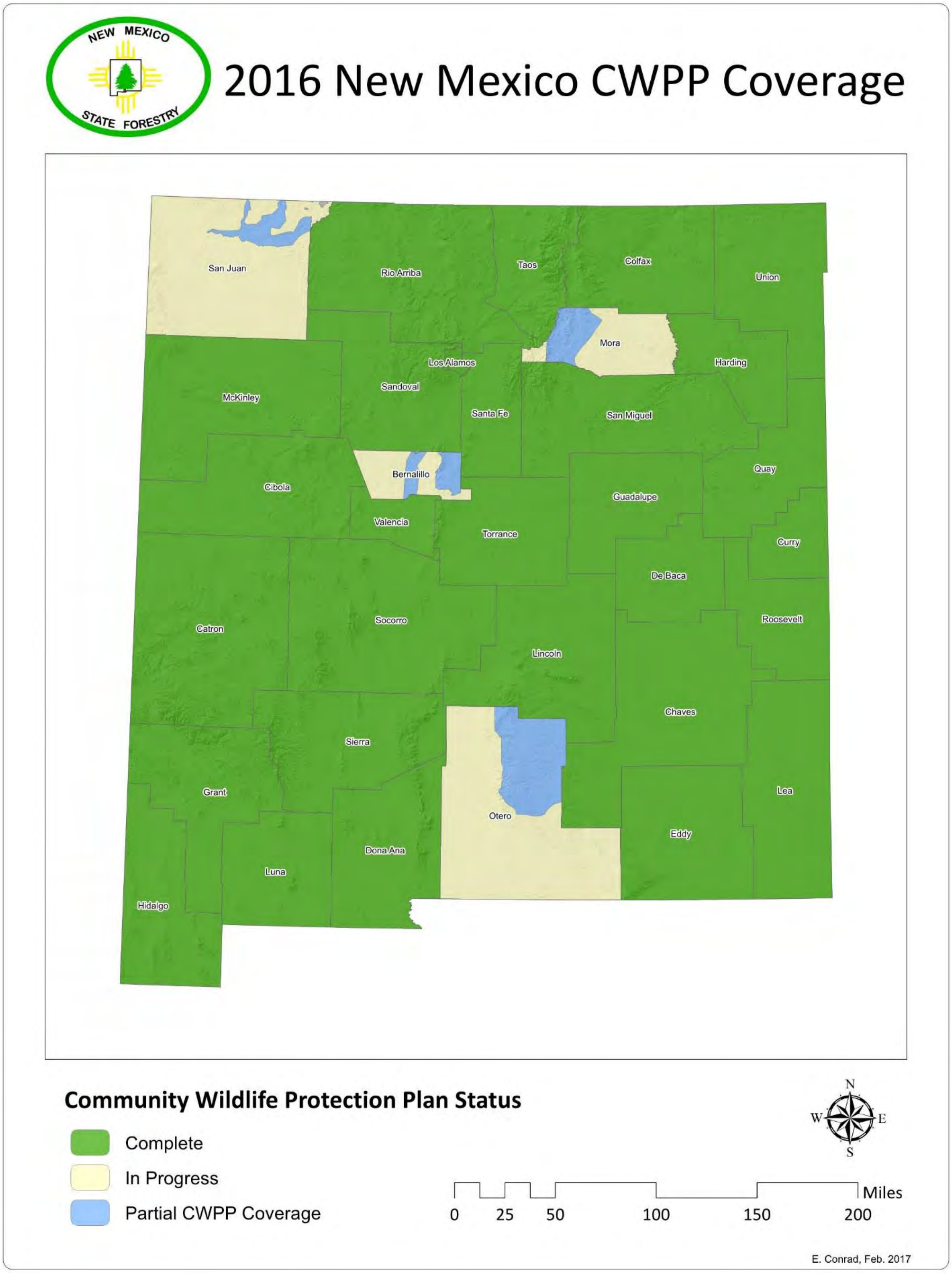
Figure 4-242 Communities at Risk to Wildfire



The New Mexico Fire Planning Task Force requires that CWPPs be updated within five years of adoption. In 2015, the Fire Planning Task Force adopted new guidelines for updating Community Wildfire Protection Plans.[167] The guidelines outline the process, requirements and recommendations for updating a CWPP in New Mexico.

[167] Source: http://www.emnrd.state.nm.us/SFD/FireMgt/documents/2015_CWPP_Update_Guidelines_Final_151028.pdf

Figure 4-243 Community Wildfire Protection Plan Communities



Community Wildfire Protection Plan Summary and Checklist[168]

Step One: Convene Decision Makers

- Form a core team made up of representatives from the appropriate local governments, local fire authority, and State agency responsible for forest management.

Step Two: Engage Interested Parties

- Contact and encourage active involvement in plan development from a broad range of interested organizations and stakeholders.
- Identify and engage local representatives of the USFS and BLM.
- Contact and involve other land management agencies as appropriate.

Step Three: Establish a Community Base Map

- Work with partners to establish a baseline map of the community that defines the community's WUI and displays inhabited areas at risk, forested areas that contain critical human infrastructure, and forest areas at risk for large-scale fire disturbance.

Step Four: Identify Problems to Be Addressed

- Work with partners to identify problems to be addressed, including fuel hazards; risk of wildfire occurrence; structural ignitability; local preparedness capability; and location of homes, businesses, essential infrastructure and other community values at risk.
- This "community risk assessment" can be simple or complex depending on the resources available to the community and partners.

Step Five: Establish Community Priorities and Recommendations

- Use the base map and community risk assessment to facilitate a collaborative community discussion that leads to the identification of local priorities for fuel treatment, reducing structural ignitability, and improving fire response capability.
- Clearly indicate whether priority projects are directly related to protection of communities and essential infrastructure or to reducing wildfire risks to other community values.

Step Six: Develop an Action Plan and Assessment Strategy

- Consider developing a detailed implementation strategy to accompany the CWPP, as well as a monitoring plan that will ensure its long-term success.

Step Seven: Complete the Community Wildfire Protection Plan

- Consider the CWPP complete for the year and date stamp the document.
- Communicate the results to the community and partners.
- Collect information to update the plan for revision the following year.

The New Mexico Forest Action Plan (originally published as the State-wide Natural Resource Assessment & Strategy and Response Plans by New Mexico State Forestry in June 2010) includes an analysis of wildfire risk.[169] The document explains several data gaps that would need to be addressed in order to improve the wildfire risk map. The document also includes a wildfire risk analysis for each of the six State

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[168] Source: Adapted from "Preparing a Community Wildfire Protection Plan: A handbook for Wildland-Urban Interface Communities" by the New Mexico Fire Planning Task Force for use in New Mexico.

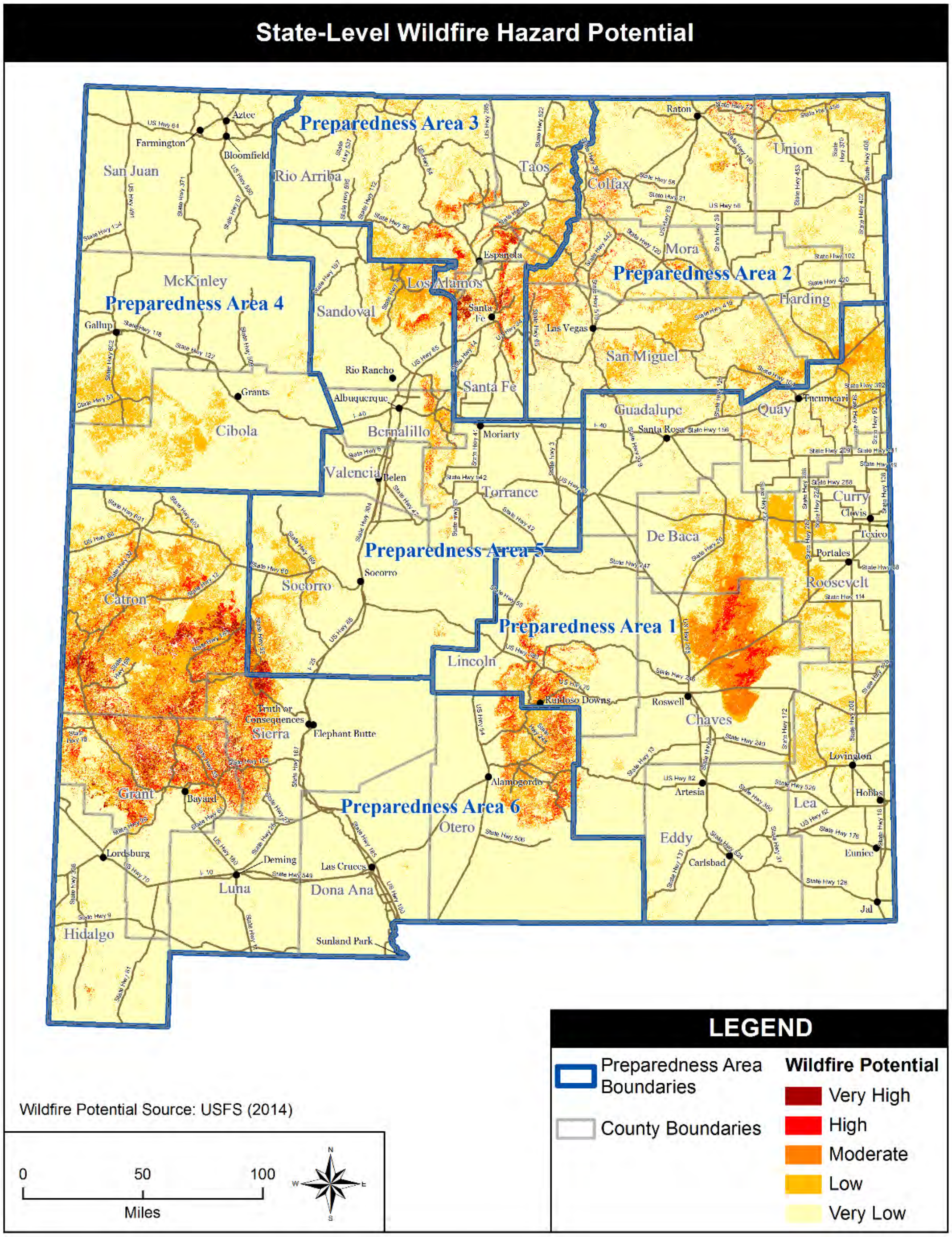
[169] Source: New Mexico Forest Action Plan, New Mexico State Forestry Division, http://www.emnrd.state.nm.us/SFD/statewideassessment.html

Forestry Districts. The data models will be reviewed and revised as necessary in the next update of the Forest Action Plan, slated for 2020.

The map below shows updated (2014) Wildfire Hazard Potential based on models produced by the U.S. Forest Service Rocky Mountain Research Station (https://www.firelab.org/project/wildfire-hazard-potential). The map depicts the relative potential for wildfire that would be difficult for suppression resources to contain.

Figure 4-244 displays the State-wide wildfire hazard potential model results by Preparedness Area, and the following Figure 4-245 through Figure 4-250 show wildfire hazard potential for each Preparedness Area.

Figure 4-244 Wildfire Hazard Potential Model Results[170]



[170] Source: The US Forest Service developed a national-scale 2015 wildfire potential map. It is available for download at: http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp

Figure 4-245 Preparedness Area 1 Wildfire Hazard Potential, 2014

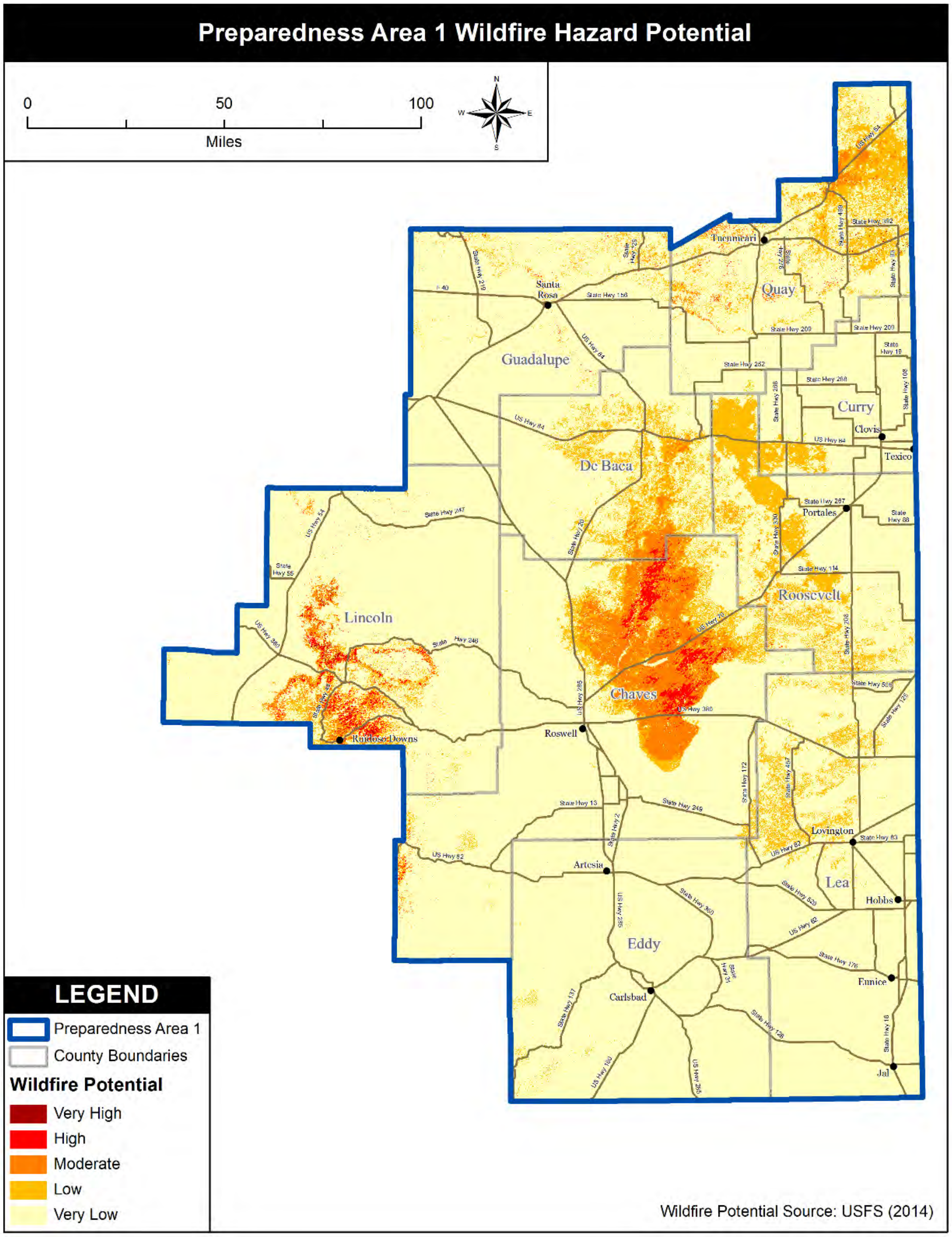


Figure 4-246 Preparedness Area 2 Wildfire Hazard Potential, 2014

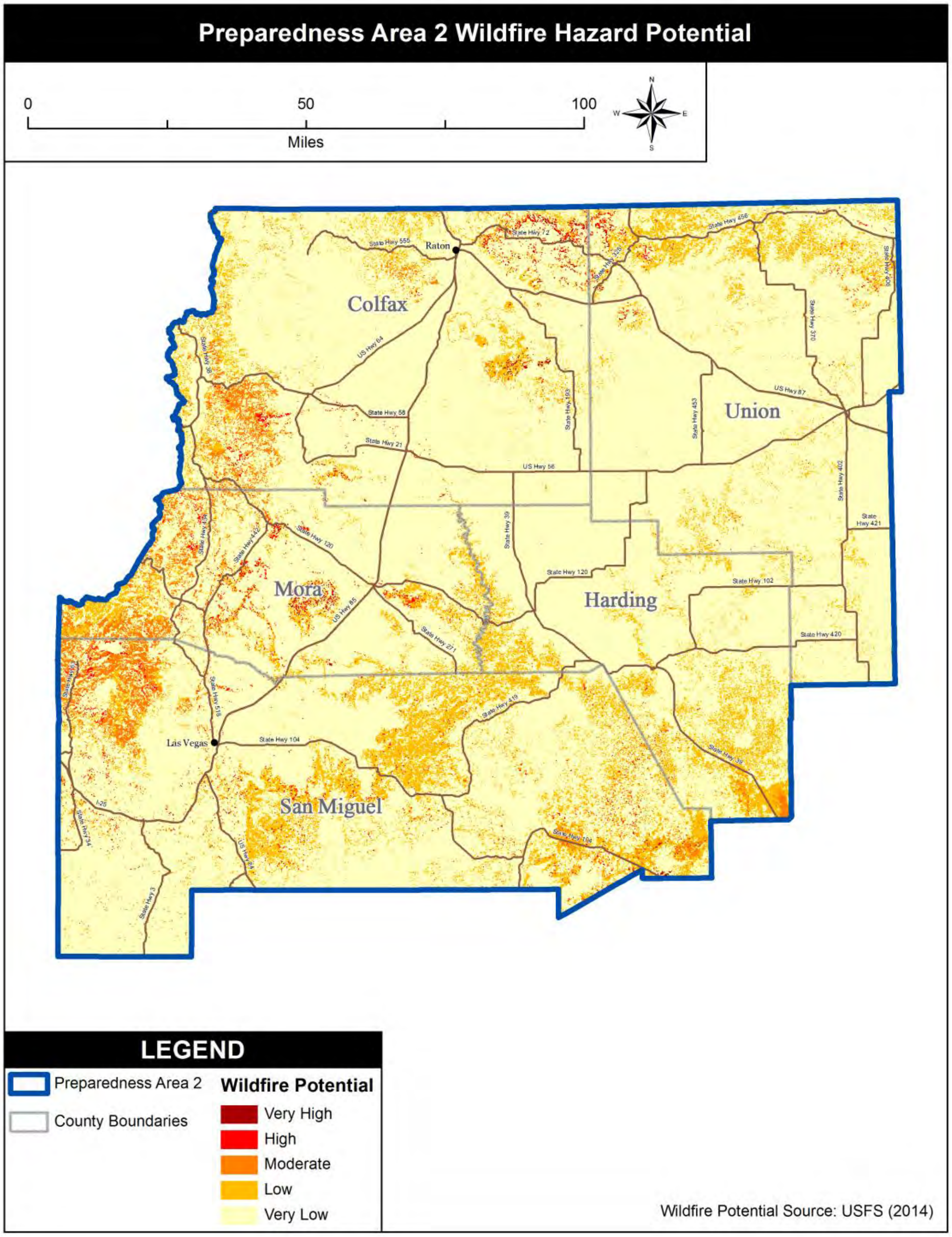


Figure 4-247 Preparedness Area 3 Wildfire Hazard Potential, 2014

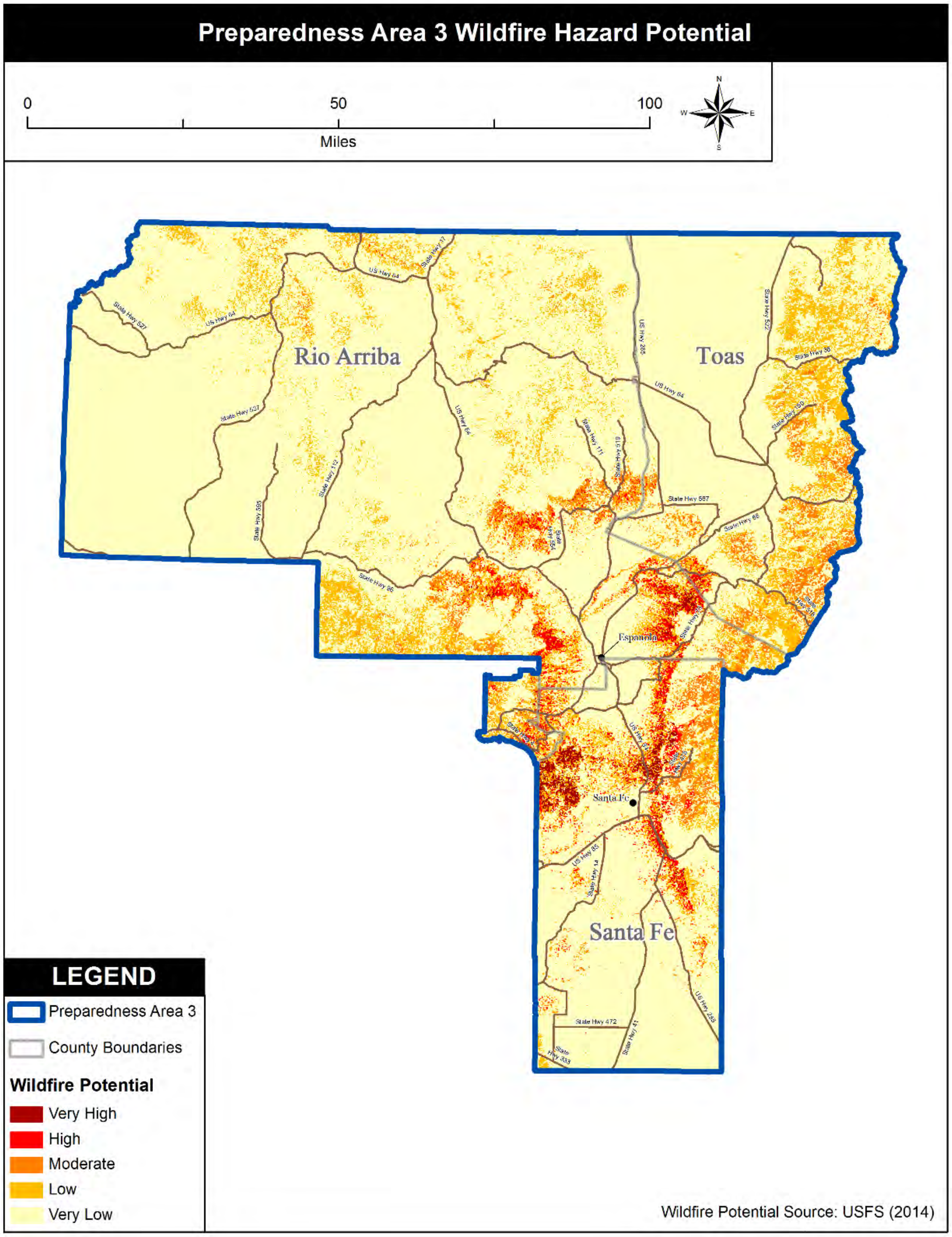


Figure 4-248 Preparedness Area 4 Wildfire Hazard Potential, 2014

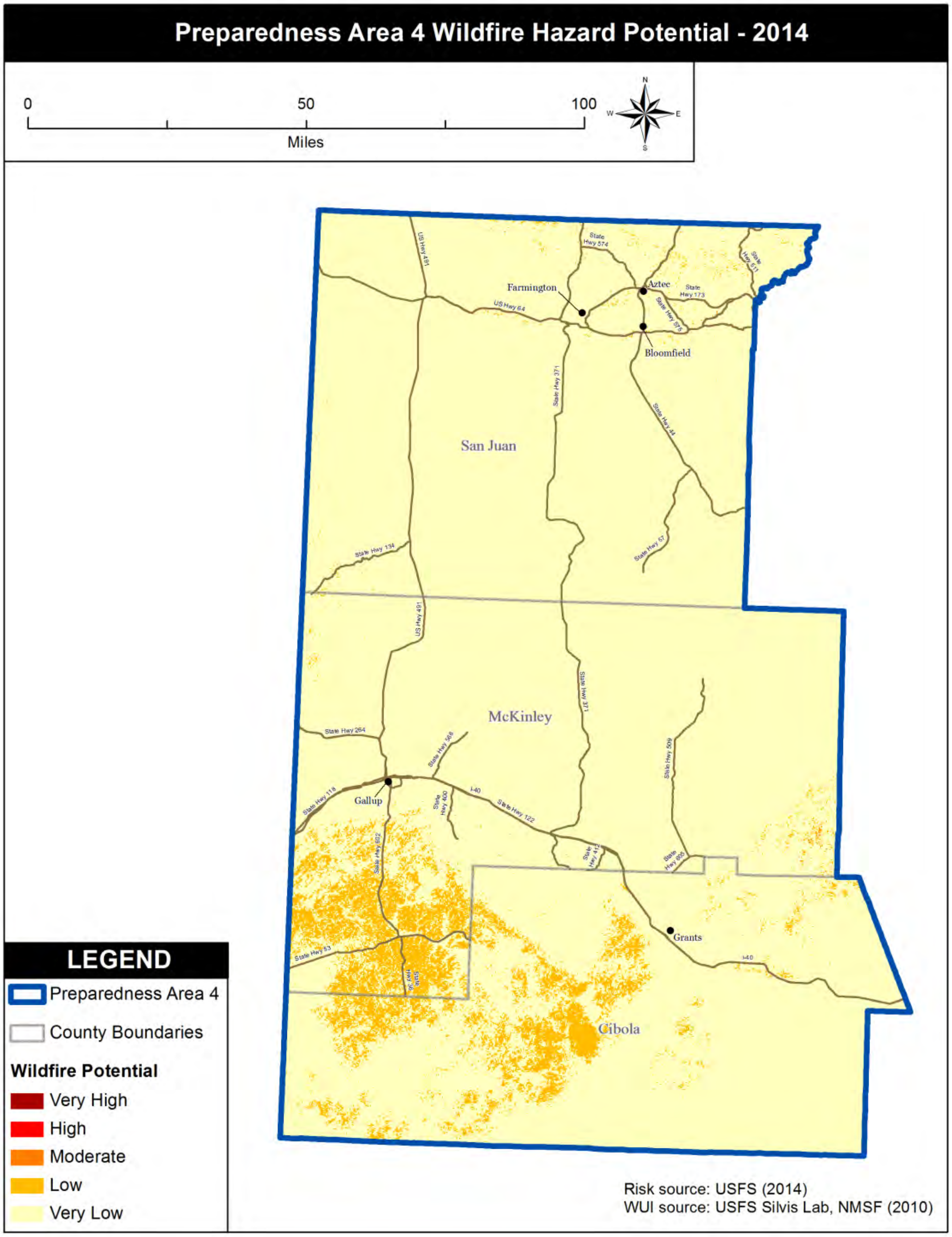


Figure 4-249 Preparedness Area 5 Wildfire Hazard Potential, 2014

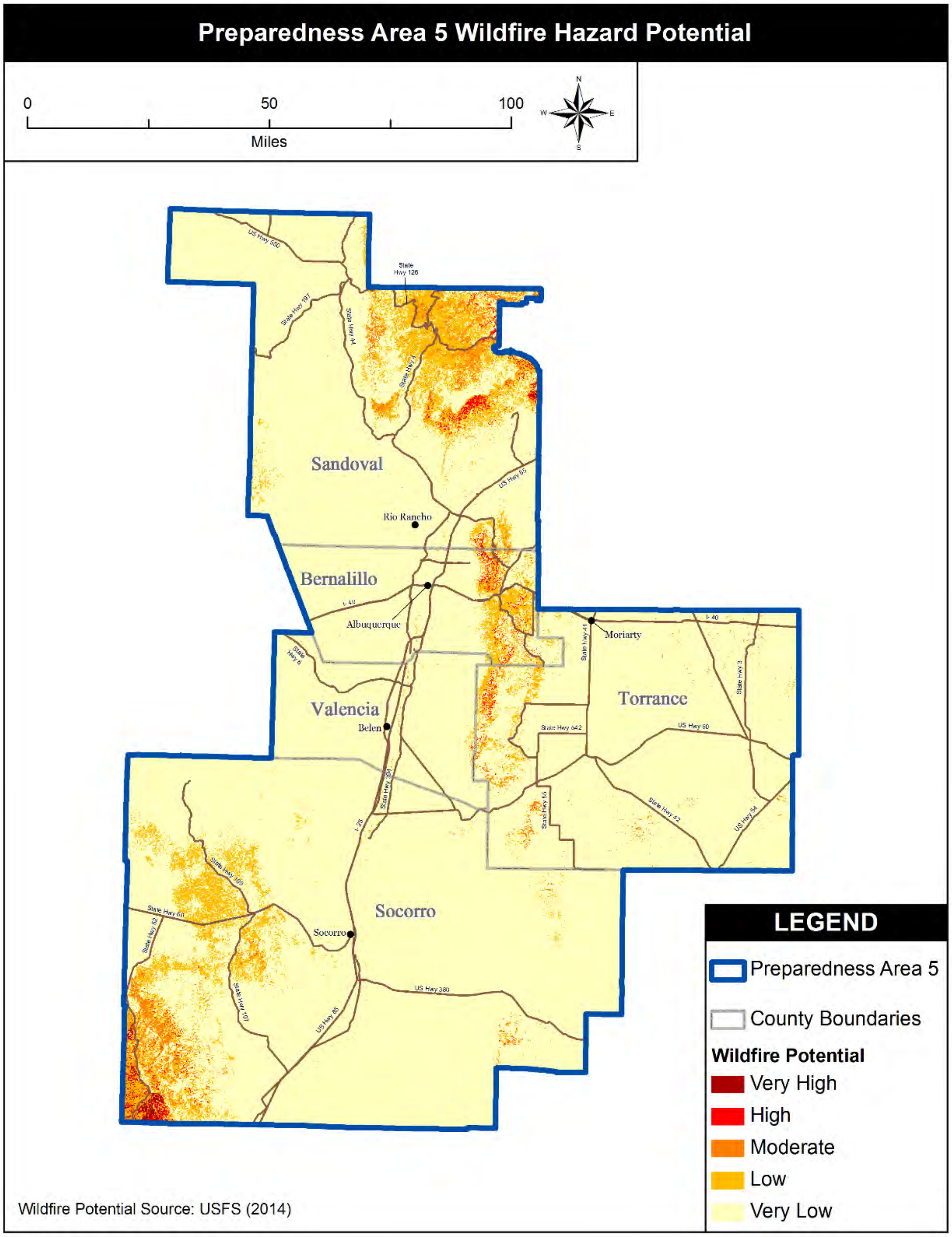


Figure 4-250 Preparedness Area 6 Wildfire Hazard Potential, 2014

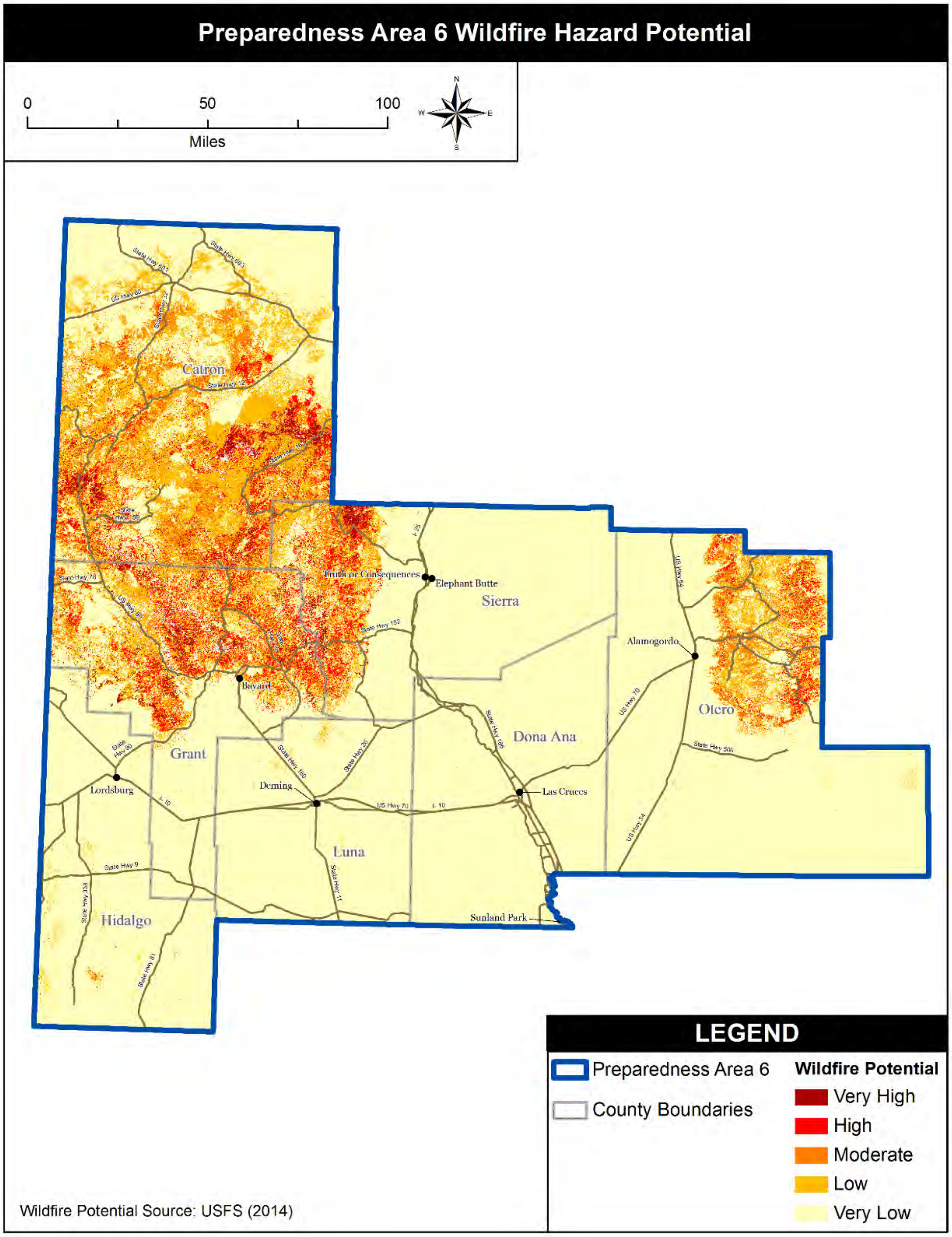


Figure 4-251 identifies potential impacts from a wildland fire for the purposes of EMAP compliance.

Figure 4-251 Potential Impacts from Wildland Fire

Subject	Potential Impacts
Agriculture	Of all the hazards, wildfire is the most concerning to agriculture. Crops can be destroyed, agriculture commodities in storage can be destroyed, grazing land and the animals using it can be destroyed and agriculture infrastructure is vulnerable. Agriculture producer lives have been lost combatting wildfire.
Health and Safety of the Public	The public is at risk to injuries from heat and smoke.
Health and Safety of Responders	Responders are at risk from heat exposure, burns, dehydration, smoke inhalation, etc.
Continuity of Operations	Those operations that are in or near the wildfire may be shut down or even destroyed by the fire. Operations outside the fire area may experience loss of electricity or communications if transmission lines and towers are damaged or shut down for safety reasons. Municipal water service may be interrupted if intakes are shut down due to ash or sediment.
Delivery of Services	Service delays are anticipated to operations within or near the fire areas.
Property, Facilities, Infrastructure	Fire can cause damage or destruction of property and infrastructure. Infrastructure near the fire areas may be barricaded or restricted to use by responders.
Environment	High severity fires can cause large areas to be denuded of plant life and subsequently animal life. These bare areas are susceptible to erosion and post-fire runoff that can contaminate water supplies or fill waterways with contaminants or sediment. High temperature fires can cause the soils to be damaged, and plant recovery may be delayed.
Economic Condition	A wildfire can cause damages to residences, businesses, and other highly valued assets in a community that can have lasting effects.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

4.5.14.6 *Data Limitations*

Because each agency and organization compiles data and maps using different reference points, it is difficult to collapse all of the information into one comprehensive map or listing. The State of New Mexico reports the number of statistical fires (fires that start on State and private lands, for which State Forestry is responsible) in the Energy, Minerals and Natural Resources Department's Annual Report (published on EMNRD's website: http://www.emnrd.state.nm.us/ADMIN/publications.html). The Southwest Coordination Center publishes year-to-date and historical fire data for other jurisdictions on its website (https://gacc.nifc.gov/swcc/predictive/intelligence/intelligence.htm), but the numbers for State fires differ from the State's data because of different reporting requirements. It would be very helpful to have all large fires and fires that threatened or damaged structures cataloged. It would also be helpful to have all damage estimates cataloged.

It would be helpful to have historical information on the number of fires and acres burned organized by county and information on the cause of fire organized by county. If data were available for several years, trends by county and Preparedness Area could be generalized. Ultimately, mitigation activities could be targeted at the highest risk communities.

It would also be helpful to have an analysis of burn scar areas and increased flood/debris flow maps. This type of analysis would enable wildfire and flood mitigation activities to target high risk areas.

4.5.14.7 *What Can Be Mitigated?*

Wildfires can be a significant threat to the citizens, structures, infrastructure, and natural resources within New Mexico. As a result, the SHMPT has identified the wildfire hazard as a priority in the Plan Update.

Mitigation options for wildland fire need to address not only the management of fuels, but also the potential for growing population in wildfire threat areas. The State Forestry Division has conducted a State-wide assessment on forest health and outlined mitigation efforts and priorities to reduce fuel loads and create more defensible space. More specific mitigation goals and actions are detailed Table 2 in the 2015 State Forester's Review and Plans for 2020 Update to the New Mexico Forest Action Plan.[171] A summary of the actions most relevant to this Plan Update is included in the Mitigation Actions section of this Plan Update.

Wildfire can have lasting impacts on a community, including contributing to the risk of other hazards such as flooding and landslides. To prevent the cycle of drought, wildfire, and flooding, a systematic approach is needed that will institute a proactive method of mitigation. Two sources of information, developed by the USACE, to be evaluated include the Burn Scar Hydrology, and the Debris Flow Impact, which helps to establish non-regulatory corridors in areas where development is discouraged due to risk from increases of debris flow.

Based on statistical information about fire causation and occurrence, the trend has been that human-caused fires cause more fires to occur and burn more acreage than natural caused fires. This trend offers a mitigation opportunity for education and outreach to reduce the number and acreage of fires in the State. However, while human-caused fires are more numerous, wildland fuel loads contribute to the rate of spread and intensity of wildfire regardless of the source. Reduction of wildland fuels and continued maintenance are critical in reducing the spread and damage potential of wildfires.

4.5.14.8 *Changing Weather Patterns*

It is important to note that climate change impacts will increase vulnerability to several natural hazards, including wildland fire. Increased warming, drought, and insect outbreaks, all caused by or linked to

[171] Source: New Mexico State Forestry Division, http://www.emnrd.state.nm.us/SFD/documents/2016NMSFFAPReviewReport.pdf

climate change, have increased wildfires and impacts to people and ecosystems in the Southwest. Fire models project more wildfire and increased risks to communities across extensive areas. The 2014 publication *Climate Change Impacts in the United States* cautions that climate change is exacerbating the major factors that lead to wildfire: heat, drought, and dead trees. Between 1970 and 2003, warmer and drier conditions increased burned area in western U.S. mid-elevation conifer forests by 650%. Climate outweighed other factors in determining burned area in the western U.S. from 1916 to 2003. Winter warming due to climate change has exacerbated bark beetle outbreaks by allowing more beetles, which normally die in cold weather, to survive and reproduce. Wildfire risk is increased in stands of conifers with dry needles and in areas with extensive dead and down trees. More wildfire is projected as climate change continues, including a doubling of burned area in the southern Rockies.[172]

4.6 Hazard Ranking

Through a survey, the Planning Team ranked the natural hazards according to priority. Each hazard was given a rank of one through 14 by each survey participant based on their prioritization of the hazard. The ranks given for each hazard were averaged across all participants, and then final ranking scores were determined based on the averages. The top ranked hazard was wildland/wildland urban interface fires. The top four hazards were determined to be wildland/wildland urban interface fires, floods, thunderstorm, and drought. The lowest ranked hazard was volcanoes. The full results are listed in Figure 4-252 below.

Figure 4-252 SHMPT Natural Hazards Rankings

Natural Hazards	Ranking
Wildland/Wildland Urban Interface Fires	1
Floods	2
Thunderstorm	3
Drought	4
Winter Storm	5
High Wind	6
Extreme Heat	7
Dam Failure	8
Tornado	9
Earthquake	10
Landslide	11
Land Subsidence	12
Expansive Soil	13
Volcanoes	14

Overall, based on the HIRA, local roll up, and hazard ranking, the hazard priorities have not changed since the 2013 Plan. Wildland/Wildland Urban-Interface, floods, and drought remain the top three priority hazards for the State of New Mexico. The Governor and leadership in the State have not changed since the 2013 Plan. However, there is more guidance, direction and emphasis from the Office

[172] Source: National Climate Assessment, 2014. http://nca2014.globalchange.gov/report/regions/southwest.

of the Governor to prioritize both mitigation and prevention projects/funding to limit disaster impacts. Overall priorities have remained consistent.

5 CAPABILITIES AND RESOURCES

This capability and resource assessment section examines the ability of the State of New Mexico to implement and manage a comprehensive mitigation strategy, which includes a range of mitigation actions. The strengths, weaknesses, and resources of partner agencies and jurisdictions are identified in this assessment as a means for developing an effective and appropriate hazard mitigation program. Additionally, the capabilities identified in this assessment have been evaluated collectively to develop recommendations that support the implementation of successful mitigation actions throughout the State.

This section identifies capabilities and resources related to: programs implemented by NMDHSEM including, hazard mitigation assistance grant programs, community assistance program, emergency management performance grant programs, local and tribal mitigation planning, and public assistance and 406 mitigation. Next hazard-specific capabilities are evaluated. Federal and State programs are then summarized. Lastly, a review of change in mitigation capabilities since December 2012 is discussed. The assessment of capabilities and resources emphasizes accessible technical and financial resources available at the State and Federal levels.

The Capabilities and Resources Appendix (Appendix B), includes listings referenced in this section of the Plan Update.

5.1 Programs Implemented by NMDHSEM

5.1.1 Mitigation Planning

Planning Grants: Having a FEMA approved Mitigation Plan is one of the eligibility requirements for a project to be funded with Hazard Mitigation Assistance (HMA) grants. For tribes that want to go directly to the federal government for a disaster declaration, a Mitigation Plan is one of the eligibility requirements. The effectiveness of the plans is evidenced by State agencies, tribes and local communities implementing mitigation actions, prioritization of mitigation actions for each jurisdiction and improved coordination among plan participants.

For all presidential disasters declared after October 30, 2000:

- State mitigation plans must be developed that meet the regulations in CFR 44 Section 201.4.
- Local mitigation plans must be developed that meet the regulations in CFR 44 Section 201.6.
- Tribal mitigation plans must be developed that meet the regulations in CFR 44 Section 201.7.

FEMA's 2013 Local Mitigation Planning Handbook provides step-by-step guidance on how to develop a local mitigation plan (https://www.fema.gov/media-library/assets/documents/31598). FEMA's 2011 Plan Review Guide is used by the State and FEMA to assure that local plans meet the federal requirements (https://www.fema.gov/media-library/assets/documents/23194). In December 2017, a new Tribal Plan Review Guide was released. It includes a Tribal Mitigation Plan Tool as Appendix A. To download go to https://www.fema.gov/media-library/assets/documents/18355

In general, mitigation plans include the following information:

- Public and private sector involvement in the planning process;
- Hazard Identification and Risk Assessment;
- A mitigation strategy that identifies mitigation goals, measures, and priorities;
- A plan maintenance and review process; and
- Documentation that the governing body of the jurisdiction requesting approval of the plan has formally adopted the plan.

A list and map of approved mitigation plans in the State are shown in Figure 5-1 and Figure 5-2. As of March 31, 2018, there are 26 local and tribal mitigation plans approved in New Mexico. Covered by these plans are 17 counties, 72 cities/towns, seven tribes, two universities and four other entities. An additional 17 local plans and six tribal plans are under development. Summaries of the hazards, capabilities, vulnerabilities and mitigation actions included in the local and tribal plans are incorporated in the related sections of this State Mitigation Plan Update.

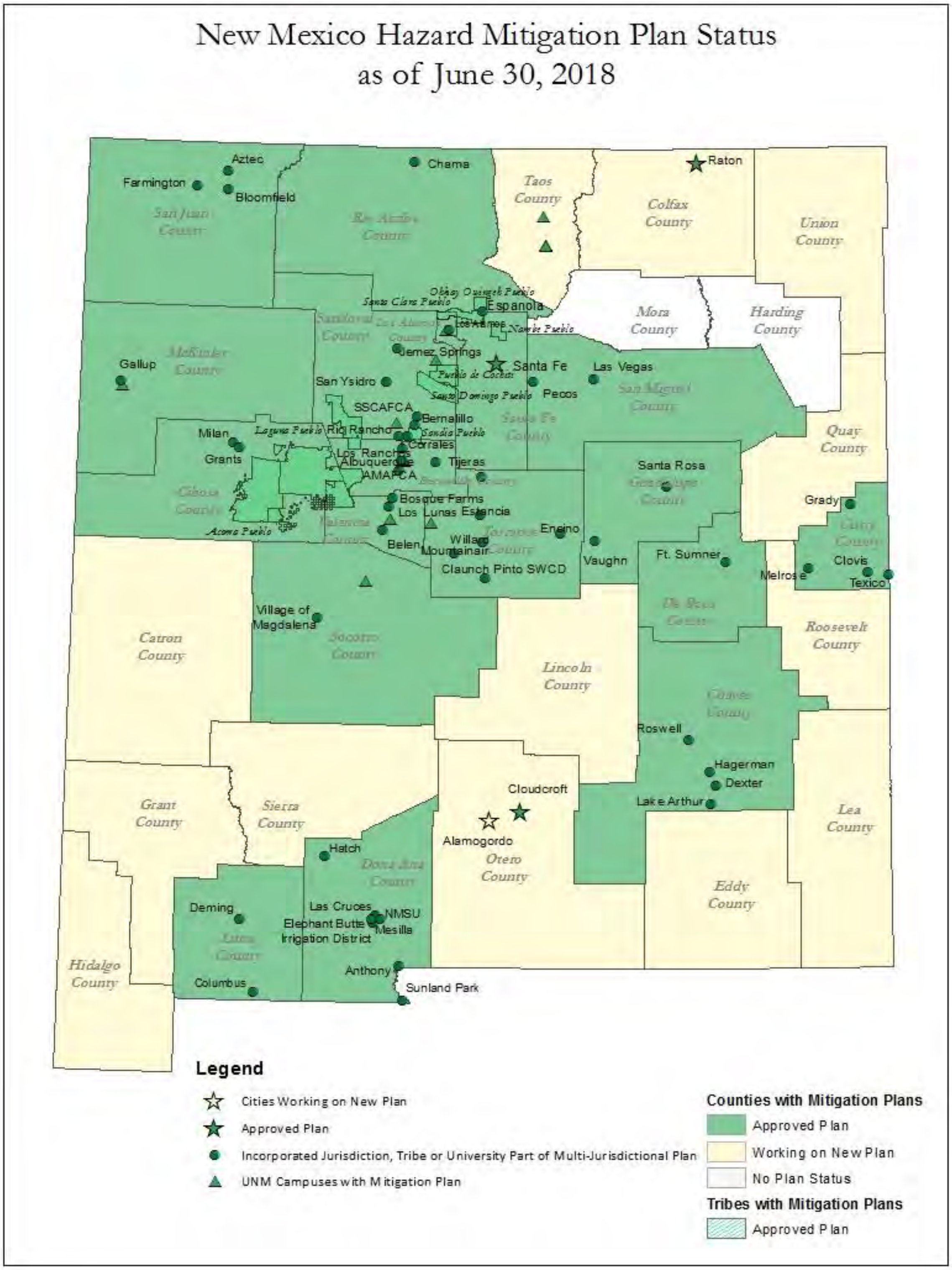
The State Mitigation program staff advise local and tribal entities that the mitigation plan creation process takes up to two years. In general, 6 months for funding and contracting, one year to develop the plan and another 6 months for State/FEMA approval. Based on available staffing, mitigation plan reviews take approximately one to two months once submitted to the State. After preparing and sending the Plan Review Tool, the State staff conduct a technical assistance call to review all comments. Once the plan meets all requirements, the State sends the plan to FEMA for review. If a Plan Review Tool is prepared that includes a rejection, the State provides the document to the local contact and facilitates a FEMA/State/local technical assistance call to review all comments. Once the plan is Approved Pending Adoption, the State sends the APA letter and Plan Review Tool to the local within one week of receipt. The State sends the final plan with adoption resolutions to FEMA within one week of receipt from the local. Once the plan is Approved, the State sends the Approval letter and Plan Review Tool to the local within one week of receipt.

Figure 5-1 List of Approved Mitigation Plans as of June 30, 2018

Jurisdiction	County	Approval Date	Participating Jurisdictions
Acoma Pueblo	Cibola	1/25/2018	Acoma Pueblo
Bernalillo County	Bernalillo	8/31/2015	Bernalillo County, Albuquerque, AMAFCA, Los Ranchos de Albuquerque, Tijeras
Chaves County	Chaves	10/28/2014	Chaves County, Dexter, Hagerman, Lake Arthur, Roswell
Cibola County	Cibola	11/24/2015	Cibola County, Grants, Milan
Cloudcroft, Village of	Otero	7/26/2017	Cloudcroft
Cochiti Pueblo	Sandoval	7/29/2015	Cochiti Pueblo
Curry County	Curry	9/30/2015	Curry County, Clovis, Grady, Melrose, Texico
De Baca County	De Baca	7/6/2015	De Baca County, Village of Fort Sumner

Jurisdiction	County	Approval Date	Participating Jurisdictions
Dona Ana County	Dona Ana	2/13/2014	Dona Ana County, Anthony, Elephant Butte Irrigation District, Hatch, Las Cruces, New Mexico State University, Mesilla, Sunland Park
Guadalupe County	Guadalupe	1/12/2016	Guadalupe County, Santa Rosa, Vaughn
Laguna Pueblo	Cibola	7/9/2015	Laguna Pueblo
Los Alamos County	Los Alamos	3/20/2016	Los Alamos County
Luna County	Luna	12/29/2014	Columbus, Deming, Luna County
McKinley County	McKinley	12/3/2014	Gallup, McKinley County
Nambe Pueblo	Santa Fe	9/13/2013	Nambe Pueblo
Ohkay Owingeh	Rio Arriba	12/4/2017	Ohkay Owingeh
Raton, City of	Colfax	9/25/2015	Raton
Rio Arriba County	Rio Arriba	4/13/2015	Rio Arriba County, Chama Village, Espanola
San Juan County	San Juan	4/23/2014	San Juan County, Aztec, Farmington, Bloomfield
Sandia Pueblo	Sandoval	2/18/15	Sandia Pueblo
Sandoval County	Sandoval	3/12/2014	Sandoval County, Bernalillo (Town of), Corrales, Jemez Springs, Rio Rancho, Sandia Pueblo, San Ysidro, Santo Domingo Pueblo, SSCAFCA
San Miguel County	San Miguel	12/9/2014	San Miguel County, Las Vegas, Pecos
Santa Clara Pueblo	Rio Arriba	10/28/2013	Santa Clara Pueblo
Santa Fe, City of	Santa Fe	12/1/2014	City of Santa Fe
Santa Fe County	Santa Fe	5/30/2018	Santa Fe County
Santo Domingo Pueblo	Sandoval	9/3/2015	Santo Domingo Pueblo
Socorro County	Socorro	3/20/2018	Socorro County, Village of Magdalena
Torrance County	Torrance	12/13/2017	Torrance County, Claunch Pinto Soil and Water Conservation District, Encino, Estancia, Mountainair
University of New Mexico	Bernalillo	6/9/2016	University of New Mexico
Valencia County	Valencia	6/1/2015	Valencia County, Belen, Bosque Farms, Los Lunas

Figure 5-2 Map of Approved Mitigation Plans as of June 30, 2018



DHSEM field deploys Local Mitigation Plan training (FEMA G318) at least once each year. If enough interest is expressed, the training is offered a second time. The Mitigation for Emergency Managers training (G393) had been taught through 2014. The course was no longer approved for dissemination and starting 2015 only G318 is offered. FEMA Region provided a one-day overview of tribal mitigation plan training in November 2016. Below are the dates and locations of mitigation planning training provided since January 2012.

- Dona Ana County April 2014 (G393)
- San Juan County May 2014 (G393)
- Santa Fe April 2015 (G318)
- Los Alamos July 2016 (G318)
- Acoma Pueblo November 2016 (tribal)
- Rio Arriba County November 2016 (tribal)
- McKinley County April 2017 (G318)
- Dona Ana County July 2017 (G318)
- Lincoln County July 2018 (G318)

FEMA provided reservists to assist the State with mitigation plan reviews and technical assistance to locals/tribes. Without the excellent customer service, extensive knowledge and intense time commitment from the dedicated reservists, New Mexico would not have made so much progress on mitigation planning.

5.1.2 Hazard Mitigation Assistance Grant Program

The State relies exclusively upon federal mitigation grant programs available through the Federal Emergency Management Agency to fund mitigation projects. Local jurisdictions, tribes and State agencies may pursue outside funding sources at their discretion.[173]

The State of New Mexico Department of Homeland Security and Emergency Management acts as the grantee for available FEMA Hazard Mitigation Assistance grant programs (HMA), evaluates and recommends projects to FEMA for funding, and passes federal grant funds through to sub-grantees (municipal government, county government, state government and tribal entities). The non-federal share is usually borne by the applicant for mitigation grants. Sub-applicants may meet their match by cash, in-kind services, or a combination of the two. Future funding of all federal grants depends upon continued funding by Congress.

FEMA's HMA grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. Currently, the State of New Mexico administers the following FEMA HMA grant programs:[174]

- Hazard Mitigation Grant Program: assists in implementing long-term hazard mitigation measures following Presidential disaster declarations; funding is available to implement projects in accordance with State, Tribal and local priorities.

[173] Additional resources for mitigation planning and funding are available on the FEMA website: http://www.fema.gov/hazard-mitigation-planning-resources#3

[174] FEMA Fiscal Year 2013 Unified Hazard Mitigation Assistance Guidance

- Pre-disaster Mitigation Program: provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster; the goal is to reduce overall risk to the population and structures, while also reducing reliance on Federal funding from Presidential disaster declarations.
- Flood Mitigation Assistance Program: provides funds on an annual basis so that measures can be taken to reduce or eliminate the risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP).

New Mexico communities have utilized funds from the Hazard Mitigation Grant Program and the Pre-disaster Mitigation grant program to reduce local risk and vulnerability to hazards. The 2015 Hazard Mitigation Assistance Unified Guidance provides the most recent information on available FEMA mitigation grant programs including significant programmatic changes. The Robert T. Stafford Act, which is described in more detail in the following section, was amended in August of 2016.[175]

The Biggert-Waters Flood Insurance Reform Act of 2013 combined FEMA's Repetitive Flood Claims and Severe Repetitive Loss programs with the Flood Mitigation Assistance grant program. With modified definitions of repetitive loss and severe repetitive loss properties that were instituted by the Biggert-Waters Act, there are currently 36 repetitive loss and two severe repetitive loss structures in the State. More information on repetitive loss structures is found in the flood hazard identification of the HIRA, Repetitive Loss Properties Section.

The Mitigation Program will provide information to all potential applicants across the State announcing the availability of HMA, giving program details, explaining the application process, general program eligibility, key deadlines and references to the State's mitigation web page for more information.

Additionally, the Mitigation Program will review submitted mitigation applications consulting with the State Coordinating Officer (SCO), State and Federal agencies as needed. All project requirements must meet the minimum requirements of 44 CFR 206.434 (b) and 44 CFR 206.435 (b). The State Mitigation Administrative Plan describes the criteria for project selection, although other factors may be considered. The criteria include, but are not limited to:

- A community or tribe that has a FEMA approved mitigation plan;
- A completed application by the submittal deadline;
- Accomplish multiple objectives including damage reduction, environmental enhancement, and economic recovery when appropriate;
- Measures that best fit within an overall plan for development and/or hazard mitigation in the community or disaster area as described in the local Natural Hazard Mitigation Plan;
- Measures that, if not taken, will have a severe detrimental impact on the applicant, such as potential loss of life, loss of essential services, or economic hardship in the community;
- Measures that have the greatest potential impact on reducing future disaster losses;
- Measures that are designed to accomplish multiple objectives for damage reduction, environmental enhancement, and economic recovery;

[175] Source: https://www.fema.gov/media-library/assets/documents/15271

- Solve a problem independently or constitute a functional portion of a solution whether there is assurance that the project as a whole will be completed; and
- Acquisition of Repetitive Loss or Severe Repetitive Loss properties.

If the grant application requests exceed the amount of available funding, the State would prioritize projects that maximize benefits. Based upon applications submitted and available funding, plans and projects would be prioritized for funding according to the following approach. Preparedness Bureau staff forms a Ranking Committee based upon the criteria established in the State Mitigation Administrative Plan (see above) and the criteria below. The Ranking Committee recommendations are provided to the Governors Authorized Representative (GAR) for approval. After the GAR provides approval, the SHMO contacts each applicant to notify them if their project was selected or not. If a project is withdrawn or is determined to not meet all eligibility criteria, the project with the next highest ranking is funded up to the maximum amount of federal dollars remaining.

Points are given for each criterion as follows:

- Completed application - If an application is not complete, it is not qualified for ranking.
- Prevents harm to human life.
- Reduces amount of property damage, both public and private, from natural hazards.
- A real-world event has had severe detrimental impact on the applicant, such as potential loss of life, loss of essential services, or economic hardship in the community.
- Reduces the number of necessary evacuations.
- Shortens recovery time (community function, natural environment, other).
- Project is included in the applicant's General Plan, Comprehensive Plan, or Infrastructure Capital Improvement Plan.
- Project is identified as a high priority in an adopted plan of the applicant.
- Applicant is a community with intense development pressure.
- Improves communication, collaboration and integration among State, Tribal and Local emergency management agencies.

In the future, the State may prioritize projects that have a non-federal share exceeding the minimum match requirement or have the highest cost-benefit ratio. Discussions have also centered on prioritizing the highest priority hazards such as wildfire, flooding, and thunderstorms. However, to date, no formal determination has been made to prioritize mitigation actions according to these additional potential criteria.

5.1.2.1 *Hazard Mitigation Grant Program*

Section 404 of the Robert T. Stafford Disaster Relief Emergency Assistance Act created the Hazard Mitigation Grant Program (HMGP) in November 1988. The HMGP assists states and local communities in implementing long-term hazard mitigation measures following a major disaster declaration. The grant is a cost-share of 75% federal share and 25% non-federal share. On October 30, 2000, the Robert T. Stafford Disaster Relief and Emergency Assistance Act was amended by Public Law 106-390 and Section 404 is referred to as the Disaster Mitigation Act of 2000 (DMA2K). The State administers the Hazard Mitigation Grant Program and is responsible for selecting projects for funding from the applications submitted by communities. The State then forwards selected applications to FEMA for an eligibility determination.

Objectives of the Hazard Mitigation Grant Program are;

- To prevent future losses of lives and property due to disasters;
- To implement state or local Hazard Mitigation plans;
- To enable mitigation measures to be implemented during immediate recovery from a disaster; and
- To provide funding for previously identified mitigation measures that benefit the disaster area.

How does the Hazard Mitigation Grant Program differ from mitigation funded under the Public Assistance Program?

The Hazard Mitigation Grant Program can fund mitigation measures to protect public or private property, so long as these measures fit within the overall mitigation strategy for the local community or tribe, and comply with program guidelines. The Hazard Mitigation Grant Program can be used to fund mitigation measures State-wide (not only in communities identified for federal assistance in the presidential disaster declaration to repair damaged public facilities). The Hazard Mitigation Grant Program can be used for any natural hazard risk reduction activity, not only the natural hazard that caused the presidential disaster declaration. Hazard Mitigation Grant Program funds can be used to prepare a local, state or tribal mitigation plan. A FEMA approved Mitigation Plan is one of the eligibility requirements for the Hazard Mitigation Grant Program.

HMGP derives its funding from a percentage of the eligible damages under a Stafford Act Disaster Declaration in which Public Assistance (PA) and/or Individual Assistance (IA) were authorized. The HMGP funding formula is an additional 15% of each Public Assistance Grant (Category C through G only). To date, Management Costs have been provided to New Mexico as an additional 4.89% of the total HMGP amount awarded. For very large disaster declarations, the percentage changes. Management Costs for HMGP are 100% federal share with no required state share. In New Mexico, Management Costs are utilized by DHSEM to administer the State Mitigation Program; there is no pass-through to sub-grantees.

For public property damaged in the presidentially declared disaster, it is appropriate to consider funding mitigation measures under Public Assistance ("Section 406" of the Stafford Act) before applying for Hazard Mitigation Grant Program funding ("Section 404" of the Stafford Act). Public Assistance funds allow a sub-applicant to add mitigation measures to the design of a pre-existing damaged facility if measures are cost-effective or are required by code. Mitigation funded under Public Assistance is only for public facilities damaged by the presidentially declared disaster. 406 Mitigation allows improvements or modifications to eligible PA projects, such as increasing culvert size, stabilizing stream banks or reinforcing bridge abutments. These mitigation actions must be cost-effective in reducing future disaster losses without creating a new footprint.

Applicant Eligibility: New Mexico applicants eligible for the Hazard Mitigation Grant Program are:

- State and local governments;
- Native American tribes or authorized tribal organizations; and
- Certain private non-profit organizations or institutions.

Beginning in 2015, tribes could apply direct to FEMA for a disaster declaration if certain criteria are met. With a direct disaster declaration, the tribe would receive all Hazard Mitigation Grant Program funds associated with that direct disaster. More information on the pilot guidance can be accessed at https://www.fema.gov/news-release/2017/01/10/fema-finalizes-pilot-guidance-tribal-disaster-declarations-process-stafford

Although individuals cannot apply directly for Hazard Mitigation Grant Program funds, an eligible applicant may submit an application on their behalf.

Awards and Sub-grant Types: Three types of awards or Sub-grants are available under the Hazard Mitigation Grant Program;

- Planning activities are awards to States or Sub-grants to eligible applicants to develop or upgrade their natural hazard mitigation plan. Hazard Mitigation Grant Program funds can be used to prepare a state, tribal or local mitigation plans. A maximum of 7% of the federal share of each grant can be used for planning.
- 5% Initiative Projects are awards to States or Sub-grants to eligible applicants to implement measures to reduce risk from natural disasters. Although these measures need to be cost effective, they do not need to meet the benefit cost analysis criteria. A maximum of 5% of the federal share of each grant can be used for planning.
- Regular Project activities are awards to States or Sub-grants to communities to implement measures to reduce risk from natural disasters. Regular projects must meet the benefit cost analysis criteria. Funding remaining from planning and 5% initiative can be utilized for regular projects.

Project Sub-grants: A project must, at a minimum, be:

- Cost Effective;
- Comply with environmental and historic preservation regulations;
- Technically feasible;
- Within a jurisdiction or tribal entity boundary that has a FEMA-approved mitigation plan;
- Identified in the applicant's Natural Hazard Mitigation Plan;
- All applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area (a Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) has been issued); and
- The community must not be suspended or on probation from the NFIP.

The Hazard Mitigation Grant Program can be used to fund any type of natural hazard mitigation activity including projects to protect either public or private property. Examples of projects include:

- Minor localized flood control projects (examples include installation/modification of stormwater management facilities like culverts, construction/modification of retention/detention basins, construction/modification of floodwalls/dams)
- Non-localized flood risk reduction projects (examples include construction/demolition/rehabilitation of dams, construction/modification of levees/floodwalls, large-scale channelization of a waterway)
- Wildfire hazardous fuel reduction and defensible space;

- Elevation or acquisition of structures from hazard-prone areas;
- Structural and non-structural retrofitting to protect structures from future damage;
- Safe room construction;
- Code enforcement; and
- 5% initiative projects that are not required to provide a positive benefit cost ratio (examples include outreach, education, warning sirens, generators, etc.).

Taking action to mitigate the causes of damage immediately after a disaster occurs can significantly reduce future flood damages. Hazard Mitigation Grant Program mobilizes financial and technical assistance in the aftermath of disasters – exactly the time when citizens and local elected officials are most receptive to undertaking projects and initiatives that reduce the impacts of future disasters.

How the Hazard Mitigation Grant Program Works: The State serves as the grantee and program administrator for the Hazard Mitigation Grant Program. The State:

- Sets mitigation priorities;
- Provides technical assistance to communities applying for the Hazard Mitigation Grant Program funds;
- Evaluates grant applications based on minimum eligibility criteria and State priorities;
- Works with FEMA to approve planning and project awards;
- Awards planning and project sub-grants to applicants; and
- Ensures that all applicants are aware of their sub-grant management responsibilities.

Since the 2013 State Plan was approved, phasing of projects has been allowed. FEMA can award Phase 1 of a project to allow a sub-grantee to complete all eligibility requirements. In New Mexico, this has included completion of final construction drawings, final cost estimation, final Benefit Cost Analysis and environmental clearance. Phase 2 is awarded after all eligibility requirements are met. In New Mexico, Phase 2 has been called the 'implementation' of the activity (for example, the actual thinning of the hazardous wildfire fuels or the construction of the flood mitigation project). The phasing approach allows for the sub-grantee to be assured at least 75% reimbursement for the Phase 1 costs (of course, all required supporting documentation must be supplied). It is anticipated that the first Phase 2 awards will be made in the fall of 2018.

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. In-kind and cash contributions can be used for the non-federal share.

A list of recent projects funded through Hazard Mitigation Grant Program is found in Figure 2-1 and Figure 2-2 in Appendix B. The Public Assistance Categories A-G can also be found in Figure 2-3 in Appendix B. Below are summaries of the projects that were funded through the Hazard Mitigation Grant Program.

FEMA-DR-945 was a flood event in Lea County and Hobbs in 1992. The City of Hobbs used all of the available HMGP funding for a comprehensive city-wide drainage study (note; this would not be an eligible activity under the current HMGP).

FEMA-DR-992 was a flood event in 1993 along the Gila, San Francisco and Mimbres Rivers in southwestern New Mexico. The Town of Silver City used the HMGP funding for two structural drainage improvement projects.

Between FEMA-DR-992 and FEMA-DR-1202, the HMGP funding formula changed to 75% federal share and 25% non-federal share.

FEMA-DR-1202 was a record-breaking winter storm that affected much of eastern New Mexico in January of 1998. The resulting HMGP funding went to Lovington for purchase and installation of a tornado warning system and to Hobbs for the buy-out of seven properties subject to repetitive flood loss. In order to meet the 'open space in perpetuity' requirement, these properties are inspected and photographed every three years.

FEMA-DR-1301 in 1999 was a flood event that affected several counties, from Doña Ana in the south to San Juan in the northwest. That HMGP funding went to Eddy County for purchase and installation of a NOAA weather repeater in Artesia and for lightning protection for a new emergency communications tower, (the project was later withdrawn). Funding also went to Zuni Pueblo to provide structural flood protection for their Senior Citizen's Center, which is subject to repetitive flood loss.

FEMA-DR-1329 in 2000, known as the Cerro Grande Disaster, provided ample funding for numerous HMGP projects. These were: (1) the production of a wildfire mitigation video by the Forestry Division, EMNRD; (2) the purchase and installation of a telephone alert system by the City of Santa Fe; (3) the creation of a precipitation monitoring system for use in the area of Rio Rancho and Corrales by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA); and (4) fuel reduction projects within the jurisdictions of Angel Fire, Ruidoso, and Las Vegas.

FEMA-DR-1514 in 2004, a flood event in Eddy, Bernalillo, Mora, and San Miguel Counties, generated approximately $408,000 in HMGP funds. Several applications were made. A mitigation plan for Taos County was funded from this grant and was subsequently de-obligated at the request of the County.

FEMA-DR-1659 in 2006, a flood event covering 19 counties in the State generated over $2.4 million in HMGP funds. Pueblo of Isleta was awarded $45,000 for mitigation planning. The Pueblo of Isleta Mitigation Plan was approved in September 2012. As part of FEMA-1659, the Pueblo of Jemez was awarded $31,500. However, they chose to de-obligate in the spring of 2010.

FEMA-DR-1690 in 2007 was declared for severe storms and flooding. There were no mitigation plans or projects funded by Hazard Mitigation Grant Program. However, $147,570 was available in funding.

FEMA-DR-1783 in 2008 was declared for severe storms and flooding that resulted in $2,120,979 for the Hazard Mitigation Grant Program. Two local mitigation plans were funded with $104, 013 federal share.

FEMA-DR-1936 in 2010 was declared for severe storms and flooding that resulted in $1,376,378 for the Hazard Mitigation Grant Program. Three mitigation plans were funded totaling $70,500 federal share (Chaves County, De Baca County, and Santa Clara Pueblo). Phase I of a flood mitigation detention pond project was funded for the City of Farmington. The project did not meet all eligibility requirements and Phase 2 was not funded. DHSEM utilized $68,819 for wildfire mitigation public service announcements.

FEMA-DR-1962 in 2011 was declared for a severe winter storm and extreme cold that resulted in $265,070 federal share for the Hazard Mitigation Grant Program. One mitigation plan was funded for Cibola County for $15,000.

FEMA-DR-4047 in 2011 was declared for flooding that resulted in $4,077,356 for the Hazard Mitigation Grant Program. Six mitigation plans were funded totaling approximately $170,900 (Alamogordo, Cochiti Pueblo, Lea County, Rio Arriba County, Village of Ruidoso, and San Juan County). DHSEM utilized $30,000 for the 2013 State Mitigation Plan update. Phase 1 of the Lincoln County Wildfire Thinning Project Phase 1 was funded (federal share $49,002) and the NM Department of Agriculture produced Wildfire Mitigation newspaper inserts federal share ($90,965). DHSEM received State Management Costs to administer this grant.

FEMA-DR-4079 in 2012 was declared for flooding that has resulted in $7,441,168 for the Hazard Mitigation Grant Program. There were seven projects awarded with $7,293,361 in federal share (SSCAFCA Arroyo Safety Education and Outreach Project, Village of Corrales Salce Basin Flood Mitigation, Lincoln County Wildfire Mitigation Education and Outreach, NM Department of Agriculture Watershed Health Outreach, SSCAFCA Alberta Road Drainage Improvements, SSCAFCA Montoya Arroyo Bank Stabilization, and SSCAFCA Lomitas Negras Arroyo Channel Stabilization). State Capital Outlay funds were utilized for a portion of the non-federal match for the SSCAFCA Alberta Road Project and the Corrales Salce Basin Project. All non-federal match was provided by State Capital Outlay funds for the SSCAFCA Montoyas Arroyo Bank Stabilization Project. DHSEM received State Management Costs to administer this grant.

FEMA-DR-4147 in 2013 was declared for severe storms and flooding that resulted in $71,220 for Santa Clara Pueblo. This was a direct disaster declaration with FEMA as Grantor and Santa Clara Pueblo as Grantee; this was the first direct tribal disaster declaration in FEMA Region VI.

FEMA-DR-4148 in 2013 was declared for flooding that has resulted in $899,235 for the Hazard Mitigation Grant Program. One local mitigation plan and one tribal mitigation plan were funded totaling $64,827 (Hidalgo County and Ohkay Owingeh) and both are under development. DHSEM received State Management Costs to administer this grant.

FEMA-DR-4151 in 2013 was declared for severe storms and flooding that has resulted in $8,953,966 for Santa Clara Pueblo. This was a direct disaster declaration with FEMA as Grantor and Santa Clara Pueblo as Grantee; this was the second direct tribal disaster declaration in FEMA Region VI.

FEMA-DR-4152 in 2013 was declared for severe storms, flooding, and mudslides that have resulted in $6,004,820 for the Hazard Mitigation Grant Program. Seven local mitigation plans were funded with federal share of $232,422 (Torrance County, Mescalaro Apache Tribe, Taos County, UNM, Pojoaque Pueblo, Catron County, Santa Ana Pueblo). There are also six projects with $1,477,226 federal share (UNM Earthquake Retrofit, Nambe Pueblo Flood Warning System, Nambe Pueblo Debris Flow Barrier, Socorro County Wildfire Thinning Bosque South Phase 1, Dexter Warning Sirens, Hagerman Warning Sirens). State Capital Outlay funds were utilized for a portion of the non-federal match for the Nambe Debris Flow Barrier Project. Federal funds for planning in the amount of $207,305 also covered costs for State-wide susceptibility maps (landslide, rockfall and collapsible soils) and for this State Mitigation Plan Update. DHSEM received State Management Costs to administer this grant.

FEMA-DR-4197 in 2013 was declared for severe storms and flooding that has resulted in $1,299,374 for the Hazard Mitigation Grant Program. Three projects have been awarded so far with $181,570 in federal share (Socorro County Wildfire Thinning Bosque North Phase 1, Claunch Pinto Soil and Water Conservation District Wildfire Thinning Phase 1, Bloomfield Generator). DHSEM received State Management Costs to administer this grant.

FEMA-DR-4199 in 2014 was declared for severe storms and flooding that has resulted in $12,896,165 for the Hazard Mitigation Grant Program. Five local mitigation plans have been funded totaling $195,000 federal share (Sierra County, Village of Angel Fire, Otero County, Zia Pueblo, Zuni Pueblo). $433,353 federal share (UNM EDAC State-wide Acequia Inventory and Risk Assessment and the State Forestry Division Wildfire Treatment Mapping and Outreach Project). Six projects have been funded so far totaling $1,737,933 federal share (Santa Clara Pueblo Flood Mitigation Phase 1, Los Alamos Defensible Space and Outreach Phase 1, Los Alamos Reservoir Canyon Road Flood Mitigation Phase 1, SSCAFCA Lisbon Flood Mitigation, Rio Rancho SportsPlex Phase 1, San Miguel County Generator). DHSEM received State Management Costs to administer this grant.

Evaluation of Hazard Mitigation Grant Program (HMGP)

HMGP has been the most effective of the mitigation grant programs for mitigation projects throughout the State. DHSEM will monitor the effectiveness of the HMGP projects after a hazard event occurs. If a mitigation project is successful, the impacts of the natural hazard will have been reduced.

The benefit of this grant program is that applicants are able to carry out mitigation projects and update their hazard mitigation plans. One limitation of this grant program is that funding is only made available through a presidential disaster declaration. Thus, it is not a reliable and consistent funding source. The two main challenges that cause a project to not get awarded funding are; the lack of the 25% non-federal match, and the lack of available resources needed to develop a fully eligible project application. Tracking of awards and available funding has been greatly improved since the last plan update.

Another limitation of the program is that the Management Costs are not sufficient to administer, track and oversee all sub-grants awarded. The State must find additional funding to assure that all requirements are being met. The Emergency Management Preparedness Grant is being utilized to support the State Mitigation Program and cover expenses to fully administer HMGP.

HMGP Summary from January 2012 to April 2018;

- $13,343,138 in federal funds have been awarded for plans and projects
- $1,277,585 in State Capital Outlay funds have been awarded through DHSEM grants for non-federal match of HMGP Projects
- $3,211,002 in State agency, tribal and local funds have been committed for non-federal match

5.1.2.2 *Pre-Disaster Mitigation Program*

The Pre-Disaster Mitigation (PDM) Program was authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 USC, as amended by Section 102 of the Disaster Mitigation Act of 2000. Funding for the program has been provided through the Pre-Disaster Mitigation Program to assist tribal, local, and State communities in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. The Pre-Disaster Mitigation

Program is an annual nationally competitive funding source provided by FEMA. Beginning with federal fiscal year 2015, tribes were eligible to apply directly to FEMA for PDM funds.

The amount of funding for PDM is allocated by congress each federal fiscal year. Each state, territory and tribe gets a set-aside after congress awards a specific budget and FEMA deducts management/administrative costs. Remaining funding is awarded based on a national competitive process. The application process and eligibility criteria for the set-aside and for the nationally competitive awards are the same. The annual Notice of Funding Opportunity identifies the amount of the set-aside, priorities for funding, the due dates for applications and the Period of Performance for the grant. For PDM federal fiscal year 2012 and 2014 funds, each state and territory was able to apply for up to 1% of the national award (after administrative costs and tribal set aside were deducted). For PDM federal fiscal year 2016 and 2017 funds, each state, territory and tribe was able to apply for up $575,000. Any remaining funds were awarded based on the national selection.

Pre-disaster Mitigation funds were awarded to New Mexico for the following federal fiscal years; 2002, 2003, 2004, 2008, 2010, 2012, 2014, 2016, and 2017.

To date, Management Costs have been provided to New Mexico as an additional 10% of the total project costs awarded. Management Costs for PDM are 75% federal share and 25% state share. In New Mexico, Management Costs are utilized by DHSEM to administer the State Mitigation Program; there is no pass-through to sub-grantees.

Applicant Eligibility: Pre-disaster Mitigation Program is the same as the Hazard Mitigation Grant Program:

- State and local governments;
- Native American tribes or authorized tribal organizations; and
- Certain private non-profit organizations or institutions.

Although individuals cannot apply directly for Pre-disaster Mitigation funds, an eligible applicant as described above may submit an application on their behalf.

Award and Sub-grant Type: Two types of awards or Sub-grants are available under the Pre-disaster Mitigation Program;

- <u>Planning activities</u> are awards to States/Tribes or sub-grants to communities to develop or update their natural hazard mitigation plan. Pre-disaster Mitigation Program funds can be used to prepare a state, tribal or local mitigation plans.
- <u>Project activities</u> are awards to States/Tribes or sub-grants to communities to implement measures to reduce risk from natural disasters.

<u>Project grants</u>: A project must, at a minimum, be:

- Cost Effective;
- Comply with environmental and historic preservation regulations;
- Technically feasible;
- Within a jurisdiction or tribal entity boundary that has a FEMA-approved mitigation plan;
- Identified in the applicant’s Natural Hazard Mitigation Plan;

- All applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area (a Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) has been issued); and
- The community must not be suspended or on probation from the NFIP.

The Pre-Disaster Mitigation Program can be used to fund any type of natural hazard mitigation activity including projects to protect either public or private property. Examples of projects include:

- Minor localized flood control projects (examples include installation/modification of stormwater management facilities like culverts, construction/modification of retention/detention basins, construction/modification of floodwalls/dams)
- Non-localized flood risk reduction projects (examples include construction/demolition/rehabilitation of dams, construction/modification of levees/floodwalls, large-scale channelization of a waterway)
- Wildfire hazardous fuel reduction and defensible space;
- Elevation or acquisition of structures from hazard-prone areas;
- Structural and non-structural retrofitting to protect structures from future damage; and
- Generators for critical facilities.

How the Pre-Disaster Mitigation Program Works: The State serves as the grantee and program administrator for the Pre-disaster Mitigation Program. The State submits plan or project applications up to the amount of the specific federal fiscal year set-aside. Any additional plan or project applications are prioritized by the State for the national competitive funds that remain after all set-asides for tribes, states and territories are budgeted. The State:

- Sets mitigation priorities;
- Provides technical assistance to communities applying for the PDM funds;
- Evaluates grant applications based on minimum eligibility criteria and State priorities;
- Works with FEMA to approve planning and project awards;
- Awards planning and project sub-grants to applicants; and
- Ensures that all applicants are aware of their grant management responsibilities.

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. In-kind and cash contributions can be used for the non-federal share. Federal cost share can increase up to 90% if the subgrantee meets the requirements of a small impoverished community.

A list of recent projects funded through the Pre-disaster Mitigation Program is found in Figure 2-2, Appendix B.

Below are summaries of the projects that were funded through the Pre-Disaster Mitigation Program.

In FY 2002, FEMA granted each state $50,000 to initiate the new mitigation planning process. That funding was 100% federal. The State used $9,000 to contract training for local mitigation planners and $41,000 for assisting with the new State Hazard Mitigation Plan. The training effort was effective in training more than 20 local jurisdictions in the processes and practices used in local mitigation planning. This was a direct benefit to local jurisdictions, all of which are faced with the need to produce a DMA2K-compliant mitigation plan. The State also benefited by hiring a skilled contractor to present the training.

In FY 2002, FEMA allocated $293,031 to New Mexico in PDM Planning Grant funds. There was no funding for construction projects. Subsequently, the State divided this amount among the 17 jurisdictions that applied for it and withheld $2,662 for administrative costs related to the grant. The PDM grant was effective in assisting local jurisdictions in their planning effort, many of which hired contractors to assist them with the work. They would not have had the ability to carry out the planning effort without this funding. The effectiveness of dividing this funding among 17 jurisdictions can be debated. It is possible that the funding could have been more effective if a larger grant had been made to fewer jurisdictions. This is one of the difficulties in apportioning grant funding.

In FY 2003, FEMA allocated $248,375 to New Mexico for PDM Planning Grants. The State granted a significant portion of this funding to one jurisdiction, Albuquerque- Bernalillo County, which contains the bulk of the State population. The remainder was awarded to three other jurisdictions. The State retained a portion of the PDM funding to assist with writing the State's DMA2K-compliant mitigation plan.

Again, in FY 2004, FEMA allocated $131.5 million nationwide for PDM Grants to be used for either construction or planning projects. FEMA did not allocate any funding to individual states; all applications were evaluated competitively. DHSEM solicited applications State-wide for this funding and subsequently submitted four applications to FEMA, totaling just over $894,000. All of the projects submitted were in accord with mitigation priorities identified in the draft State Hazard Mitigation Plan. Only one PDM grant from New Mexico was funded, which was for mitigation planning in Torrance County. A side benefit was that FEMA used their new E-Grant application system for the first time for this grant, and both State and applicants learned this new method. In FY 2004, Torrance County's mitigation plan was funded with PDM money.

The FY 2005 application was for a drainage project for Carlsbad. This application was rejected. New Mexico's FY 2006 application was for funding for updating the State mitigation plan. This too was denied.

In FY 2007, FEMA allocated a $500,000 set aside for each state. DHSEM solicited applications State-wide for this funding and subsequently submitted seven applications to FEMA, totaling just over $643,000. Five of our applications were for mitigation plans, and the other two were for drainage projects. Only the plan applications were selected. The New Mexico Institute of Mining and Technology served as the sub-grantee for the Multi-jurisdictional Multi-hazard Socorro County Mitigation Plan. The Plan was approved September 2011. The Otero County Mitigation Plan was a single jurisdictional plan and was approved in November 2012. The University of New Mexico Mitigation Plan covered all campuses State-wide and was approved in December 2010. The Sierra County Mitigation Plan was a Multi-jurisdictional Plan and was approved in June 2012. The Lincoln County Mitigation Plan was a single jurisdictional plan and was approved in October 2012.

2008 Pre-disaster Mitigation funded one mitigation plan for Nambe Pueblo. This plan was approved September 2013.

2010 Legislative Pre-disaster Mitigation funded the San Miguel County Multi-jurisdictional Mitigation Plan. Federal share was $51,365.

2012 Pre-disaster Mitigation funded six multi-jurisdictional mitigation plans (Valencia County, McKinley County, Bernalillo County, Luna County Plan, Guadalupe County and Curry County). Federal share was $206,628.

2014 Pre-disaster Mitigation funded two multi-jurisdictional mitigation plans (Quay County and Grant County) plus one tribal mitigation plan (Taos Pueblo). Federal share was $101,250. This was the first time that DHSEM both applied for and received State Management Costs to administer a PDM grant.

2016 Pre-disaster Mitigation funded one flood mitigation project (SSFACFA Cactus Ponds). Federal share was $299,977. One additional construction project was not funded, as all eligibility criteria were not met. This was the first time that New Mexico submitted a construction project for consideration and the first time that the State submitted a project to be considered in the national competition. DHSEM received State Management Costs to administer this PDM grant.

2017 Pre-Disaster Mitigation has selected six multi-jurisdictional plans (Chaves County, Dona Ana County, McKinley County, San Juan County, San Miguel County and Union County) and one City plan (Santa Fe). Federal share is expected to be $299,977. One flood mitigation project was selected for funding, SSCAFCA Bosque de Bernalillo Project. Once awarded, federal share is anticipated to be $395,605. DHSEM expects to receive State Management Costs to administer this PDM grant.

Evaluation of Pre-Disaster Mitigation (PDM) Grant Program
Up through federal fiscal year 2014, Pre-disaster Mitigation funding has been used mostly for mitigation planning in the State. The first construction project to be funded with a Pre-disaster Mitigation award was in federal fiscal year 2016.

The benefit of this grant program is that applicants can rely on an annual funding to get mitigation plans created or updated. Also, without a federal disaster declaration making HMGP funds available, this is the only regular source of funding for mitigation plans and projects.

There are several limitations to the grant program. The main challenges that cause sub-grantees not to apply are the lack of the non-federal match, lack of resources available to develop a fully eligible project application and lack of 'shovel ready' projects. Also, with the nationally competitive funds, New Mexico's small rural communities have a hard time competing with larger communities with higher population, higher structural/infrastructure damage, and a greater ability to cost share. Tracking of awards and available funding has been greatly improved since the last plan update.

Another limitation of the program is that the State must supply 25% of the Management Costs and there is very limited State general funds available. In addition, the Management Costs are awarded at the time of the project awards. Therefore, all of the time and expense of assisting sub-grantees and preparing the application must be paid for out of another very limited funding source.

PDM Summary from January 2012 to April 2018;

- $1,727,639 in federal funds have been awarded for plans and projects
- $575,538 in tribal and local funds have been committed as non-federal match

Flood Mitigation Assistance

Flood Mitigation Assistance was created as part of the National Flood Insurance Reform ACT of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. The Flood Mitigation

Assistance program is made available to states on an annual basis as a competitive grant. There is no state-specific set-aside. The Flood Mitigation Assistance program provides grants to tribes and communities for projects that reduce the risk of flood damage to structures that have National Flood Insurance Program coverage. This funding is available for flood mitigation projects. The State administers the Flood Mitigation Assistance program and is responsible for prioritizing projects for funding from the applications submitted by tribes and local communities. The State then submits selected applications to FEMA for national competitive selection.

Applicant Eligibility: Any State agency, participating NFIP community or qualified local organization is eligible to submit for Flood Mitigation Assistance. Communities that are suspended or are on probation from the NFIP are ineligible. Although individuals cannot apply directly for Flood Mitigation Assistance funds, a local government may submit an application on their behalf.

Award and Sub-grant Type: Project activities are awarded on a per project basis to an eligible applicant to implement measures to reduce risk from flooding.

Project grants: At a minimum, a project must be:

- Cost Effective;
- Cost-beneficial to the National Flood Insurance Program;
- Technically feasible; and
- Physically located in a participating NFIP community or must reduce future flood damages in an NFIP community.

A project must also conform with:

- The minimum standards of the NFIP Floodplain Management Regulations;
- The applicant's Natural Hazard Mitigation Plan; and
- All applicable laws and regulations, such as Federal and State environmental standards or local building codes.

Examples of Eligible Projects: Projects that reduce the risk of flood damage to structures insurable under the National Flood Insurance Program (NFIP) are eligible. Such activities include:

- Minor localized flood control projects (examples include installation/modification of stormwater management facilities like culverts, construction/modification of retention/detention basins, construction/modification of floodwalls/dams)
- Non-localized flood risk reduction projects (examples include construction/demolition/rehabilitation of dams, construction/modification of levees/floodwalls, large-scale channelization of a waterway)
- Elevation or acquisition of structures from flood-prone areas; and
- Dry flood proofing.

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a nonfederal source. Federal cost share can increase for repetitive loss structures (up to 90% federal/10% non-federal) and severe repetitive loss structures (up to 100% federal).

How Flood Mitigation Assistance Works: The State serves as the grantee and program administrator for the Flood Mitigation Assistance. The State:

- Sets mitigation priorities;
- Provides technical assistance to communities applying for FMA funds;
- Evaluates grant applications based on minimum eligibility criteria and State priorities;
- Works with FEMA to approve projects and award funds to communities; and
- Ensures that all applicants are aware of their grant management responsibilities.

Previous to detailed record keeping, FMA funds were also awarded for the Town of Silver City, City of Hobbs and Dona Ana County to prepare flood mitigation plans. Federal share for these plans was $41,677.

In FY 2003, DHSEM (called Office of Emergency Management at that time) executed a Flood Mitigation Assistance sub-grant with the Town of Estancia for a flood mitigation plan in the amount of $15,200. Estancia withdrew the project and refunded any advance payment in favor of working with Torrance County on the multi-jurisdictional and multi-hazard Mitigation Plan.

The State Mitigation Program staff provide NFIP specific data to the local communities when they are developing their mitigation plans. The following information is provide upon request; communities in the NFIP, number of policies per community, amount of claims paid out; number of Repetitive Loss properties, number of and Severe Repetitive Loss properties. Mitigation program staff encourage the Local Floodplain Administrators to contact the Repetitive Loss and Severe Repetitive Loss property owners to explain the advantages of acquisition. The State Floodplain Coordinator and the State Hazard Mitigation Officer provide outreach about the benefits of flood mitigation, including acquisition, to get structures/people out of harm's way. In presentations to NMEMA, NMFMA and other audiences, Mitigation Program staff describe the increase in federal cost share for Repetitive Loss and Severe Repetitive Loss structures. Other than the acquisitions in Hobbs, there has not been voluntary interest in maximizing the benefits of FMA funding.

Evaluation of Flood Mitigation Assistance Grant Program

The State has encouraged tribes and local governments to include a description of the Flood Mitigation Assistance Program in their mitigation plans and to identify projects that would be eligible for the Flood Mitigation Assistance Program.

Benefits of this program are that in the absence of a federal disaster declaration, state agencies, tribes, and local communities could utilize funding for flood mitigation projects. However, it is difficult to have nationally competitive projects due to the low population and rural nature of development in the State. There have not been any flood mitigation projects submitted for funding that meet the requirements for this program. In general, the flood mitigation projects that have been submitted for HMA funding have not specifically benefited an NFIP insured structure. So funding has been provided under HMGP or PDM.

Community Assistance Program – State Support Services Element

The Community Assistance Program State Support Services Element (CAP-SSSE) program derives its authority from the National Flood Insurance Act of 1968, as amended, the Flood Disaster Protection Act of 1973, and from 44 CFR Parts 59 and 60. This program provides funding to States to provide technical assistance to communities in the National Flood Insurance Program (NFIP) and to evaluate community performance in implementing NFIP floodplain management activities. This program provides funding for the State Floodplain Coordinator, a full-time position at DHSEM. FEMA Regional Offices and DHSEM negotiate a CAP-SSSE Agreement that specifies activities and products to be completed in a Statement of Work. The Agreement enables the State coordinating agency to meet FEMA's requirements by providing technical assistance and monitoring and evaluating their work. Where possible, the Agreement should integrate the expertise of the State on how best to build and maintain community floodplain management capability. The Agreement is not intended to fund all floodplain management activities undertaken by the NFIP State coordinating agency, only those activities that the Region and State identify. All states, territories and the District of Columbia are eligible to participate in CAP-SSSE. Under CAP-SSSE, NFIP funds are available on a 75% federal and 25% non-federal cost-share basis to help the State coordinating agency provide technical assistance to communities and to monitor and evaluate their work. The 25% share calculation is based on the amount of the federal share ($75 federal requires $18.75 non-federal match).

Each Governor has selected a State coordinating agency for the NFIP; DHSEM is the coordinating agency in New Mexico. Activities include the following:

- Ensuring that communities have the legal authorities necessary to adopt and enforce floodplain management regulations;
- Establishing minimum State regulatory requirements consistent with the NFIP;
- Providing technical and specialized assistance to local governments and the general public;
- Coordinating the activities of various State agencies that affect the NFIP; and
- Encouraging and assisting communities to qualify for NFIP participation.

The duties and responsibilities of the NFIP State Coordinator's office are set forth in 44 CFR §60.25 of the NFIP regulations. State responsibilities generally include:

- Monitoring legislation to allow local units of government to adopt ordinances that ensure continued eligibility;
- Encouraging and assisting communities to qualify for participation;
- Ordinance assistance;
- Community assistance;
- Coordination of local floodplain activities;
- Flood Insurance Study (FIS) and mapping assistance;
- Conducting Community Assistance Visits and Community Assistance Contacts;
- Establishing minimum State standards;
- Mitigation; and
- Training.

New Mexico Floodplain Managers Association (NMFMA) is the professional association for floodplain managers in New Mexico. Its goals are to promote public awareness of proper floodplain management, promote the professional status of floodplain management and secure all benefits, promote a liaison between individuals concerned with proper floodplain management, encourage the exchange of ideas, and keep individuals concerned with proper floodplain management well informed through educational and professional seminars and to provide a method for dissemination of information, both general and technical. NMFMA is the certifying agency for floodplain managers in New Mexico. As of June 9, 2018, there are 181 Certified Floodplain Managers in the State.

It partners with DHSEM to provide flood awareness education and training across the State. NMFMA is also an active partner in the National Weather Service Turn Around Don't Drown (TADD) campaign by providing local jurisdictions with TADD signs for low water crossings. DHSEM continues to fund attendee registration and travel reimbursement from CAP-SSSE for eligible attendees at NMFMA workshops and training.

DHSEM through CAP-SSSE has funded the following New Mexico Floodplain Managers Association (NMFMA) projects through sub-grant agreements:

- FloodSmart Calendars;
- TADD signage and outreach;
- Flood Simulation Tables and outreach;
- Revising and printing of State-wide floodplain manager reference materials
- Website redesign; and
- Workshop and training reimbursement. A floodplain management survey was developed by NMFMA and DHSEM to encourage feedback on improving the State Floodplain Management Program, to up-date contact information for the 104 NFIP communities in the State, identify any issues and describe unmet needs. The State Floodplain Coordinator will continue to circulate the survey for maximum participation and follow up on any issues or requests for assistance from the State Program.

5.1.2.3 *Hazard Mitigation Grant Program – Post Fire (HMGP-PF)*

A Fire Management Assistance Grant (FMAG) is a FEMA grant program specifically used as reimbursement for fire suppression activities, prepositioning activities, emergency services due to the fire, and temporary repair of damaged facilities caused by fire suppression. Funds are used to reimburse eligible applicants which include: state agencies, local governments, Indian tribal governments. In New Mexico, FMAG funding is administered by DHSEM Recovery Unit.

In June 2018, FEMA announced a new grant program specifically for post fire assistance to provide for long term mitigation of burn scar areas and acreage downstream that could be impacted. Eligible sub-grantees are state agencies, local governments, tribes and non-profits. If funds are not utilized by the communities impacted by the FMAG, the state can provide funding to any eligible applicant for any natural hazard mitigation activity.

Section 20602 of the Bipartisan Budget Act of 2018 authorizes FEMA to provide mitigation funding for October 1, 2016 to September 30, 2018 Fire Management Assistance Grants.

Funding is made available to the FMAG declared county or counties. A mitigation project may be outside of the declared county as long as risk reduction benefits the declared county. If funding cannot be used in these areas, then it may be utilized statewide regardless of whether it benefits a declared county.

Applicant Eligibility: New Mexico applicants eligible for HMGP-PF are the same as those eligible under HMGP.

- State and local governments;

- Native American tribes or authorized tribal organizations; and
- Certain private non-profit organizations or institutions.

Although individuals cannot apply directly for HMGP-PF funds, an eligible applicant may submit an application on their behalf.

Awards and Sub-grant Types: Three types of awards or Sub-grants are available under HMGP-PF and they are the same as the Hazard Mitigation Grant Program;

- Planning activities are awards to States or Sub-grants to eligible applicants to develop or upgrade their natural hazard mitigation plan. Hazard Mitigation Grant Program funds can be used to prepare a state, tribal or local mitigation plans. A maximum of 7% of the federal share of each grant can be used for planning.
- 5% Initiative Projects are awards to States or Sub-grants to eligible applicants to implement measures to reduce risk from natural disasters. Although these measures need to be cost effective, they do not need to meet the benefit cost analysis criteria. A maximum of 5% of the federal share of each grant can be used for planning.
- Regular Project activities are awards to States or Sub-grants to communities to implement measures to reduce risk from natural disasters. Regular projects must meet the benefit cost analysis criteria. Funding remaining from planning and 5% initiative can be utilized for regular projects.

Project Sub-grants: A project must, at a minimum, be:

- Cost Effective;
- Comply with environmental and historic preservation regulations;
- Technically feasible;
- Within a jurisdiction or tribal entity boundary that has a FEMA-approved mitigation plan;
- Identified in the applicant's Natural Hazard Mitigation Plan;
- All applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area (a Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) has been issued); and
- The community must not be suspended or on probation from the NFIP.

HMGP-PF can be used to fund any type of natural hazard mitigation activity including projects to protect either public or private property. Examples of projects include:

- Minor localized flood control projects (examples include installation/modification of stormwater management facilities like culverts, construction/modification of retention/detention basins, construction/modification of floodwalls/dams)
- Non-localized flood risk reduction projects (examples include construction/demolition/rehabilitation of dams, construction/modification of levees/floodwalls, large-scale channelization of a waterway)
- Wildfire hazardous fuel reduction and defensible space;
- Elevation or acquisition of structures from hazard-prone areas;
- Structural and non-structural retrofitting to protect structures from future damage;
- Safe room construction;

- Code enforcement;
- 5% initiative projects that are not required to provide a positive benefit cost ratio (examples include outreach, education, warning sirens, generators, etc.).

Taking action to mitigate damage immediately after a wildfire can significantly reduce future fire and flood damages. HMGP-PF mobilizes financial and technical assistance in the aftermath of a fire – exactly the time when citizens and local elected officials are most receptive to undertaking projects and initiatives that reduce the impacts of future disasters.

How HMGP-PF works: The State serves as the grantee and program administrator for the HMGP-PF. The State:

- Sets mitigation priorities;
- Provides technical assistance to communities applying for the funds;
- Evaluates grant applications based on minimum eligibility criteria and State priorities;
- Works with FEMA to approve planning and project awards;
- Awards planning and project sub-grants to applicants; and
- Ensures that all applicants are aware of their sub-grant management responsibilities.

FEMA will provide a national aggregate calculation based on an average of historical Fire Management Assistance designations from the last 10 years. The total amount available for HMGP-PF for New Mexico is $425,008 for each Fire Mitigation Assistance declaration because the State has a 'standard' hazard mitigation plan. Funding from multiple events will be aggregated into one grant under the first declaration. This will support larger projects, streamlined grants management, and expedited closeout.

Similar to HMGP, for HMGP-PF FEMA can award Phase 1 of a project to allow a sub-grantee to complete all eligibility requirements. Typically, Phase 1 includes completion of final construction drawings, final cost estimation, final Benefit Cost Analysis and environmental clearance. Phase 2 is awarded after all eligibility requirements are met. In New Mexico, Phase 2 has been called the 'implementation' of the activity (for example, the actual thinning of the hazardous wildfire fuels or the construction of the flood mitigation project). The phasing approach allows for the sub-grantee to be assured at least 75% reimbursement for the Phase 1 costs (of course, all required supporting documentation must be supplied).

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. In-kind and cash contributions can be used for the non-federal share.

In July 2018, DHSEM received a funding notice from FEMA identifying $1,275,024 as the maximum federal award. This figure was calculated based on $425,008 per FMAG (for States with a 'standard' hazard mitigation plan) multiplied by the three FMAGs that were declared in the State between October 1, 2016 and September 30, 2018. Of this amount, a maximum of $89,252 can be used for mitigation planning and up to $63,751 can be used for 5% initiative projects. Details on application deadlines and priorities for selection are still being developed. As required by the grant, priority will be given to the locations impacted by the FMAGs. Funding not utilized by those communities will be available State-wide.

Evaluation of HMGP-PF: As this is a new program, there has not been any application, award or project activity. In the next Pan Up-date an evaluation will be included.

5.1.3 Community Assistance Program - State Support Services Element

The primary benefit of this grant is that it provides funding for a full-time State Floodplain Coordinator. The main challenge of this grant program is that the funding cycle does not allow for sufficient time to expend all of the available funds. If the award of the funds happened sooner in the cycle, DHSEM and NMFMA could take better advantage of this grant. It is anticipated that FFY18 CAPSSSE funds will serve as a 'bridge year' to allow the federal funding to reflect the State fiscal year (July 1 to June 30). After the bridge year, CAP-SSSE funding is anticipated to be awarded prior to the beginning of the State fiscal year and cover the costs for the 12 months of the State fiscal year.

New directions for the State Floodplain Management Program include increase in the number of CAVs conducted each year and an increase in the number of CACs conducted each year. Starting with FFY18, the goal will be for each NFIP community will have a CAV every five years and a CAC every three years.

5.1.4 Emergency Management Performance Grant Program (EMPG)

The EMPG is a comprehensive funding mechanism whereby FEMA funds a variety of State emergency management functions. The funding formula is 50% federal and 50% non-federal. Many of the local and county emergency managers are funded through this program.

Only the aspects of EMPG that relate to mitigation are included in the following discussion. DHSEM has participated in EMPG since its inception (although the agency name has changed numerous times through that period). EMPG incorporates the Mitigation Assistance Program, which used to be a stand-alone program.

In FY 2003, DHSEM (then called Office of Emergency Management) granted $10,000 to Doña Ana County to assist in converting their Flood Mitigation Plan to a Multi-hazard Mitigation Plan.

In FY 2004, DHSEM (then called Office of Emergency Management) hosted a Post- Earthquake Building Inspection course. This class presented both rapid and detailed evaluation procedures for inspecting and identifying the safety of affected buildings.

EMPG has funded an annual educational earthquake program for school teachers called "Rockin' 'Round New Mexico" held every summer since 1995. The Workshop provides hands-on mineral resources curriculum and an overview of geology, mining, mineralogy and environmental problems to New Mexico educators for kindergarten through 12^{th} grade. The New Mexico Institute of Mining and Technology provides the matching funds and implements the workshop. The Workshop is organized, facilitated and implemented by educators at New Mexico Institute of Mining and Technology. They invite other educators and researchers to present and be part of the program. The Workshop allows educators to teach educators. The teachers that implement the program are mostly college, university or Ph.D. level educators. The teachers that take the Workshop as participants tend to be educators for kindergarten through 12^{th} grade. The three-day Workshop is held in a different part of the State each summer so that teachers can be exposed to the diverse geologic resources and potential hazards throughout New Mexico. Lessons learned and teaching tools are brought back to the classroom in order to make earth science understandable and relatable in an age appropriate manner.

Other EMPG earthquake-related grants include the New Mexico Institute of Mining and Technology scientific study of the "Taos Trench."

Evaluation of Emergency Management Performance Grant for Mitigation

Benefits of this program are that in the absence of a federal disaster declaration, communities and tribes could utilize funding for any type of natural hazard mitigation project or education/outreach effort. However, there are many competing priorities for the EMPG funding, including preparedness training, materials, and equipment. Another limitation of this grant is that the maximum federal share is 50% (compared to the typical 75% federal share for Hazard Mitigation Grant Program and the Pre-disaster Mitigation grant program). The primary use of the EMPG funds is currently for State and local salaries plus operating costs.

5.1.5 Local Preparedness Area Program

The purpose of the New Mexico Department of Homeland Security and Emergency Management's Local Preparedness Program is to provide technical assistance for local emergency management programs. This is achieved through a continuous cycle of planning, training, equipping, exercising, evaluating and taking action to correct and mitigate hazards. Primarily, Local Preparedness Coordinators (LPCs) provide technical assistance for the following activities;

- Liaison between the local communities, tribes, and State Mitigation Program;
- Dissemination of relevant mitigation planning and project reference material;
- Capability development based on emergency management shortfalls;
- National Incident Management System compliance for local jurisdictions;
- Planning, training, and exercise grant applications, statements of work, and performance reporting;
- Exercise design, assessments and after-action reports/improvement plans;
- Training and exercise needs assessments and coordination with DHSEM Training and Exercise Officers;
- Development of emergency operations plans; and
- Coordinate and maintains EAPs for DHSEM.

LPCs assist the Mitigation Program staff to coordinate with the local emergency management community. For example, LPCs provide technical assistance to local contacts on mitigation plan reviews, sub-grant agreement requirements and field inspections. In April 2018 LPCs provided logistic support for five wildfire preparedness/mitigation workshops. Each three-hour workshop was conducted by NM State Forestry (under an HMGP sub-grant) in the morning and each Preparedness Area Quarterly Meeting was conducted in the afternoon.

A map depicting Preparedness Areas is shown in Figure 5-3 and a listing of the tribal entities located in each Preparedness Area is below.

Preparedness Area 3 includes the following tribes:

- Nambe Pueblo, Pojoaque Pueblo, San Ildefonso Pueblo, Tesuque Pueblo (Santa Fe County)
- Jicarilla Apache, Ohkay Owingeh Pueblo, Santa Clara Pueblo (Rio Arriba County)
- Picuris Pueblo, Taos Pueblo (Taos County)

Preparedness Area 4 includes the following tribes:

- Navajo, Ute Mountain (San Juan County)
- Navajo, Zuni Pueblo (McKinley County)
- Acoma Pueblo, Laguna Pueblo, Ramah Navajo, Tojajiilee Navajo (Cibola County)

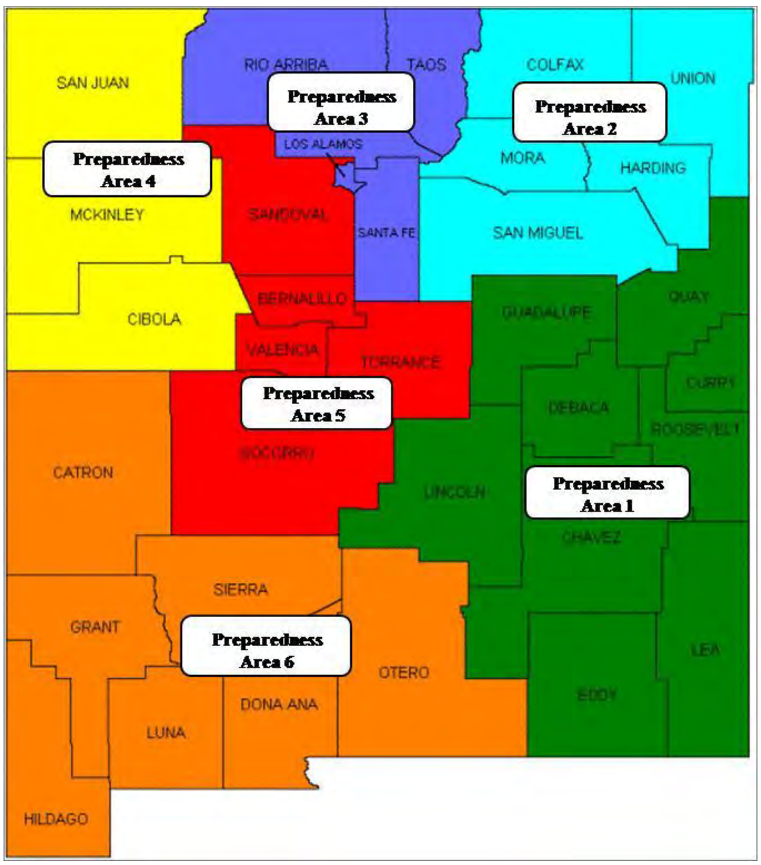
Preparedness Area 5 includes the following tribes:

- Cochiti Pueblo, Jemez Pueblo, Sandia Pueblo, San Felipe Pueblo, Santa Ana Pueblo, Santo Domingo Pueblo, Zia Pueblo (Sandoval County)
- Isleta Pueblo (Bernalillo County)
- Alamo Navajo (Socorro County)

Preparedness Area 6 includes the following tribes:

- Mescalero Apache (Otero County)

Figure 5-3 Map of New Mexico State Preparedness Areas



5.1.5.1 *Effectiveness of State and Local Plans*

Many local communities and tribes do not have staff with extensive knowledge of mitigation planning. Additionally, most communities and tribes do not have staff time and other resources to create or update a mitigation plan. DHSEM recognizes this and is attempting to provide as much technical assistance and training as possible.

5.1.6 Public Assistance and 406 Mitigation

As described above, the FEMA Hazard Mitigation Grant Program funding amount is calculated based on 15% of the Public Assistance Category C through G Project Worksheets. FEMA processes Public Assistance grant funding according to the type of work the applicant undertakes. Eligible work must be required as a result of the federally declared event, be located in one of the designated areas identified in the federal disaster declaration, be the legal responsibility of the applicant, and be undertaken at a reasonable cost. More information is available in the Public Assistance Program and Policy Guide at https://www.fema.gov/media-library/assets/documents/111781

Eligible work is classified into the following categories:

Emergency Work

Category A: Debris removal
Category B: Emergency protective measures

Permanent Work

Category C: Roads and bridges
Category D: Water control facilities
Category E: Public buildings and contents
Category F: Public utilities
Category G: Parks, recreational, and other facilities

Under the Stafford Act Section 406, FEMA Public Assistance funding can cover the cost of mitigation measures that are implemented in conjunction with the repair of disaster-damaged facilities. The funding is limited to federally declared counties/tribes and to the eligible damaged facilities. Mitigation measures must directly reduce the potential of future, similar disaster damages to the eligible facility.
Mitigation measures can be technically complex and must be thoroughly evaluated for feasibility, including environmental and historic preservation clearance. Hazard mitigation measures funded under 406 must meet one of the following cost effectiveness criteria;

- Cost no more than 15% of the total cost of eligible repair work for the damaged facility
- Cost no more that 100% of the total cost of eligible repair work and be on the list of FEMA-approved 406 mitigation measures
- Have a benefit-cost ratio equal to or greater than 1.0

Examples of reasonable 406 mitigation measures include;

- Construction of flood protection around damaged facilities
- Installation of new drainage facilities (including culverts) along damaged roads
- Slope stabilization to protect facilities
- Retaining walls, rip rap or gabion baskets
- Geotextile fabric for erosion control
- Use of disaster-resistant materials

The chart below (Figure 5-4) summarizes the amount of funding that has been provided to eligible applicants for Federally declared disasters from 2008 to present. Additional detail is available in the Capability Appendix (Figure 2-1 and 2-3, Appendix B). This data is as of August 8, 2017.

Figure 5-4 Funding Provided to Eligible Applicants for Federally Declared Disasters from 2008 to Present

Disaster Number	Total Project Amount	Amount included for 406 Mitigation	Number of 406 Project Worksheets	% of C-G Project Worksheets
1936	$9,988,263	$3,449,063	290	43.87%
1783	$51,010,550	$616,767	43	34.40%
4047	$35,759,446	$46,898,731	15	41.03%
4079	$246,515,566	$34,004	9	15.79%
4148	$7,485,874	$169,832	22	13.66%
4152	$54,870,776	$4,361,806	98	14.89%
4197	$12,165,573	$1,704,087	15	40.54%
4199	$116,054,204	$46,898,731	15	48.39%
Totals	$533,850,251	$104,133,022	507	19.51%
19.5% is the 406 funding as a percent of the total PA project amount				

5.2 Drought Specific (Includes Water Planning)

New Mexico Drought Plan

The current Drought Plan for New Mexico is dated 2006 (click here to access the 2006 New Mexico Drought Plan) with a Recommendation Report dated 2008 (click here to access the 2008 State Water Plan) and a status report from January 2013. The impact sectors identified in the Drought Plan and subsequent updates/status reports are agriculture, wildlife, wildland fire, watersheds, drinking water, economics, tourism, and recreation.

The most recent Drought Executive Order was signed by Governor Martinez on July 11, 2018 (Executive Order 2018-031). This order summarizes the current drought conditions in New Mexico and declared a state of emergency State-wide. The Executive Order also directs the following actions:

- A review of the New Mexico Drought Plan and revisions as needed including an assessment of current conditions, evaluation of drought impacts and recommendations for response and mitigation actions to be taken.
- The New Mexico State Drought Task Force to review and recommend actions to the governor and to other governing bodies in the State.
- For the New Mexico State Drought Task Force to recommend to the governor recipients and objects of emergency funding.
- Firework bans and other reasonable fire prevention measures were to be implemented by local governing bodies.

The status report from January 2013 includes approximately 20 pages of drought-specific actions that are underway or are recommended for action. The following categories of activities most directly apply to the natural hazard mitigation focus of this Plan Update;

- Wildfire prevention education/outreach;

- Wildfire pre-suppression;
- Wildfire fuel reduction treatment;
- Wildfire model ordinances and building codes;
- Improve forest and watershed health; and
- Range, crop and livestock management.

Drought Monitoring Working Group of the New Mexico Drought Task Force

The New Mexico Drought Task Force is referenced under drought in the Hazard Identification and Risk Assessment Section of this Plan Update, What Can Be Mitigated section (4.5.2.7). The Drought Monitoring Working Group (DMWG) is responsible for monitoring all available climatological data, soil moisture readings, reservoir storage levels, and other pertinent information necessary to analyze the current status of drought conditions in the State of New Mexico. The DMWG also examines and reports on long-term forecasts to assist the Drought Task Force in their preparedness and response actions. Members include water resource, agriculture, and climate professionals from all levels of government. The monthly meetings are facilitated by the State Climatologist and National Weather Service Albuquerque Office. Information from the monthly meetings can be found at http://www.nmdrought.state.nm.us/dtf_workgroup.html

New Mexico Department of Agriculture

The New Mexico Department of Agriculture and New Mexico State University sponsor community drought task forces with the local emergency manager. The sponsorship is from the College of Agriculture, Consumer, and Environmental Sciences through the Southwest Border Food Protection and Emergency Preparedness Center. Using a tool developed and sponsored by the Extension Disaster Education Network, drought mitigation strategies are explored by the community and reduction strategies implemented. An example would be the elimination of some water consuming trees along river, wise water usage and building capacity from rainfall.

State Water Plan

The New Mexico Interstate Stream Commission (ISC), administratively attached to the New Mexico State Engineer (OSE), oversees the development of the State's 16 water planning regions' water plans and the State Water Plan. The ISC recently completed updates of the 16 regional plans and is currently updating the State Water Plan due in 2018. The updated and original regional and State water plans are on the agency's website.

The State Water Plan statute calls for "a comprehensive, coordinated State water plan" for the State's waters. The Plan is to be reviewed and updated as needed every five years, also per State statute. Implementation, evaluation, and review reports of the State Water Plan are on the agency's website.

In addition to technical data about water supplies and demands, the updated regional water plans include information about existing or proposed policies, programs, and projects the major stakeholders in the region identified to address regional water issues.

Many of the regional plans highlight watershed restoration as a high priority to reduce wildfire and floods. The inclusion of the projects, programs and policies (PPP) list is to provide users of the plan – water managers and interested citizens – with information about specific strategies to solve water-related problems within the region and identify possible regional partners. The purpose of these lists is threefold: to provide the regions with information about funded Water Trust Board water projects and programs, Infrastructure Capital Infrastructure Projects (ICIP), and Capital Outlay projects. The 2016 and 2017 Regional Water Plans' PPP lists are a start to gather this information and provide it to regions and entities responsible for solving communities' water problems. The lists will be updated by the State and the regions in the future. Subject to resources, the ISC intends to further develop this tool for the benefit of the implementing well-planned and cost-effective water solutions.

The State Water Plan, as a blueprint for the strategic management of the State's waters, is being updated this year, and for the first time, will incorporate the updated regional data and recommendations for solutions to water problems. The 2018 State Water Plan also will reflect updated priorities for water management priorities and include goals and strategies for addressing water issues regionally and State-wide.

A strong feature of the current State Water Plan 2018 update process is robust public engagement activities. Those methods include regional and topical meetings and opportunities for input over the next year. Per the statute: "the ISC shall convene water planners and stakeholders from diverse constituencies to advise it and the office of State engineer on the State water plan, including State-wide policies, priorities, goals and objectives for the plan, issues of State-wide concern and strategies for implementation of the plan".

The State Water Plan law recognizes the necessity of coordination among other State agencies with water-related responsibilities and states that the plan will: "Promote strategies and mechanisms for achieving coordination with all levels of government". As such, ISC planners are coordinating with other several other State agencies to link efforts and provide resources to the public, water planners, and legislators for solving water issues. A section in the 2018 State Water Plan will provide a resource table of program and contact information about state, federal, non-government entities' grant and loan opportunities, as well as links to other water resource information.

5.3 Earthquake Specific

National Earthquake Hazard Reduction Program (NEHRP)

State funding NEHRP is a federally funded earthquake program that focuses on earthquake risk reduction. The State of New Mexico does not have funds to apply to this program at this time. Therefore, direct funding cannot be provided. For the FFY19 funding, New Mexico Institute of Mining and Technology may apply for the funding and provide staff salary as the required non-federal match (considered 'in-kind'). Eligible activities are;

1. Seismic mitigation planning;
2. Property inventory and seismic inspection of critical structures and lifelines;
3. Update to local building codes and zoning codes, and ordinances to enhance seismic safety;
4. Earthquake awareness and education;
5. Encourage the development of multi-jurisdictional groups.

A rapid visual assessment for eight counties along the Rio Grande Rift was funded under NEHRP in 2010, as the funds were 100% federal at that time. According to Subject Matter Expert Dr. Claudia Wilson, "the State should complete basic vulnerability assessments in New Mexico leading to projects the State may need to do as protectorate".

Since January 2012, DHSEM utilized NEHRP funding to provide ShakeOut posters and State-specific earthquake risk flyers. The funds were directly provided to a consortium partner. DHSEM worked with the consortium partner to produce the State-specific materials. The poster announced the date and registration information for the ShakeOut. The earthquake risk flyer included New Mexico specific earthquake facts on one side and information about the ShakeOut on the other side. Dissemination occurred via local emergency managers and floodplain managers plus digital versions of the files were posted on the State Department of Education, Safe Schools website.

ShakeOut!

The first New Mexico ShakeOut was hosted in 2014; it is an annual earthquake drill that encourages participants to 'Drop, Cover and Hold On". The drill encourages planning and preparation for reducing risk during earthquakes. DHSEM worked with the Southern California Earthquake Center to create a New Mexico specific website (https://www.shakeout.org/newmexico/). For the first New Mexico ShakeOut! The Southern California Earthquake Center up-dates and maintains the website using a FEMA grant and there is no charge to the State for this service. In 2014, there were more than 102,000 participants in the New Mexico ShakeOut!; the majority were Albuquerque Public Schools participants. The New Mexico ShakeOut has also been implemented in 2015, 2016 and 2017. DHSEM conducted a formal drill for ShakeOut! in 2015. In 2016 and 2017, DHSEM conducted informal presentations and run-through of the 'drop, cover and hold-on' drill in the State Emergency Operations Center each year. State-wide, participation in 2017 was more than 6,000. Individual communities throughout the State have implemented ShakeOut! drills as part of their annual emergency exercise requirement. DHSEM Earthquake Program Manager provides outreach to local emergency managers on ShakeOut! through Preparedness Area Coordinators, NMEMA membership email list serve and NMEMA Quarterly Meetings.

Hazus Estimated Annual Earthquake Losses for the United States

In April 2017, a new assessment of the nationwide earthquake risk has been published by FEMA in an update of FEMA P-366, Hazus Estimated Annual Earthquake Losses for the United States. Informed decision-making on mitigation policies, priorities, strategies, and funding levels in the public and private sector rely on estimating the degree of earthquake risk in the U.S. According to the report, steadily increasing damages and losses are primarily due to three factors: 1) significant growth in earthquake-prone urban areas, 2) vulnerability of the older building stock, including poorly engineered non-ductile concrete buildings, and 3) an increased interdependency in terms of supply and demand for the businesses that operate among different parts of the world. The study can be accessed at https://www.fema.gov/media-library-data/1497362829336-7831a863fd9c5490379b28409d541efe/FEMAP-366_2017.pdf

The results of the study are useful in the following ways;

1. Improving understanding of seismic risk in the nation

2. Providing a baseline loss estimate for earthquake policy development, the promotion of State and local risk awareness, and comparison of mitigation action in states and high-risk local communities
3. Supporting the adoption and enforcement of seismic provisions of building codes
4. Comparing the seismic risk with that of other natural hazards
5. Supporting pre-disaster planning for earthquake response and recovery

New Mexico Bureau of Geology

The New Mexico Bureau of Geology and Mineral Resources is a research and service division of the New Mexico Institute of Mining and Technology (NM Tech), and was established by legislation in 1927. The Bureau serves as the State's geological survey. Staff assist a diverse population through offices, publications, and a website (https://geoinfo.nmt.edu/).

The main goals for the Bureau are to:

- Conduct research and interact with State and Federal agencies and industry to facilitate prudent exploitation of the State's geological resources.
- Distribute accurate information to scientists, decision makers, and the New Mexico public regarding the State's geologic infrastructure, mineral and energy resources, and geohydrology (including water quantity and quality).
- Create accurate, up-to-date maps of the State's geology and resource potential.
- Provide timely information on potential geologic hazards, including earthquakes, volcanic events, soils-and subsidence-related problems, and flooding.
- Act as a repository for cores, well cuttings and a wide variety of geological data. Provide convenient physical and internet access for New Mexicans to such resources.
- Provide public education and outreach through college teaching and advising, a Mineral Museum, and teacher- and student-training programs.
- Our staff serve on a number of boards and commissions within the State and the region concerned with various geoscience-related issues.

Rockin' Around New Mexico

Each summer, the New Mexico Bureau of Geology conducts a 3-day geology workshop for K-12 teachers. July 2017 was the twenty-first year that the workshop has been offered. The workshop is based at a new location every-the-year and includes hands-on sessions along with field trips to explore local geology. Topics include mineral resources and mining, environmental geology, paleontology, seismic hazards, mitigation, and school earthquake safety. Past workshops have been held in Truth or Consequences (2018), Socorro (2017/2015/2013/2010), Las Vegas (2016), Silver City (2014), and Jemez Springs (2012/2011).

The workshop is held for teachers who are interested in expanding their knowledge about geoscience and natural hazards. Workshop participants learn about the relationships between earthquakes, magma bodies, and faults in determining landscape dynamics and stability in New Mexico. Additional topics include hydrology and subsurface structural features, including sediments, faults, and fractures.[176]

[176] Source: https://geoinfo.nmt.edu/education/rockin/home.html

Rio Grande Rift Catastrophic Earthquake Response Plan

In April 2012 representatives from FEMA R6 and NM DHSEM met to discuss the concept of All-Hazards planning, which resulted in NM DHSEM requesting planning support to address New Mexico's earthquake hazard—associated with the Rio Grande Rift (RGR), a massive and rare continental or dry land rift. Because DHSEM identified the natural hazard in both the State Hazard Mitigation Plan and Threats and Hazards Identification Risk Assessment (THIRA) worksheet, FEMA R6 requested funding from FEMA Headquarters to support the deliberate planning initiative, which was approved for federal fiscal year 2015.

The New Mexico Rio Grande Rift Catastrophic Earthquake Response Plan (RGR Plan) describes how FEMA, other federal agencies and additional community partners will support the State pursuant to the Stafford Act and other appropriate non-Stafford Act legal authorities.

The NM RGR Plan is a scenario-based Federal Support Plan intended to outline the joint agreement for federal actions, primarily in the first 96 hours post-incident, in response to a Level 1, no-notice, catastrophic earthquake in New Mexico. The RGR Plan was developed in coordination with local, tribal, state, federal, and private sector partners. The focus was on;

- Interoperability of Command, Control, Communications, and Computers
- Logistics
- Continuity of Operations
- Devolution planning for Continuity of Government

The scenario entails a magnitude 7.0 earthquake on the Sandia-Rincon faults of the RGR impacting Albuquerque and surrounding areas to include 11 of New Mexico's 33 counties, representing over 1.17 million residents—over half the State's total population—and over $15.7 billion dollars in economic loss.

Some of the most beneficial results of the planning process included:

- Assisting the State with assessing their preparedness for responding to a Level 1 incident with recommendations for improvement
- Assisting the State and other stakeholders with communicating the value of Continuity of Operations and Continuity of Government
- Enhancing the existing All-Hazards Emergency Operations Plan and other plans

Vigilant Guard Multi-Agency Exercise

Vigilant Guard 2018 was a multi-agency, multi-day full-scale exercise held August 3 to August 8, 2017 in various locations around the State. The New Mexico National Guard was the lead on this exercise with support from federal/state/local participants. The primary purpose of the exercise was to improve State-wide protection, response and recovery capabilities. Emergency management professionals and volunteers conducted this full-scale exercise to practice tasks, activities and processes that would be implemented if there were a similar 'real world' event. An extensive After Action Report was generated to identify successes and challenges; the After Action Report also details recommended changes to processes and procedures with assigned responsible parties. The scenario was based on;

- **EXERCISE** - a ground rupturing magnitude 7.0 earthquake occurring without warning in the Rio Grande Rift on the Sandia-Rincon faults immediately impacting Albuquerque and the surrounding areas.
- **EXERCISE** - up to 1.17 million residents throughout 11 counties detecting varying shake intensities and reported their experience through the USGS system, media and social media.
- **EXERCISE** - liquefaction throughout a 90 square-mile area and landslides along Sandia Mountain, impacted the narrow eastern I-40 pass between Albuquerque and Tijeras.
- **EXERCISE** - over 10,000 buildings were damaged beyond repair and wide-spread gas-related fires further contributed to building damage and collapse resulting in over 6.5 million tons of debris.
- **EXERCISE** - Approximately 30% of response personnel were available due to portions of I-25 and I-40 being temporarily impassable and the status of multiple bridges and overpasses are not known.

Earthquake Emergency Handbook

The Earthquake Emergency Handbook was created by the Western States Seismic Policy Council, for rural communities who have limited resources. It is intended to guide response if an earthquake should occur within the first 48 to 72 hours, in the time before State and Federal assistance is made available. The creation of the handbook was in response to a 6.0 magnitude earthquake that took place on February 21, 2008 in Wells, Nevada. The disaster review produced after this earthquake included a section on lessons learned, which stated that an emergency handbook was needed for incident commanders in similar situations. This handbook is made available as a pocket-sized document for use in the field, and can be accessed by the following link: http://www.wsspc.org/wp-content/uploads/2017/01/Handbook_FINAL_New.pdf

Copies of the handbook can be ordered by contacting Bob Carey with the Utah Division of Emergency Management. Contact information is provided below:

Utah Division of Emergency Management, c/o Bob Carey, Earthquake Program Manager
State Office Building, Room 1110
Salt Lake City, Utah 84114-1201
Email: bcarey@utah.gov
Phone: (801) 538-3784

5.4 Flood Specific

Cooperating Technical Partnership

The Cooperating Technical Partners (CTP) Program was developed by the Department of Homeland Security's Federal Emergency Management Agency (FEMA) for state, local, regional, or tribal organizations and universities. It is an innovative approach to creating partnerships between FEMA and entities that have the interest and capability to become more active participants in the FEMA flood hazard mapping program and to strengthen the effectiveness of the National Flood Insurance Program and support FEMA's mitigation objectives by leveraging partnerships to deliver high-quality hazard identification and risk assessment products, provide outreach support, and empower communities to take action to reduce risk based on informed multi-hazard based data and resources. The Earth Data

Analysis Center at the University of New Mexico is the New Mexico CTP for FEMA Region VI and coordinates its efforts with (NMFMA), the U.S. Army Corps of Engineers New Mexico Silver Jackets team, and the New Mexico Geospatial Advisory Council (NMGAC). The goal of the CTP is a 25% local share.

Multi-hazard Risk Portfolio

The New Mexico CTP, EDAC, has developed a State-wide Multi-Hazard Risk Portfolio (MHRP) in order to prioritize watersheds for Risk MAP and mitigation activities. The MHRP is designed to provide a state level or regional level risk assessment. The MHRP is a multi-year, multi-stakeholder approach to summarizing and identifying natural hazards by watershed. During year one, HUC-8 watersheds were assessed and prioritized based on flood risk, the next hazard analyzed was wildfire risk and the last landslide risk. The GIS data developed during the production of the MHRP is available for download on RGIS and the digital document is available for download at https://edac.maps.arcgis.com/apps/MapSeries/index.html?appid=6f088cfb22504f8994c3a21661f733c9

Base Level Engineering (BLE)

BLE is a watershed-wide engineering modeling method that uses high resolution ground elevation, automated riverine hydrologic and hydraulic modeling, and manual model review to prepare broad and accurate flood risk information. This allows for a baseline understanding of flood risk in a cost efficient and timely manner. It will also allow FEMA to assess and update its current flood hazard inventory more efficiently while increasing operational transparency.

The BLE approach also produces a range of flood risk datasets to include Floodplains (10%, 1% and 0.2% annual chance events), Water Surface Elevation Grids (1% and 0.2% annual chance events), Flood Depth Grids (1% and 0.2% annual chance events), and Hazus Flood Risk Assessment. This wealth of information is intended to elevate the delivery of Zone A FIRMs. Production of countywide FIRMs in areas that are currently unmodernized or unmapped allows FEMA to work with local communities, industry and Cooperating Technical Partners to expand the partnerships and further inform the National Flood Hazard inventory with the submittal of Letters of Map Revision.

Use the following link to find out more about Base Level Engineering *(http://www.riskmap6.com/documents/resource/FEMA_R6_BLE_FACTSHEET_V2.pdf)*

Local communities can adopt the BLE results to support floodplain management activities. Community access to the data allows the community to review the data prior to FIRM update or creation. This arms communities with data to assist regulation and development decisions without mandatory purchase of flood insurance and other requirements that are unearthed by creation/update of a FIRM and provides flood risk information for areas of on-going development where FIRMs may not indicate flood risk. The availability of BLE modeling provides communities a discussion point with local developers and provides them digital hydraulic model files for refinement.

BLE datasets can be used to produce a watershed or river basin Flood Risk Report, Flood Risk Database and series of Flood Risk Maps. These Flood Risk Products can be analyzed and integrated with local hazard mitigation planning efforts. The data sets can also provide insight to local communities about how datasets may be used locally in advance of an updated FIRM map.

The availability of the 1% and 0.2% floodplains, water surface elevation and flood depth grids also provide point and click information that is required for a number of FEMA grant applications. Additionally, the BLE datasets and hydraulic models may be used as a starting point for local engineering assessments, greatly reducing the financial burden on local communities to provide best available data.

FEMA has recently developed new guidance to support the emerging creation and evolving definition of BLE, to be posted once finalized at https://www.fema.gov/media-library/assets/documents/34953 .

Under certain circumstances BLE data can be utilized to provide Base Flood Elevation for Letters of Map Amendment (LOMA). While the BLE data can be utilized when local communities or property owners submit for Letters of Map Revision (LOMR) or Physical Map Revision (PMR), there are still large data processing costs ($100,000+) to do so.

Evaluation of the Cooperating Technical Partnership

This program allows for state and local governments to integrate more site-specific data, reference information and historical data into the floodplain mapping effort. However, most of the State's local communities, tribes, and educational institutions cannot provide a non-Federal match for these efforts.

Community Rating System (CRS)

The Community Rating System (CRS) is an element of the NFIP which recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. The Community Rating System (CRS) recognizes and encourages comprehensive community floodplain management activities that exceed the minimum NFIP standards. The CRS has been developed to provide incentives in the form of premium discounts for communities to go beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding. There are 11 CRS communities in New Mexico, out of a total of 104 participating communities. Additional information on the CRS and a listing of participating New Mexico communities are found in the flood hazard profile section of this Plan Update, National Flood Insurance Program subsection and Figure 4-78.

Evaluation of the Community Rating System

The CRS is highly effective in reducing flood insurance premium rates for participating communities. However, smaller communities with limited staff, have difficulty implementing new flood risk reduction activities and maintaining the required documentation. The communities with the higher number of NFIP policies have more incentive to get a lower CRS rating (more dollar savings for policy holders). Because the dollar savings is to the policy holders and not the community, many communities do not provide the resources necessary to obtain and maintain the CRS rating.

USGS Debris Flow Models and Predictive Models

USGS produced several debris flow models for individual wildfire burned areas. The debris flow model reports for the Track Wildfire (2011) and Las Conchas Wildfire (2011) were issued in 2011. The debris flow model for the Whitewater-Baldy Complex Wildfire (2012) was issued in 2012. The debris flow model for the Little Bear Wildfire (2012) was issued in 2013. A report on the pre-wildfire evaluation for the Sandia and Manzano Mountains and surrounding areas was issued in 2014. A report on the pre-wildfire evaluation for the Jemez Mountains was issued in 2016. Summaries of these reports can be found in the Hazard Identification and Risk Assessment section of this Plan Update, Flooding and Debris

Flow Post-fire subsection. Reference links to post-wildfire debris flow models and pre-wildfire evaluations are listed in the Capability Appendix (Appendix B, Section 2.3.5, Wildfire).

Acequia Mapping Project

The Earth Data Analysis Center, through a Sub-grant Agreement with the New Mexico Department of Homeland Security, was tasked with mapping and analysis of acequia data State-wide. The Office of the State Engineer served as the Subject Mater Expert on the project.

EDAC collected and updated acequia GIS line work locations throughout the State. EDAC also integrated attributes for each of the mapped locations. Analysis of the impact of natural hazards on acequias was also conducted. Impacts were identified through the FEMA Public Assistance Program.

Two forms of analysis were completed for each area, one being a proximity analysis using the FEMA National Flood Hazard Layer (NFHL). The second being the processing of recipients of public assistance to support disaster recovery within the region on acequia infrastructure. Having both of these results, as well as the updated location information, DHSEM and New Mexico stakeholders can better identify areas of increased risk and help refine and identify areas for mitigation action.

The NFHL provides users with the ability to determine the flood zone, base flood elevation and floodway status for a particular geographic location. This information can be used for planning purposes, to understand insurance requirements and to inform mitigation actions. It also has National Flood Insurance Program (NFIP) community information, map panel information, cross section and hydraulic structure information, Coastal Barrier Resource System (CBRS) information (if applicable) and base map information, such as road, stream and public land survey data. The NFHL dataset represents the current effective flood risk data for those parts of the country where maps have been modernized. It is a compilation of effective Flood Insurance Rate Map (FIRM) databases and Letters of Map Revision (LOMR). The NFHL is updated as new data reaches its designated effective date and becomes valid for regulatory use under the NFIP.

National Dam Safety Program

The New Mexico Office of the State Engineer’s Dam Safety Bureau has been the recipient of grant funding from the National Dam Safety Program of the Federal Emergency Management Agency for a number of years. These grants have been on the order of $70,000 per fiscal year. The NM Dam Safety Bureau has applied this grant funding to support training of dam safety engineers, education and outreach to dam owners and other tasks in New Mexico. Funding has been used to support the promotion of preparation of Emergency Action Planning for High and Significant Hazard dams.

National Levee Database

The US Army Corps of Engineers (USACE) is conducting an inventory and review of non USACE levees that will be added to the National Levee Database (NLD). The inventory and review will identify the condition and analyze the flood risks associated with each location. As part of the nation-wide inventory and review, USACE will;

- Conduct a one-time inspection and risk assessment on levees that are identified;
- Provide information to State agencies related to the condition, benefits, and flood risks associated with levees within the State; and

- Offer information on best practices and tools for levee inspections and risk assessments to interested State agencies.

Participation in this effort by the State is ‘voluntary and does not create a federal responsibility to operate, maintain, repair, or replace levees assessed by USACE.’ Based on recent discussions with USACE, it seems reasonable to expect that they will provide 10 to 12 levee inventory reviews by September 30, 2018 with additional levees to be reviewed in future federal fiscal years as resources allow. It is anticipated that the Office of the State Engineer, Dam Safety Bureau will be the lead State agency on this effort. DHSEM will serve as a liaison with the emergency management and floodplain management communities.

Silver Jackets

The Silver Jackets is an US Army Corps of Engineers supported effort to bring together multiple state, federal, and sometimes tribal and local agencies to learn from one another and apply their knowledge to reduce the risk of flooding and other natural disasters in the United States and enhance response and recovery efforts when such events do occur. The New Mexico Silver Jackets team is comprised of the USACE, FEMA and NMDHSEM. EDAC as the State CTP, the Albuquerque office of the National Weather Service also participate in Silver Jacket activities in New Mexico.

5.5 Tornado Specific

Tornado Shelters Act (TSA)

The Tornado Shelters Act enables local governments to utilize Community Development Block Grant (CDBG) funds from Housing and Urban Development to create community tornado shelters (“safe rooms”) in manufactured housing communities.

5.6 Wildfire Specific

Fire Prevention and Outreach Program

There are numerous fire prevention outreach and education programs throughout the State. A partial list is below. Most of the programs are administered or coordinated by the State Forestry Division of the New Mexico Energy, Minerals and Natural Resources Department.

- Communities at Risk Report (www.nmforestry.com)
- Firewise Program (www.firewise.org)
- Ready Set Go! (http://wildlandfirersg.org/)
- Living with Fire (www.nmforestry.com)
- Smokey Bear (www.smokeybear.com)
- New Mexico Fire Information (www.nmfireinfo.com)
- NMWatch Active Wildfires Mapping Site (www.nmwatch.org)
- Social Media such as Facebook and Twitter
- State Forestry Education and Outreach links can be found at http://www.emnrd.state.nm.us/SFD/FireMgt/FirePreventionandOutreachProgram.html

New Mexico Vegetation Treatments Geodatabase

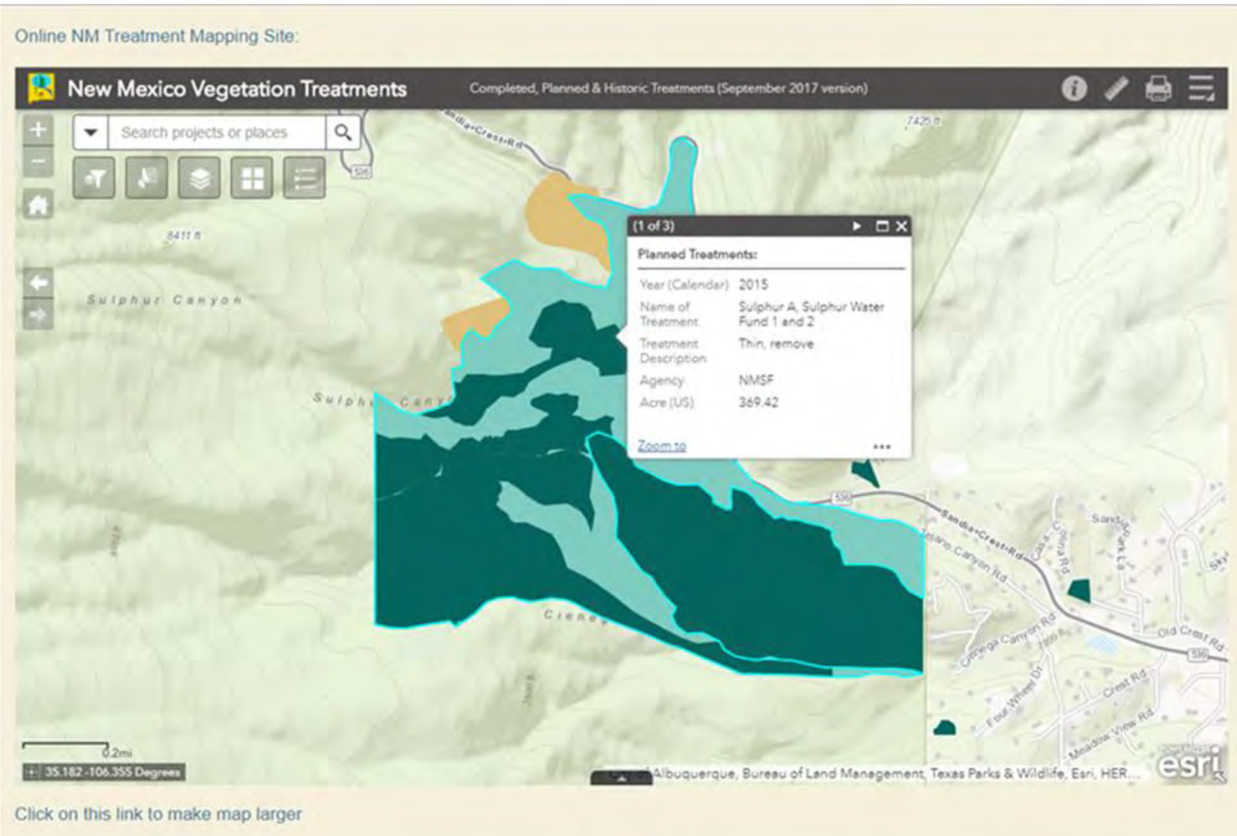
The New Mexico Opportunity Mapping Project is a collaborative effort by agencies and NGOs to develop up-to-date, accessible information about forest and watershed restoration across New Mexico. The purpose of the Opportunity Mapping Project is to enable planners and managers from all jurisdictions to access data that can help them make decisions about how to invest or match their "next dollar" in a way that will complement past restoration work and achieve a larger-scale outcome. The New Mexico Opportunity Mapping Project is developed as an on-line database where any agency, organization or partnership effort can enter information about their project. The resulting maps and data can be accessed at various scales by any user.

The NM Vegetation Treatments geodatabase is the first phase of the Opportunity Mapping Project. This first phase was funded through Hazard Mitigation Grant Program sub-grant agreement with DHSEM. Developed and maintained by the New Mexico Forest and Watershed Restoration Institute (NMFWRI), the geodatabase has information about completed, planned, and historic vegetation treatments. It is a collaborative collection of data from a variety of agencies including the US Forest Service, NM State Forestry, Bureau of Land Management, State Land Office and Tribal Agencies.

The database and other existing data layers can be viewed as an interactive map at www.vegetationtreatments.org. The WebApp can serve as a vital tool for Local and State entities. This WebApp contains vegetation treatment projects including Completed (1996-present), Historical (pre-1996) and Planned in the State of New Mexico and a small part of southern Colorado. It contains multiple layers that can be toggled on and off by using the check-boxes in the Layer List (located in the top right corner of the WebApp). Only the layers with boxes checked will be visible. If all layers are on, when layers overlap the layers are visible based on hierarchy in the Layer List, meaning the layers on top will be visible over the layers underneath them. Additionally, different layers become available at different scales. When zoomed out far enough, the treatment layers appear as points, which are the centroids of the area of treatment, and the actual area is not visible. When zoomed in enough, the treatment layers appear as polygons of the actual area of treatment and their centroids are not visible. Only the layers that are toggled on will show up in the table of contents.

Treatment attribute information can be viewed by clicking on a polygon or point on the map. The WebApp additionally has the functionality to search, filter, or query the geodatabase for specific projects, locations, land ownership, etc. using the search bar and the tools directly below the search bar in the top left corner of the map. The geodatabase is updated quarterly in March, July, September, and December. Figure 5-5 shows an example of a treatment project in the interactive map.

Figure 5-5 New Mexico Vegetation Treatments Geodatabase WebApp



State Fire Assistance – Wildland Urban Interface (SFA-WUI) Program

This grant program, funded 50:50 by various federal agencies, is administered by the Forestry Division of the NM Energy, Minerals, and Natural Resources Department (EMNRD). State Fire Assistance – Wildland/Urban Interface Program seeks to benefit local communities where the Wildland/Urban Interface is a concern through fuel reduction and the creation of defensible space. Local governments are the grant recipients, and projects may be done on private land in conjunction with landowners. This is a very popular program, and there are always more requests than there are funds available.

Volunteer Fire Assistance (VFA) Program

The Volunteer Fire Assistance Program is similar to the RFA program, but it provides for the placement of "Wildland Coordinators" in rural counties that do not have a county fire marshal or countywide supervision of rural fire departments. This program increases the capability of rural volunteer fire department to meet wildland firefighting requirements and provides continuity in training, certification, and leadership. VFA is a program of the US Forest Service, administered by EMNRD.

Forest Health Initiative

The Forest Health Initiative Program provides cost share funds for the reduction of insect and pathogen (disease) risk through forest improvement. The objective is to improve degraded (e.g. overcrowded, infested, and/or infected) forestland to a healthier, more resilient State. Landowners who have a minimum of 10 acres of forestland and a stewardship/management plan in place are eligible to apply.

Forest Health Initiative funds can also be used to help landowners develop long-term forest management plans where none presently exist. Eligible applicants include private, state, and local government owners of forest or woodlands with a 30 percent non-federal match requirement.

Collaborative Forest Restoration Program (CFRP)

CFRP is another USFS program intended to assist public or private forest owners with an opportunity to reduce wildfire dangers that threaten the community as a whole.

Wildfire Risk Reduction for Rural Communities

The Wildfire Risk Reduction for Rural Communities Program provides seed money through the Bureau of Land Management (BLM) in cooperation with the New Mexico Association of Counties (NMAC) to at-risk communities to help offset the costs of reducing wildland fire risk to non-federal WUI areas in New Mexico. Funding is intended to directly benefit communities that may be impacted by wildland fire initiating from or spreading to BLM public land. The program gives priority to outreach and education projects such as Fire Adaptive Communities, Firewise, and Ready, Set, Go, as well as encourages Community Wildfire Protection Plan (CWPP) updates for plans that are more than five years old. Eligible applicants include a county government or municipality, a 501(c)(3) organization in the State of New Mexico, a statutorily recognized political subdivision such as a soil and water conservation district, or a Native American tribe working on behalf of one or more communities at risk of wildfires in the State of New Mexico. All applicants must be located in the WUI and have a completed and approved CWPP, as well as contribute a 10% cost share to the project.

New Mexico Wildfire Risk Assessment Portal (NM WRAP)

The New Mexico Wildfire Risk Assessment Portal is an interactive web-mapping application. It provides access to information that determines wildfire risk across the State of New Mexico. It is designed to support the community wildfire protection planning needs of government officials, hazard mitigation planners and wildland fire professionals, and inform the general public. Phase II, anticipated to be accessible in October 2018, will provide the following abilities and enhancements:

- Define a project area, generate a detailed risk summary report
- Export and download wildfire risk GIS data
- Additional data layers that provide further information about wildfire risk

NM WRAP can be accessed at https://edac.unm.edu/projects/nmwrap/

5.7 All Hazard and Other Resources

New Mexico Building Codes

The State of New Mexico Construction Industries (CID) is within the State Regulations and Licensing Department. CID oversees permitting for public agency structures State-wide. CID also oversees permitting for private sector structures for communities that do not have a building permitting program. Before permits are submitted to CID, they must receive zoning approval from either the local or county zoning authority.

The Division has approximately 100 personnel State-wide that review and approve building permits plus conduct building inspections.

The State has adopted the 2015 International Building Code. However, the State has not adopted the National Fire Protection Association Codes (NFPA 5000). The Division currently regulates to the following building codes;

- 2015 New Mexico Commercial & Residential Building Code
- 2015 International Building Code
- 2015 International Residential Code
- 2012 Solar Energy Code (IAPMO)
- 2009 NM Energy Conservation Code
- ICC/ANSI A117.1-2009
- 2012 New Mexico Plumbing and Mechanical Code
- 2012 Uniform Mechanical Code (IAPMO)
- 2012 Uniform Plumbing Code (IAPMO)
- 2012 Uniform Swimming Pool, Spa and Hot Tub Code
- 2014 New Mexico Electrical Code
- 2014 National Electrical Code
- 2012 National Electrical Safety Code
- Liquefied Petroleum Gas Standards
- 2008 NFPA 58
- 1999 NFPA 57
- 2006 NFPA 54
- 1998 NFPA 52
- 1999 NFPA 1192

The residential and commercial building codes include some natural hazard mitigation elements. For example, wind and snow load regional charts are utilized for compliance. Floodplain compliance is confirmed by the local floodplain administrator prior to a permit being submitted to CID.

The State of New Mexico Manufactured Housing Division (MHD) is within the State Regulations and Licensing Department. MHD oversees construction of manufactured homes at the facility where assembly takes place. Local communities with permitting programs provide a placement permit for the installation to assure compliance with each community's zoning regulations.

Geospatial Data

The Community Anchor Site Assessment (CASA) Database was built as part of the New Mexico Department of Information Technology (NMDoIT) State's Broadband Mapping Program. This geospatial database currently contains information on institutions such as: hospitals, police stations, fire stations, National Guard Emergency Readiness Centers, State government buildings, schools, and libraries, Emergency operations Centers, and community and senior centers. The CASA database includes information for each facility such as name, address, telephone number, latitude, longitude, and broadband network connectivity. NMDoIT continues to update and keep the CASA database current. However, it was not built with information from County Assessors, and therefore, there is no valuation data for the facilities. The Earth Data Analysis Center, the New Mexico Cooperating Technical Partner, has an interactive website that can be utilized to research the locations of different critical facilities State-wide in relationship to the NFIP Special Flood Hazard Boundaries. The reference link is http://nmflood.org/content/interactive-maps/. Additionally, the State's Broadband Mapping Program has an interactive website that shows the availability of broadband internet services in relation to the CASA database. The reference links is https://nmbbmapping.org/mapping/.

The New Mexico Resource Geographic Information System (RGIS) Program within the Earth Data Analysis Center at the University of New Mexico is legislatively designated as the New Mexico State digital geospatial data clearinghouse. RGIS contains a wide range of free digital geospatial data that can be used to address a variety of questions including emergency response, preparedness and hazard mitigation. Susceptibility maps for landslide, rock fall and collapsible soils will be up-loaded to RGIS in 2018. The production of the maps was funded through Hazard Mitigation Grant Program.

The National Geospatial-Intelligence Agency (NGA) and the Homeland Infrastructure Foundation-Level Data (HIFLD) working group have assembled the Homeland Security Information Program (HSIP) Gold database of critical facilities and critical infrastructure. HSIP Gold data may only be used during Presidential Disaster or Emergency Declarations or by personnel in the New Mexico All Source Intelligence Center (NMASIC) via the DH1View. The HIFLD Open Data Portal provides National foundation-level geospatial data within the open public domain, this data is available for download in a variety of geospatial file formats. It can be accessed here: https://hifld-dhs-gii.opendata.arcgis.com/.

Additional critical infrastructure data is available from other data stewards. For example, the NMDOT has information on bridges and landslide locations. One mitigation action will be to identify and combine publicly available critical infrastructure information into CASA so that State agencies, local communities and tribes and can access this information.

Once the available data has been identified, it will be important to determine which facilities should be classified as critical structures. For example, not all State Government owned or managed facilities are critical. The buildings or complexes that house communications systems or the archival information may be labeled as critical, while office building may not be identified as critical. An office building that houses staff during business hours could be evacuated and continue operations in a different location. Another mitigation action would be to build a definition of what kind of building or facility should be considered as critical and identify which facilities and infrastructure fall within the definition. This would allow mitigation actions to target the facilities considered the most critical.

A Map of critical facilities for the State and each Preparedness Area is included in Section 6, **State-Owned or Managed Critical Facilities**, Figure 6-5.

Wildlife/Habitat

The Biota Information System of New Mexico (BISON-M) contains accounts for wildlife occurring in New Mexico and Arizona, including threatened, endangered and sensitive species. For more information go to; http://www.bison-m.org/

The New Mexico Game and Fish Habitat Handbook encourages incorporation of conservation practices in the earliest possible stages of project development. It contains conservation measures, with respect to specific land use practices, targeted toward minimizing impacts of projects on wildlife and wildlife habitats. Below is the Handbook link which provides useful information for project planning and mitigation. http://wildlife.state.nm.us/conservation/habitat_handbook/index.htm

Light Detection and Ranging (LIDAR)

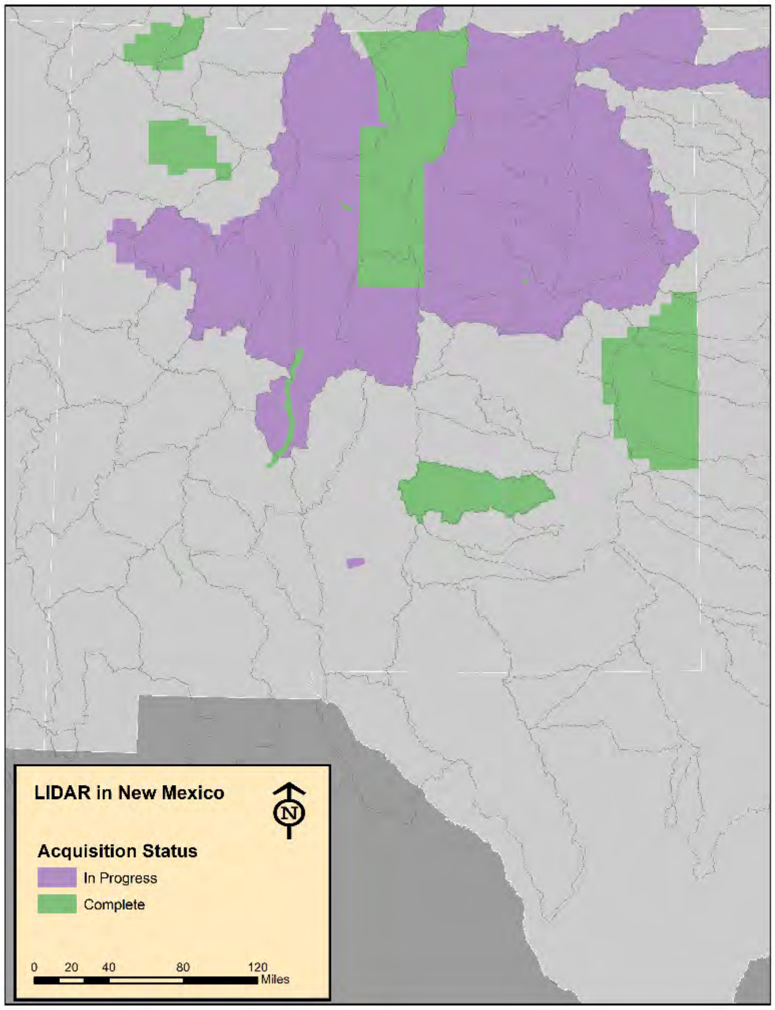
The New Mexico Geospatial Advisory Committee (GAC) formed a LIDAR Planning and Acquisition Subcommittee in 2014 in response to New Mexico's needs for enhanced elevation data. The Subcommittee consisted of representatives from local, state and federal agencies including, US Army Corps of Engineers, US Bureau of Reclamation, US Forest Service, US Natural Resources Conservation Service, Bureau of Land Management, NM Bureau of Geology, Santa Fe County, Mid-Region Council of Governments, UNM Earth Data Analysis Center and the NM Geospatial Data Clearinghouse. The Subcommittee developed the NM State-wide Lidar Acquisition Plan to guide the prioritization and collection of LIDAR data in New Mexico.

FEMA Region VI as part of its 2017-2022 Regional Multi-Year Plan has developed a LIDAR Acquisition Strategy that is projected to complete LIDAR acquisition State-wide for New Mexico by 2022. The Region VI Multi-Year investment plan prioritizes the collection and use of high quality elevation data in the form of LIDAR to prepare engineering analysis to determine the flood risk throughout the Region.

LIDAR data can be used for the identification and assessment of other natural hazards in the state including landslides, alluvial fans, and geologic faults, as well as forest and environmental assessments.

Figure 5-6 shows where LIDAR data are currently available and where it is currently being collected in New Mexico.

Figure 5-6 LIDAR Data Availability in New Mexico



Small Business Administration (SBA) Mitigation Loan Program

The Small Business Administration provides low-interest loans to small businesses for the mitigation of natural hazards. This is not a grant program, and DHSEM has no part in it except to make its availability known to potential applicants. Further inquiries must be made directly to SBA.

Figure 5-7 presents a summary of those mitigation programs that are available to the State.

Figure 5-7 Mitigation Related Funding Programs Available in New Mexico

Program	Funding Formula (Federal:Non Federal)	Grantee	Sub-Grantees	Funding Source
HMGP	75:25	State (DHSEM)	Local Government and Tribes	FEMA
PDM	75:25 up to 90:10	State (DHSEM)	Local Government and Tribes	FEMA

Program	Funding Formula (Federal:Non Federal)	Grantee	Sub-Grantees	Funding Source
FMA	75:25 up to 100:0	State (DHSEM)	NFIP Communities	FEMA
EMPG	50:50	State (DHSEM)	Local Government and Tribes	FEMA
CRS	Does not apply	NFIP Communities	n/a	Local Government
CTP	100% federal	UNM EDAC	n/a	FEMA
Dam Safety	varies	State (OSE)	n/a	FEMA
SFA-WUI	50:50	State (EMNRD)	Local Government	Various Federal Agencies
RFA	90:10	State (EMNRD)	Fire Departments	US-Dept. of Interior
VFA	90:10	State (EMNRD)	Volunteer Fire Departments	US Forest Service
RCA EAP	80:20	Local Government	n/a	USFS
FLEP	75:25	Private Forest Owners	n/a	USFS
CFRP	80:20	Public and Private	n/a	USFS
TSA	n/a	Local Government	n/a	US-HUD
SBA	(Low-Interest Loans)	Small Businesses	n/a	SBA

Rural Community Assistance Economic Action Program (RCA-EAP)

The Rural Community Assistance Economic Action Program is administered directly by the USFS to local governments for developing ways to utilize local forest products to produce value-added materials for resale or for the conversion of biomass materials (waste wood) to energy for heating of public buildings or other uses. It serves the interests of mitigation in that by reducing the fuel load in forests, the wildfire potential is mitigated. A more direct benefit is that it provides employment and boosts the local economy.

Essential Records Management

The New Mexico Commission of Public Records is responsible for the proper maintenance and storage of public records. The identification, protection and ready availability of essential records, databases, and hardcopy documents needed to support essential functions under the full spectrum of all-hazards emergencies are critical elements of a successful continuity plan and program. Organizations should strongly consider multiple redundant media for storing their essential records.

In this document, "essential records" refers to information systems technology, applications, and infrastructure, electronic and hardcopy documents, references, and records needed to support the continued performance of essential functions during a continuity activation. Organizations should also protect information that is needed for the resumption of normal operations for reconstitution. Each organization has different functional responsibilities and business needs. An organization decides which records are essential to its operations and then assigns responsibility for those records to the appropriate personnel.

Categories of essential records include the following:

1. Emergency Operating Records: These include records and databases essential to the continued functioning or the reconstitution of an organization during and after a continuity activation. Examples of these records are emergency plans and directives, orders of succession, delegations of authority, staffing assignments, and related policy or procedural records. These records provide an organization's ERG with the guidance they need to conduct operations during a continuity situation and to resume normal operations at the conclusion of that situation.
2. Rights and Interests Records: These include records critical to carrying out an organization's essential legal and financial functions and vital to the protection of the legal and financial rights of individuals who are directly affected by that organization's activities. These records include those with such value that their loss would significantly impair the execution of essential organization functions, to the detriment of the legal or financial rights and entitlements of the organization and the affected individual(s). Examples of these records are accounts receivable files; contracting and acquisition files; official personnel records; Social Security, payroll, retirement, and insurance records; and property management and inventory records. Any Rights and Interests Records considered critical for the continued performance of essential functions should be included in the Emergency Operating Records and maintained at the appropriate continuity facility.

Considerations for essential records management:

1. An official essential records program should:
    a. Identify and protect those records that specify how an organization will operate in an emergency or disaster;
    b. Identify and protect those records necessary to the organization's continuing essential functions and resumption of normal operations;
    c. Identify and protect those records needed to protect the legal and financial rights of the organization and the public; and
    d. Include appropriate policies, authorities, procedures and the written designation of an essential records manager.
2. Organizations should incorporate their essential records program into their overall continuity plans.
3. Organizations should develop procedures to ensure that as soon as possible after activation of continuity plans, but in all cases within 12 hours of an activation, ERG/DERG at the continuity facilities have access to the appropriate media for accessing essential records.
4. Organizations should maintain a complete inventory of essential records, along with the locations of and instructions on accessing those records. This inventory must be maintained at a back-up/off-site location to ensure continuity if the primary operating facility is damaged or unavailable. Organizations should consider maintaining these inventories at a number of different sites to support continuity operations.

5. Organizations should conduct essential records and database risk assessment to:
    a. Identify the risks involved if essential records are retained in their current locations and media, and the difficulty of reconstituting the records if destroyed;
    b. Identify off-site storage locations and requirements;
    c. Determine if alternative storage media is available; and
    d. Determine requirements to duplicate records and provide alternate storage locations to provide readily available essential records under all conditions.
6. Organizations should make appropriate protections for essential records, to include dispersing those records to other organization locations or storing those records offsite. When determining and selecting protection methods, it is important to take into account the special protections needed by different kinds of storage media.
7. Organizations should develop and maintain an essential records plan packet and include a copy of the packet at the continuity facilities. An essential records plan packet is an electronic or hard copy compilation of key information, instructions, and supporting documentation needed to access essential records in an emergency situation. Organizations should annually review this packet and document the date of the review and the names of personnel. The packet should include:
    a. A hard or soft copy of ERG members with up-to-date telephone numbers;
    b. An essential records inventory with the precise locations of essential records;
    c. Necessary keys or access codes;
    d. Continuity facility locations;
    e. Access requirements and lists of sources of equipment necessary to access the records (this may include hardware and software, microfilm readers, Internet access, and/or dedicated telephone lines); f. Lists of records of recovery experts and vendors; and
    f. A copy of the organization's continuity plans.
8. At a minimum, organizations should annually review, rotate, or cycle essential records so that the latest versions are available.
9. Organizations should annually review their essential records program to address new security issues, identify problem areas, update information, and incorporate any additional essential records generated by new organization programs or functions or by organizational changes to existing programs or functions. Organizations should document the date of the review and the names of personnel conducting the review.
10. Organizations should develop instructions on moving essential records (those that have not been prepositioned) from the primary operating facility to the alternate site and include these instructions in its continuity plan.

5.8 Federal Program Summary

The summary table of Federal grant programs that relate to natural hazard mitigation can be found in Appendix B, Federal Program Summary, Figure 2-4. Some of the programs are intended for specific hazards, while others can be applied to multiple natural hazards types. Contact information and/or reference websites are included. If available, contact information for New Mexico based personnel is also included. Below is a listing of the topic headings in the federal agency resource chart.

- Basic and Applied Research/Development
- Technical and Planning Assistance

- Hazard Identification and Mapping
- Project Support
- Financing and Loan Guarantees

5.9 Agency Plans and Programs Summary

The New Mexico Natural Hazard Mitigation Plan Update references information from a number of plans and programs that were previously developed by other State and Federal agencies. The resources listed in the References Appendix (Appendix G) have been included to provide guidance during future mitigation planning efforts. Future State and Local mitigation planning efforts should strive to support, follow, and incorporate successful principles and practices outlined below as they relate to local mitigation priorities. Below is a listing of the topic headings in Appendix G, References.

- Multi-hazard
- Dam Failure
- Drought (includes water planning)
- Earthquake
- Expansive Soil
- Flood
- High Wind
- Landslide
- Wildfire

5.10 State Natural Hazard Mitigation Program (State Mitigation Program)

5.10.1 Administration

Technical assistance is provided to State agencies, tribes and governments by the DHSEM Mitigation Program staff and consultants. Technical assistance is provided to potential sub-grantees in the form of Notice of Interest review/feedback, Sub-grant Orientation Meetings, sub-grant application review/feedback, mitigation planning training, project oversight and sub-grant management. Trainings include FEMA's Mitigation Planning for Local Government (G318) once each year and twice if requested. Two tribal-specific mitigation planning trainings were conducted in 2016 by FEMA Region.

Mitigation Program presentations are provided at the quarterly New Mexico Emergency Management Association Meetings, New Mexico Floodplain Managers Association Meetings and Preparedness Area Meetings. Additional presentations have been made at the New Mexico Infrastructure Finance Conference, Wildland Urban Interface Workshop and Rockin' Around New Mexico. The presentations include information on the status of mitigation plans throughout the State, funding opportunities, sub-grant application process, applicant eligibility and project eligibility.

The State uses FEMA Hazard Mitigation Assistance State Management Costs, Emergency Management Preparedness Grants and the Community Assistance State Support Services Element to fund the DHSEM Mitigation Program. State general fund and in-kind match are used to fulfill the required non-federal match for Mitigation Program salaries, benefits, and related support for the following:

- State Hazard Mitigation Officer (FTE): EMPG (50% federal and 50% State)
- State Floodplain Coordinator FTE): 75% federal, 25% in-kind match

- Two Mitigation Specialists (FTEs): EMPG (50% federal and 50% State)
- Sub-grant Analyst (FTE): EMPG (50% federal and 50% State)

5.10.2 DHSEM Mitigation Administrative Plan, Policies and Guidelines

DHSEM has a FEMA approved State Mitigation Administrative Plan. This plan is required by 44 CFR Part 206.437.d. and applies to all open mitigation disasters, grants and Sub-grants. The purpose of the State Hazard Mitigation Administrative Plan is to establish a functional organizational structure, define the roles, responsibilities and staffing, and outline the management procedures that DHSEM will use to administer the HMGP, PDM and FMA. DHSEM amends the Mitigation Administrative Plan whenever necessary to reflect changes in laws, organization, policy or State agency operation. DHSEM will revise the Mitigation Administrative Plan as necessary following each major disaster declaration and submit to FEMA Region for approval. The State Mitigation Administrative Plan can be downloaded at http://www.nmdhsem.org/uploads/files/Preparedness/Mitigation/NM%20Final%20Draft%20-%20State%20Admin%20Plan%20FULL%20with%20Signature.pdf

Since January 2012, the State Mitigation Program has prepared Standard Operating Guidelines (SOG) to detail the responsibilities and tasks necessary to accomplish Program and agency goals. The SOGs are up-dated on a continual basis to reflect changes to grant requirements, up-dates in FEMA policy/guidelines to improve efficiency.

5.10.3 State Statutes Related to Mitigation

Cornerstones of Emergency Management legislation in New Mexico are as follows:

- 12-11-23 to -25, Emergency Powers Code, 2005, as amended: provides State funds to be expended for disaster relief for any disaster declared by the Governor that is beyond local control. Such funds may also be used as a match for federal disaster relief grants; and,
- 12-10-2 to-5, NMSA 1978 as amended: The State Civil Emergency Preparedness Act. This Act establishes the basic structure of Emergency Management as a State agency and defines the role of local government in emergency preparedness.

Most policies that relate to mitigation are local initiatives and are not mandated by the State. State statutes that relate to mitigation interests are detailed below.

72-5-32, NMSA as amended, gives the Office of the State Engineer the responsibility to regulate dams and their appurtenances. The regulations governing dam design, construction and dam safety are included in Title 19, Chapter 25 Part 12 of the NMAC. These regulations require owners of dams that have the potential to cause loss of life and/or interruption of lifeline infrastructure to prepare and exercise an Emergency Action Plan (EAP). 19.25.12.18 of NMAC requires that the EAP be prepared through coordination with local emergency managers and that the plan be accepted by the responsible emergency managers prior to review by the State Engineer. These regulations require that the owner exercise the EAP and it is recommended that a functional exercise be carried out every five years with a tabletop exercise conducted two to three years before the functional exercise. Approximately 34% of dams in this category currently hold an approved EAP.

3-18-7, NMSA 1978 as amended describes additional county and municipal powers, flood and mudslide hazard areas, floodplain permits, land use control and jurisdiction agreements. The statute designates the New Mexico Department of Homeland Security and Emergency Management as the coordinating agency for Floodplain Management in the State 13-of New Mexico. The Preparedness Bureau's State Floodplain Coordinator is responsible for the coordinating these activities. The State Floodplain Coordinator provides technical assistance to individual communities in order to promote floodplain management practices consistent with the intent of the National Flood Insurance Program. To this end, State officials work with NFIP communities to identify and resolve floodplain management issues before they result in an enforcement action by the Federal Emergency Management Agency. The statute requires that communities with identified flood hazards adopt a floodplain management ordinance; have a CFM on staff to review floodplain development; and join the NFIP.

The State is in compliance with the NFIP (44 CFR 60.25) as summarized below:

- Enact legislation enabling counties and municipalities to regulate development within flood-prone areas;
- Encourage and help communities qualifying for participation in the NFIP;
- Assist county and municipal public bodies and agencies in developing, implementing, and maintaining local floodplain management regulations;
- Provide local governments and the public with NFIP information on the coordination of local, Federal, and State floodplain management requirements;
- Help communities in dissemination of information on minimum elevation requirements;
- Assist in riverine and coastal flood-prone areas and supply relevant information to the NFIP;
- Recommend priorities for Federal floodplain management activities based on the needs of localities within the State;
- Notify the NFIP of apparent irreconcilable differences between a community's local floodplain management program and the minimum requirements of the NFIP;
- Establish minimum State floodplain management regulatory standards consistent with those of the NFIP and other Federal and State environmental and water pollution standards for preventing pollution during flooding;
- Assure coordination and consistency of floodplain management activities with other State, area-wide and local planning and enforcement agencies;
- Assist in the identification and implementation of flood hazard mitigation recommendations which are consistent with the minimum floodplain management criteria of the NFIP;
- Participate in the floodplain management training opportunities and other flood hazard preparedness programs whenever practicable.

3-17-7, 4-37-9.1, 72-14-3.2, 6-21-23, and 72-4A-7, NMSA 1978 as amended: All relate to the requirement for applicants for financial assistance from the New Mexico Finance Authority to submit water conservation plans with funding application, effective December 31, 2005. Water conservation plans help to mitigate drought.

74-6-2 and 74-6-4, NMSA 1978 as amended: Allows the use of up to 250 gallons per day of greywater for residential irrigation, subject to certain requirements. This reduces the consumer demand for potable water.

72-4A-2 through 72-4A-7, NMSA 1978 as amended: Allows Water Trust Board funds to be used for water conservation and water re-use activities. This serves to mitigate drought.

72-14-3.1, NMSA 1978 as amended: Directs the Interstate Stream Commission to prepare a comprehensive State water plan. This plan helps mitigate drought.

68-2-34, NMSA 1978 as amended: Creates the Fire Planning Task Force and outlines its duties. This serves to mitigate wildfire, especially in the Wildland/Urban Interface.

13-5-3 NMSA 1978 as amended requires that all buildings built or funded by the State comply with floodplain ordinance requirements.

14.12.1.17 NMAC applies to the Regulation and Licensing Department, Manufactured Housing Division And was initially implemented in 2010. Local planning and zoning jurisdictions or units installed in floodplain or mudslide areas must adhere to the following;

A. All installations of residential manufactured homes must comply with the Manufactured Housing Act, all rules adopted by the division and all locally adopted zoning and planning requirements.

B. Prior to delivery of a manufactured home every dealer shall have the consumer sign a document acknowledging that the consumer has been advised to check with the local governing body in the locality of the site where the home will be installed to determine flood zone area installation requirements.

In addition, the State subscribes to and enforces the 2015 International Building Code, which requires that certain earthquake and wind loading standards be met for specified categories of structures. Each county is responsible for monitoring its own zoning and development; the State does not have oversight on this. However, counties that do not have permitting ability rely on the State Construction Industries Division to permit structures. The State Manufactured Housing Division oversees manufactured and modular home permitting.

A summary of the effectiveness and benefits of these State policies and statutes is shown in Figure 5-8.

Figure 5-8 Evaluation of Statutes Related to Development

Statute	Effectiveness	Benefit
3-18-6	This statute is not particularly effective because there is no provision of a penalty for non-compliance.	This statute serves as evidence that the State Legislature believes floodplain regulation to be important; could ease the way into NFIP for communities that are contemplating NFIP.
3-18-7	This Statute provides effective floodplain management jurisdiction	This statute enhances NFIP compliance.
3-17-7 4-37-9.1 72-14-3.2 6-21-23 72-4A-7	This statute requires a water conservation plan as a co-requisite for receiving State funds from the NM Finance Authority and the water trust board for financial assistance in the construction of any water diversion,	This statute serves to protect water users in time of drought and to clarify the need for drought contingency planning. The fact that the finance authority and water trust boards have issued tens of millions of dollars in loans

Statute	Effectiveness	Benefit
	storage, conveyance, water treatment or wastewater treatment facility.	shows that many jurisdictions are creating these plans.
74-6-2 to 74-6-4	The effectiveness of the legislation lies in the construction techniques of builders and the desire of homeowners to make retrofits. The statute does not require the installation of such systems. The fact that homeowners are not required to get State permits for installing such a system makes the process easier.	This statute serves to allow homeowners to use gray water for landscaping and gardening; therefore, it will conserve water through re-use in drought prone areas.
72-4A-2 to 72-4A-7	This statute allows funding to go to water conservation activities. Several projects around the State have been implemented that would not have been implemented had the funds not been available.	This statute serves to allow State funds from the water trust board to be used for water conservation and re-use activities, which had previously been prohibited. It will, therefore, promote water conservation in drought prone areas.
72-14-3.1	This statute is effective in planning for use of the State's limited water resource.	This statute requires a State plan to allocate the State's water resources and plan for future needs. It is beneficial to the entire State, which is facing drought conditions.
68-2-34	This statute is effective in bringing together representatives from a variety of State agencies that have a concern in the wildfire hazard.	This statute is beneficial in that the Fire Planning Task Force must identify areas of unusually high fire hazard and propose mitigation measures.
14-12.1.17	This statute would be effective in assuring that local floodplain ordinance requirements would be met in all NFIP communities.	The benefit is to reduce the impact of flood damage on life and property.
2015 International Building Code	All new buildings in the State are required to meet or exceed the standards in the International Building Code or the International Residential building code. This code requires a certain level of protection be installed in new buildings, to protect against the wind, snow loads, fires, earthquakes and other natural hazards.	This code represents a higher standard than was previously in effect, especially regarding earthquake and wind loading requirements for public buildings.

5.11 Mitigation Capabilities Changed since December 2012

Since the 2013 Mitigation Plan was prepared, there have been numerous changes in the capabilities to manage the State's Hazard Mitigation Program. Below is a summary;

1. 28 Mitigation Plans have received FEMA Approval. The plans cover;
    a. 18 counties
    b. 46 cities/towns
    c. 8 tribes
    d. 2 universities
    e. 4 other entities

2. New policies and procedures have been drafted to provide consistency in mitigation grant/sub-grant application processing, administrative procedures, and mitigation plan review:
    a. Hazard Mitigation Planning Grant Application
    b. Hazard Mitigation Project Grant Application
    c. Hazard Mitigation Administrative Plan
    d. Mitigation Program Standard Operating Guidelines
    e. Sub-grant Orientation Guidelines

3. New funding opportunities have become available including:
    a. HMGP DR-4148, DR-4152, DR-4197, DR-4199
    b. PDM 2014, 2015, 2016, 2017
    c. FMAG-Post Fire DR-5184

4. Projects and plans funded
    a. $15,070,777 in federal funds have been awarded
    b. $1,277,585 in State Capital Outlay funds have been awarded
    c. $3,786,540 in Local, Tribal and State agency funds have been committed

5. Staffing and resources at DHSEM have increased
    a. Two Mitigation Specialist positions have been created and filled
    b. Professional and administrative services contracts have provided support using State Management Costs
    c. 9 mitigation planning trainings were conducted

5.11.1 State Mitigation Program Opportunities

- There is more guidance, direction and emphasis from the Office of the Governor to prioritize both mitigation and prevention projects/funding to limit disaster impacts.
- There is more interest in the Program from State, local and Tribal entities.
- The influx of mitigation grant funding in the past few years has contributed to the interest in the Program.
- Increased funding has allowed DHSEM to provide outreach about the benefits of the natural hazard mitigation.
- More funding provides support for developing/up-dating mitigation plans but also to implement actions identified in the plans.
- Utilizing State Management Costs has allowed DHSEM to have access to additional professional resources to support the Mitigation Program for administration, training and technical assistance.
- To increase capacity, DHSEM Local Preparedness Area Coordinators are being trained to review mitigation plans.

- A majority of mitigation plans get the 72-hour turn around option from FEMA (meaning that only a few minor edits are needed).
- Having the increase in HMGP funding allowed DHSEM to accomplish five State-wide risk assessments that contributed to making the State Mitigation Plan Up-date more comprehensive. (landslide susceptibility, rockfall susceptibility, collapsible soils susceptibility, wildfire treatment locations and acequia mapping/floodplain analysis).
- In recognition that the Mitigation Program is necessary even when State Management Costs are not available to cover salaries, DHSEM is now funding salary and benefits with EMPG.
- Current staffing team has excellent attitude, experience and commitment! We are fully staffed based on the current organizational chart.

5.11.2 State Mitigation Program Challenges

- Although the Mitigation Program has grown to four full time staff, there are insufficient resources to provide all of the technical assistance needed.
- Maintaining the current number of grants and sub-grants is a challenge with the current level of staffing. Technical assistance to sub-grantees and tracking could be improved with additional resources like staff or contractors.
- Providing adequate technical assistance to locals and tribes for mitigation planning is a challenge with the current level of staffing. Training, plan reviews and technical assistance to locals and tribes could be improved with additional resources like staff or contractors.

5.11.3 Local and Tribal Mitigation Policies and Programs Opportunities

- Decision makers and policy makers that place natural hazard mitigation as a high priority.
- Staff that are encouraged to prioritize mitigation planning and project work.
- Cash or in-kind match to meet the requirement for mitigation grant funding.
- Staff or contractor with the experience and knowledge to prepare application materials, prepare construction drawings, run the benefit cost analysis software and prepare environmental assessments.
- A few mitigation oriented programs and policies at the State, local and tribal level for wildfire, flood and earthquake.

5.11.4 Local and Tribal Mitigation Policies and Programs Challenges

- Lack of follow-through on programs, policies and actions due to change in priorities.
- Change in leadership at the local or tribal level can influence the focus of limited resources.
- Lack of non-federal match.
- Lack of resources to prepare a complete application.
- Lack of resources and insufficient training to administer sub-grants.

6 VULNERABILITIES

The Vulnerability Section describes the key social and physical vulnerability concerns in the State of New Mexico including a profile of vulnerable populations and the built environment. It also includes an inventory of critical facilities and estimates of potential losses from hazard events.

After providing an overview of vulnerability in the State, the Section concludes with six Preparedness-Area-specific vulnerability assessments based on the data previously identified in the Hazard Identification and Risk Assessment chapter. In addition, the Preparedness Area vulnerability assessments incorporate relevant information about local risk and hazard priorities identified in the hazard mitigation plans developed by local jurisdictions and Tribes. Overall, the vulnerability assessment is not based on new development in the State, rather improved data since 2013 to better assess vulnerabilities.

6.1 Social Vulnerability

New Mexico faces a range of impacts from hazard events. Population growth and development across the State is increasing New Mexico's vulnerability to natural hazards by exposing more people to these hazards.

Studies have shown that social and economic variables such as race, age, income and employment can increase vulnerability and affect the ability of a community to prepare, respond and recover from hazards impacts. In particularly vulnerable systems, even small disturbances may lead to collapse. Therefore, it is important to fully understand the vulnerability of a community's population in order to develop successful vulnerability reduction strategies.

Social vulnerability measures population sensitivity to hazards as well as the ability of a population to respond and recover from hazard impacts. Because it is a complex, multidimensional concept, researchers and emergency management practitioners have come up with a number of ways of assessing local and regional social vulnerability to natural disasters. One of the most frequently used social vulnerability assessment methods is the Social Vulnerability Index (SOVI) that was developed for the purpose of identifying the driving factors of social vulnerability.[177]

Various socioeconomic factors contribute to elevated levels of risk and vulnerability to hazards. Those characteristics that influence social vulnerability most often found in the disaster literature are listed in Figure 6-1. These factors include personal wealth, age, gender, and race. Other characteristics identify special needs populations and those that lack the normal social 'safety nets' necessary for disaster recovery and resilience (i.e. the physically or mentally challenged, the homeless, non-English speaking residents and tourists).

[177] In their 2003 paper, *Social vulnerability to environmental hazards*, Cutter et al. (2003) used county-level socioeconomic and demographic data to create an index of social vulnerability to environmental hazards. They called this the Social Vulnerability Index (SOVI).

Figure 6-1 Social Vulnerability Characteristics[178]

Characteristic	Description	Increases (+) or Decreases Social Vulnerability (-)
Socioeconomic Status (Income, Political Power, Prestige)	Socioeconomic status affects the ability of a community to absorb losses and cope with hazard impacts. Wealth enables communities to better prepare for disasters through mitigation and absorb and recover from losses more quickly using insurance, social safety nets, and entitlement programs. Low status communities have little ability to absorb losses due to poverty and disadvantaged populations.	Wealth (-) Poverty (+)
Gender	Women can have a more challenging time during disaster recovery than men, often due to sector-specific employment, lower wages, and family care responsibilities.	Gender (+)
Race and ethnicity	These factors impose language and cultural barriers and affect access to post-disaster funding and occupation of high-hazard areas.	Race and ethnicity (+)
Age	Age extremes affect the ability of individuals to move out of harm's way. Additionally, parents lose time and money caring for children when daycare facilities are affected; the elderly may have mobility constraints.	Elderly (+) Children (+)
Employment loss	The potential loss of employment following a disaster increases the existing number of unemployed workers in a community. Such losses compound the impact of the hazard and leads to a slower recovery from the disaster. At an individual level, employment loss equates to a lower ability to pay for necessary goods and services, effectively lowering the ability to prepare and recovery from disasters.	Employment loss (+)
Residential property	Home value is an indicator of financial capacity. The value and quality of residential construction affect potential losses and recovery. Expensive homes are costly to replace, mobile homes are easily destroyed by water and winds. The viability of neighborhoods based on the number of unoccupied housing units also contributes to slower long term recovery.	Home value (+ and/or -) No. of unoccupied homes (+)

[178] University of South Carolina College of Arts & Sciences, Hazards & Vulnerabilities Research Institute, SoVI FAQs, http://artsandsciences.sc.edu/geog/hvri/faq

Characteristic	Description	Increases (+) or Decreases Social Vulnerability (-)
Renters	People that rent their homes do so because they are either transient or do not have the financial resources for home ownership. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or too costly to afford.	Renters (+)
Occupation	Some occupations, especially those characterized as primary extractive industries, may be severely affected by a hazard event. Primary sector jobs are impacted first during major disasters. For example, self-employed fishermen suffer when their means of production is lost (boats), and they may not have the requisite capital to resume work in a timely fashion; therefore, they may seek alternative employment. The same is true of migrant workers engaged in agriculture. Low-skilled service jobs (housekeeping, child care, and gardening) may suffer similarly as disposable income fades and the need for services declines.	Primary sector jobs (+)
Family structure	Families with large numbers of dependents or single-parent households often have limited finances to outsource care. This demands that families juggle work responsibilities and care which affects the resilience to and recovery from hazards.	High birth rates (+) Large Families (+) Single-parent households (+)
Education	Education is closely linked to poverty status, with higher educational attainment resulting in greater lifetime earnings. Lower education levels also constrain the ability to understand warning information and access to recovery information.	Little education (+) Highly educated (-)
Medical Services and Access	Health care providers, including physicians and hospitals, are important post-event sources of relief. The lack of proximate medical services lengthens the time needed to obtain short-term relief and achieve longer-term recovery from disasters. Nursing homes represent an increase in socially vulnerable people as the resident populations are less able to independently cope with disasters. The availability of health insurance is another factor influencing social vulnerability.	Health Insurance (-) Nursing home (+) Access to medical services (-)

Characteristic	Description	Increases (+) or Decreases Social Vulnerability (-)
Population growth	Counties experiencing rapid population growth lack available quality housing; social services networks may not have had time to adjust to increased populations. New migrants may not speak the language or be familiar with how to obtain relief or recovery information, all of which increase vulnerability.	Rapid growth (+)
Social Dependence	People who are totally dependent on social services (social security, food assistance) for survival are already economically and socially marginalized and require additional support in the post-disaster period.	Social Security (+) Food assistance programs (+)
Special needs populations	Infirm, institutionalized, transient and homeless people are disproportionately affected during disasters and are largely ignored during recovery.	Large special needs population (+)

Socio-economic status, gender, race, and ethnicity are the most common characteristics that define the social vulnerability of populations. Age (children and the elderly), limited language status, and housing tenure (renter or owner) also play a significant role in the ability of populations to absorb impact, respond, and recover in the event of a disaster.

Communities with high levels of social vulnerability often bear far greater impacts from disasters than others. Social vulnerability factors can contribute to elevated hazard vulnerability for a number of reasons, for example:

- Lack of individual and community wealth that can mean fewer available resources for recovery. For example, a poor family may not own a vehicle that would enable them to immediately evacuate the area. By identifying the number of families below the poverty level, Preparedness Areas can identify neighborhoods and communities that may be impacted more severely by disaster events due to a lack of resources and response capacity.
- Youth populations (18 years or under) and elderly populations (65 years or older) are more likely to need additional assistance during disasters and large concentrations of populations in either of these subgroups are an indicator of elevated community vulnerability to multi-hazards.
- People with limited language skills are more vulnerable in the event of a disaster. Their inability to understand evacuation warnings or preparedness bulletins influences their ability to comply with safety measures; the inability to communicate special needs to emergency responders or law enforcement influences their ability and willingness to receive adequate health care or emergency supplies; limited language ability also affects their ability to communicate their risks and vulnerabilities to planners and emergency managers who organize pre-disaster mitigation efforts. As a result, Preparedness Areas with populations made up of greater proportions of individuals with limited language skills have a higher social vulnerability to hazard impacts. Moreover, it will likely take those communities longer to recover from a hazard event.

Figure 6-2 Vulnerable Subgroups in the State as a Percentage of State Population[179]

	Persons In Poverty	Persons 18 Years and Younger	Persons age 25 - 64	Persons 65 Years and Older	Homeownership Rate
New Mexico	20.4%	23.6%	84.2%	16.5%	68.1%
USA	13.5%	22.8%	86.7%	15.2%	63.9%

According to the 2016 US Census, population estimates presented in Figure 6-2, approximately 23.6% of the total state population is under the age of 18 and 16.5% of the population is 65 years of age and older. This is slightly higher than that of the rest of the country. Additionally, New Mexico has a much higher poverty rate than the rest of the country with a poverty rate of 20.4%. Together, these statistics point to elevated social vulnerability to disasters among specific communities (and Preparedness Areas) across the State of New Mexico.

Communities along the U.S.-Mexico border and other communities throughout the State share particularly high vulnerabilities to climatic changes such as high temperatures, drought, and severe storms. Tribes may face loss of traditional foods, medicines, and water supplies due to declining snowpack, increasing temperatures, and increasing drought. Historic land settlements and high rates of poverty constrain some communities' abilities to respond effectively to climate challenges. Lack of financial resources and low tax bases for generating resources have resulted in a lack of roads and safe drinking water infrastructure, which makes it more daunting for some populations to address climate change issues. These economic pressures increase vulnerabilities to climate-related health and safety risks, such as air pollution, inadequate erosion and flood control, and insufficient safe drinking water.[180]

6.2 Vulnerability of the Built Environment

While social vulnerability depends on demographic factors such as age, education and poverty status, the vulnerability of the built environment is shaped by the composition of structures located in a community. This section quantifies the buildings exposed to potential hazards in the State of New Mexico. In addition to the following catalogue of critical facilities and the population information presented above, a quantitative analysis of the vulnerability of the built environment to hazards contributes to the larger vulnerability and risk assessment presented in this Plan Update.

The following Figure 6-3 provides an overview of New Mexico's built environment, presented by Preparedness Area. This information was derived from national-level inventory data associated with FEMA's Hazus loss estimation software. Data is presented for buildings, transportation and utilities.

Figure 6-3 Overview of New Mexico's Built Environment by Preparedness Area

	Total Replacement Values

[179] Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits https://www.census.gov/quickfacts/fact/table/NM,US/PST045216

[180] Adapted from: Garfin, G., et. al., 2014: Ch. 20: Southwest. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 462-486. doi:10.7930/J08G8HMN. http://nca2014.globalchange.gov/report/regions/southwest

	Total Replacement Values					
Category of Built Environment	**PA 1**	**PA 2**	**PA 3**	**PA 4**	**PA 5**	**PA 6**
Residential Buildings	$20.013 B	$4.337 B	$21.5 B	$12.139 B	$70.333 B	$20.887 B
Non-Residential Buildings	$5.536 B	$878 M	$4.638 B	$3.271 B	$15.059 B	$4.897 B
Structures Sub-Total	**$25.555 B**	**$5.217 B**	**$26.141 B**	**$15.410 B**	**$85.396 B**	**$25.787 B**
Highways	$19.930 B	$10.978 B	$9.098 B	$10.552 B	$16.320 B	$19.072 B
Railways	$1.027 B	420.2 M	$148.4 M	$381 M	$645.4 M	$950.8 M
Bus	$8.4 M	$1.0 M	$6.3 M	$2.1 M	$10.5 M	$4.2 M
Airport	$1.190 B	$308.4 M	$319 M	$357 M	$384.3 M	$855.1 M
Transportation Sub-Total	**$22.156 B**	**$11.708 B**	**$9.572 B**	**$11.292 B**	**$17.360 B**	**$20.882 B**
Potable Water	$233.3 M	$75.0 M	$429.7 M	$186.5 M	$779.6 M	$272.1M
Waste Water	$523.6 M	$281.6 M	$571.1 M	$751.3 M	$876.9 M	$610.8 M
Natural Gas	$434.4 M	$19.3 M	$149.3 M	$275.5 M	$296.7 M	$113.0 M
Oil Systems	$0.5 M	-	-	$0.5 M	$0.1 M	-
Electrical Power	$633.6 M	$211.2 M	$105.6 M	$633.6 M	$211.2 M	$633.6 M
Communication	$6.0 M	$1.2 M	$1.5 M	$3.3 M	$5.6 M	$3.5 M
Utility Sub-Total	**$1.831 B**	**$588.3 M**	**$1.257 B**	**$1.850 B**	**$2.170 B**	**$1.633 B**
Total	**$49.542 B**	**$17.513 B**	**$36.970 B**	**$28.552 B**	**$104.926 B**	**$48.302 B**

6.3 Critical Facilities

Critical facilities protection is essential because these specific facilities can have a significant impact on the scope of damage caused by a natural disaster. Impact to critical facilities during a natural disaster will likely also affect response and recovery from a natural hazard event.

For the purpose of the State Natural Hazard Mitigation Plan 'critical facilities' means: State owned or managed assets which are vital to the health, safety and well-being of New Mexicans during time of natural disaster. For the 2018 Plan Update, the State Hazard Mitigation Planning Team (SHMPT) determined that the 2013 Plan definition of critical facility was adequate and no changes were made.

Critical facilities include State owned or managed:

- Essential facilities vital to the response effort (emergency service facilities, such as police stations, fire stations, rescue squads, public works facilities, hospitals, evacuation shelters, etc.)
- Facilities that house populations requiring special consideration (nursing homes, prisons, juvenile detention centers, schools, secondary education facilities, child care centers, state hospitals and facilities, health clinics, and the Office of Medical Investigation, etc.)
- Locations where public health and safety functions are performed or coordinated (State Police District Offices, National Guard Facilities, Emergency Operations Centers, staging areas for emergency operations, Office of Medical Investigator, State Laboratory, housing for communications and computer systems, food/medical distribution centers, etc.)

- Communications networks (telephones, emergency medical radio communication system, emergency service radio systems, towers and repeater sites and base stations, television and radio stations, etc.)
- Water supply system/facilities, to include waste water treatment
- Utilities (power plants, substations, power lines, etc.)
- Transportation networks (roads, bridges, airports, rail terminals, etc.)
- Facilities that can create secondary hazards, such as nuclear power plants and hazardous materials production or storage facilities

Local hazard mitigation plans identify critical facilities within each jurisdiction, whether public or private, describe how those facilities are vulnerable to natural hazard events, and propose mitigation strategies to reduce impacts. Some critical facilities are owned by local, county, federal and/or Tribal government. These properties are beyond the scope of this State Plan Update.

Catalog of Critical Facilities

The U.S. Department of Homeland Security (DHS) Geospatial Management Office (GMO) has designed and deployed the Geospatial Information Infrastructure (GII). The GII provides a platform for users to access trusted geospatial data, map services, and geospatial applications. Geospatial information provides a key connection across homeland security-specific missions. With the GII, homeland security partners can establish a comprehensive situational and strategic awareness across the nation to better prepare, prevent, respond, and recover from crisis-related events. Access to GII is granted to authorize Federal, State, and Local emergency responders, emergency managers, homeland security officials and other personnel with official infrastructure protection responsibilities, through the Homeland Security Information Network.

The New Mexico Department of Information Technology (DoIT) utilizes a Geographic Information System (GIS) based data catalog called Community Anchor Site Assessment (CASA) as part of the State's Broadband Mapping Program. There are many layers of critical facilities data that are included in CASA. Examples of critical facilities layers are hospitals, police stations, fire stations, National Guard Emergency Readiness Centers, State government buildings, schools, and libraries. CASA also includes infrastructure such as roads, airports, and rail terminals.

CASA also includes some data associated with each of the specific structures or locations. For example, latitude and longitude is available for each structure. However, because CASA is not tied to the County Assessors' information, there is limited valuation data available. The interactive website that can be utilized to research the locations of different types of critical facilities State-wide is found at http://nmbbmapping.org/mapping/.

State-Owned or Managed Critical Facilities

SHMPT members and Subject Matter Experts were asked to review the list of State owned and managed critical facilities that were included in the 2013 State Natural Hazard Mitigation Plan. Participants were asked to submit edits, additions, and deletions. Emphasis was placed on facilities that would be considered critical during a natural hazard event. The location of each facility was then compared to known hazard areas as identified in the Risk Assessment section of the Plan Update. The New Mexico General Services Department was consulted to update the replacement value and contents value of each critical facility identified in the Plan. The potential damages to each location were estimated based on previous occurrence, damage estimation modeling, or informed analysis by Subject Matter Experts.

The exclusion of a building from the list of critical facilities does not mean that it houses a minor function. It means that the SHMPT and Subject Matter Experts determined that the activities and functions of that facility were not vital to the immediate health and safety of the residents of New Mexico during a natural hazard event. Following is a list of these facilities grouped by type. Appendix C, Critical Facility List includes a detailed listing of individual facilities, location, replacement value, contents value and potential losses for each hazard type.

Government Offices

- State Capitol Complex
- Harold Runnels Building
- Wallace/Lamy Buildings
- Villagra Building
- Bataan Memorial Building
- Siler Building F
- Simms Building

Department of Corrections

- Penitentiary of New Mexico (PNM)
- Roswell Correctional Facility (RCF)
- Southern New Mexico Correctional Facility (SNMCF)
- Springer Detention Center (SDC)
- Central New Mexico Correctional Facility (CNMCF)
- Grants Correctional Facility (GCF)

Department of Public Safety (DPS)

- DPS Headquarters
- DPS District 1
- DPS District 2
- DPS District 3
- DPS District 4
- DPS District 5
- DPS District 6
- DPS District 7
- DPS Sub-District 7
- DPS District 9
- NM DPS Mobilization Center

Department of Homeland Security and Emergency Management (DHSEM)

- State Emergency Management Center

Department of Military Affairs

- Oñate Complex
- Aircraft Maintenance Hanger
- National Guard Bernalillo Armory
- Roswell Armory
- Colfax Armory
- Belen Armory
- Socorro Armory
- Sandoval Armory

Hospitals/Medical Facilities

- University of New Mexico Hospital
- Tri-Service Building
- New Mexico Behavioral Health Institute
- New Mexico Rehabilitation Center
- New Mexico Veterans Center
- Fort Bayard Medical Center
- Miners Colfax Medical Center
- Sequoyah Adolescent Treatment Center
- Los Lunas Community Program

Radio/Communications Sites

Note: The Department of Homeland Security and Emergency Management along with the Department of Information Technology analyzed existing data to determine which radio and communication sites are critical according to the definition included in this Plan.

- Santa Fe Control (DOIT)
- Sandia Peak
- Davenport
- High Lonesome
- La Mosca
- Touch-Me-Not
- Tucumcari
- Eureka Mesa
- Archuleta (no longer exists as per DoIT)
- South Mesa
- Gallinas
- Tesuque Peak
- Galisteo (decommissioned as per DoIT)
- Caballo
- Socorro Peak
- Sierra Grande

Department of Transportation Facilities

- Department of Transportation Headquarters
- Dept. of Transportation District 1 Headquarters
- Dept. of Transportation District 2 Headquarters
- Dept. of Transportation District 3 Headquarters
- Dept. of Transportation District 4 Headquarters
- Dept. of Transportation District 5 Headquarters
- Dept. of Transportation District 6 Headquarters

Figure 6-4 provides a consolidated listing of identified critical facilities in the State by Preparedness Area. It comes as no surprise that a majority of the State's critical facilities are located in the more densely populated Preparedness Areas 3 and 5.

Figure 6-4 Critical Facilities by Preparedness Area

Facility Type	PA 1	PA 2	PA 3	PA 4	PA 5	PA 6
Corrections	1	1	1	1	2	1
Government Offices	0	0	5	0	0	0
Hospitals/Medical	1	2	3	0	4	2
Military Affairs	1	1	2	0	4	0
Public Safety	2	1	4	1	2	0
Radio/ Communications	3	2	3	2	2	2
Transportation	1	1	2	1	1	1
Total	**9**	**8**	**20**	**5**	**15**	**6**

Visualizing the location of critical facilities through mapping can contribute to more robust understanding of both vulnerability and capability in the event of a disaster. The following Figure 6-5 presents critical facility location throughout the State with Preparedness Area boundaries identified.

Additionally, the location of critical facilities in relation to wildfire hazard potential (Figure 6-6) and the Wildland Urban Interface (WUI) (Figure 6-7) was mapped State-wide. This information is analyzed in each Preparedness Area Vulnerability Assessment at the end of this Section of the Plan Update.

Figure 6-5 Statewide Critical Facilities Map

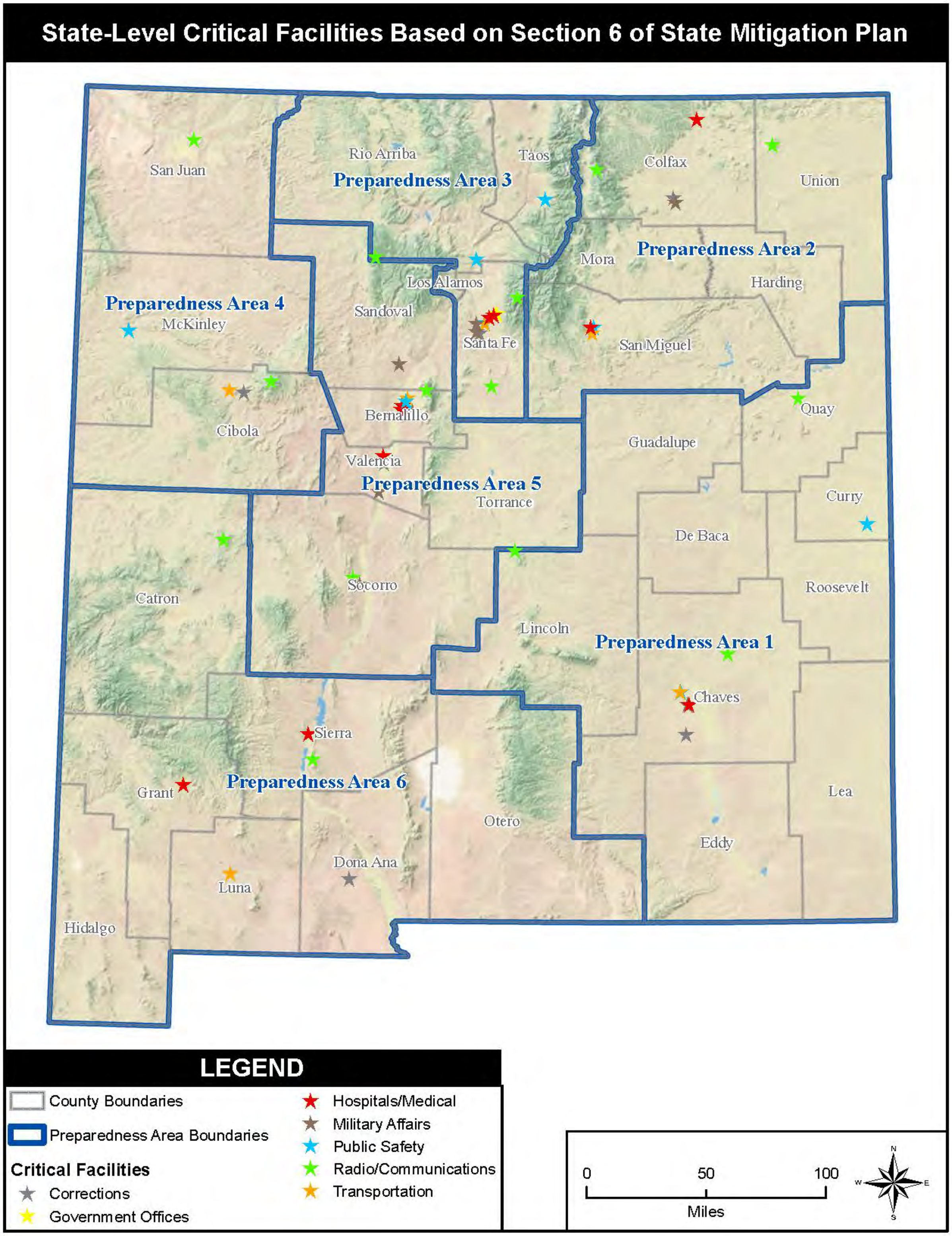


Figure 6-6 New Mexico Critical Facilities and Wildfire Hazard Potential

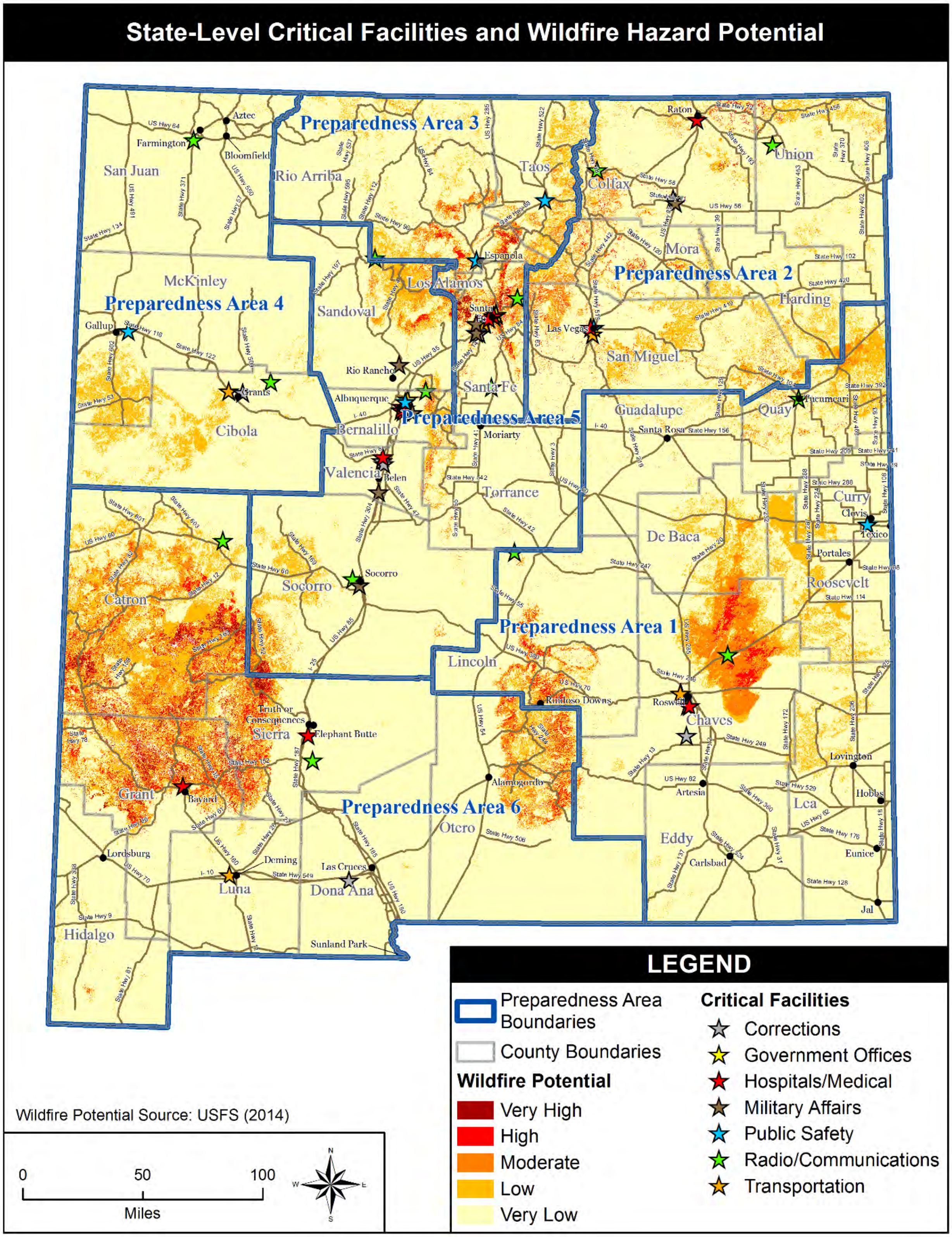
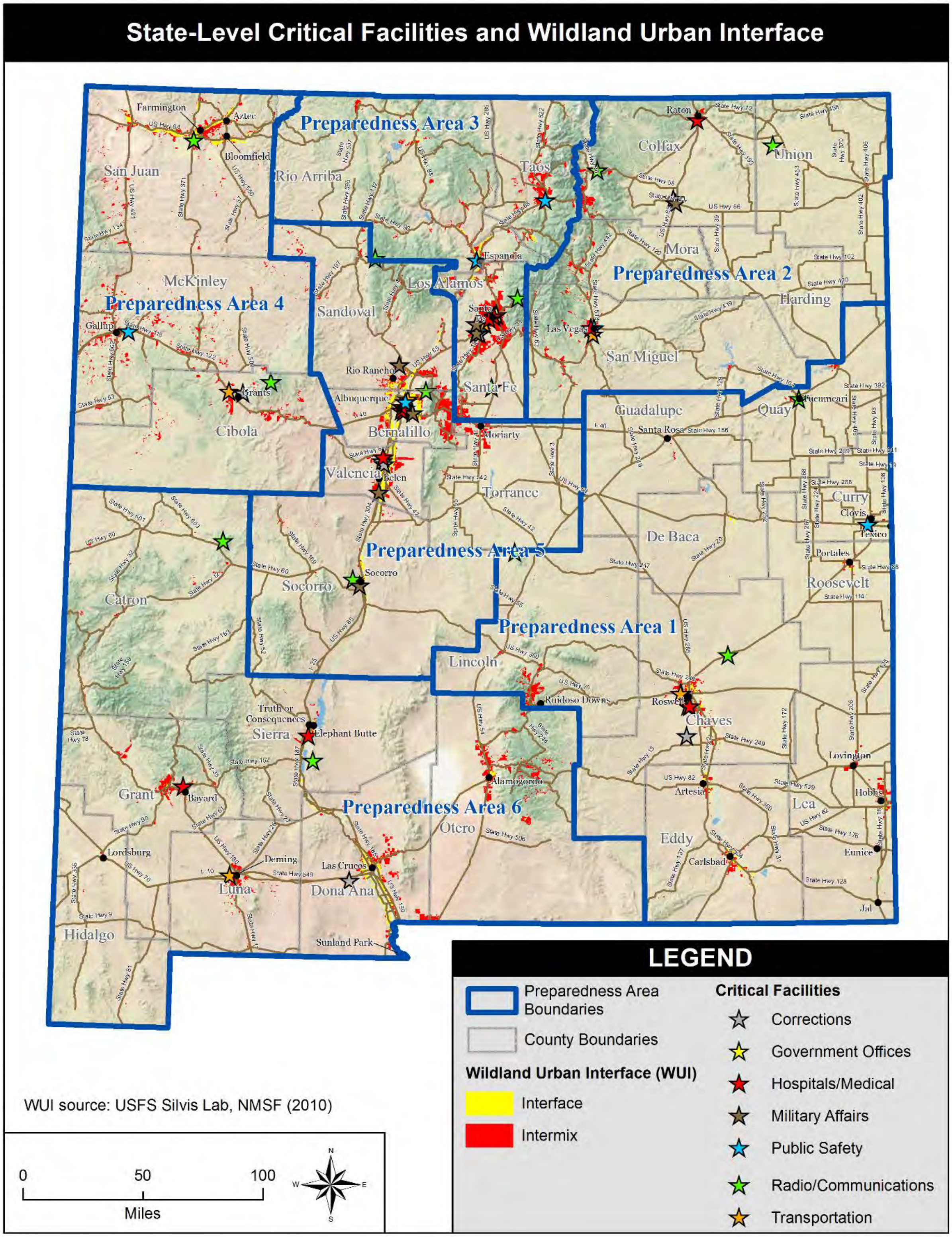


Figure 6-7 New Mexico Critical Facilities and WUI



Hazus Defined Critical Facilities

To avoid any confusion, it is also important to clarify another potential "critical facility" data source. FEMA's Hazus loss estimation software includes, in its defaults structures layer, a number of facilities that are either termed as being 'Essential' or 'High Potential Loss' facilities. According to the Hazus User Guide, essential facilities include hospitals, medical clinics, schools, fire stations, police stations, and emergency operations facilities. According to the Hazus User Guide, High Potential Loss facilities include dams, levees, military installations, nuclear power plant, and hazardous material sites.

Most references to critical facilities throughout this Plan Update relate to the SHMPT definition of State-owned facilities defined in the Critical Facilities subsection of this Section of the Plan Update. When referring specifically to Hazus's critical facilities, care has been taken to properly cite these instances when presented within this Plan Update.

Where data and resources allowed, specific vulnerabilities pertaining to some hazards profiled in this Plan Update are further described.

6.4 Vulnerability Analysis

The vulnerability analyses used information collected from Subject Matter Experts, from Hazus analysis, best available data studies/reports, and from information identified in local hazard mitigation plans developed by jurisdictions and Tribes across the State. Where local jurisdiction plans identify communities with particularly high risk, the Plan Update includes these specific communities as mitigation priority areas.

The following sub-sections provide an overview of the best available vulnerability analysis information used to update the Plan. The following information has been developed since the 2013 Plan.

Earthquake

Hazus runs were done for earthquake damage estimation based on best expert opinion regarding location and rupture parameters for the most probable maximum magnitude earthquake in each Preparedness Area. The full results of this analysis can be found in the Global Summary Reports located in Appendix C, Hazus Global Summary Reports subsection. Figure 6-8 below shows the Hazus parameters used for the most probable maximum magnitude earthquake in each Preparedness Area.

Figure 6-8 Hazus Earthquake Parameters

Preparedness Area	1	2	3	4	5	6
Location	**Carlsbad**	**Raton**	**Los Alamos**	**Farmington**	**Albuquerque**	**Las Cruces**
Type of Earthquake	Arbitrary					
Longitude	-104.23	-105.22	-106.31	-108.22	-106.62	-106.41
Latitude	32.42	36.48	35.89	36.72	35.22	32.42
Magnitude	5.5	5.5	7.3	5.5	7.3	7.3
Rupture depth (km)	5	5	15	5	15	15
Rupture length	3	3	78	3	51	71

Preparedness Area	1	2	3	4	5	6
Rupture orientation	0.00 degrees					
Fault width (km)					16.4	16.2
Note: Albuquerque rupture includes "faults north of Placitas" in addition to the Sandia and Rincon faults. Los Alamos rupture includes the entire Pajarito fault system and the southern Embudo fault system. The Las Cruces rupture includes the southern San Andres Mtns-Organ Mtns-N Artillery Range faults. Nomenclature of faults follows Machette et al. (1998).						

The summary results of the Hazus loss estimations are presented below in Figure 6-9, per Preparedness Area. The modeled losses vary greatly across the State, from over $2 Billion in anticipated losses for the most probable maximum magnitude earthquake in Preparedness Area 3 to no measurable anticipated losses for a similar event in Preparedness Area 2.

Figure 6-9 Hazus Earthquake Loss Estimates by Preparedness Area

Loss Estimates	PA 1	PA 2	PA 3	PA 4	PA 5	PA 6
Wage	$14.03 M	$8.58 M	$79.05 M	$28.28 M	$46.82 M	$33.35 M
Capital-Related	$10.70 M	$6.19 M	$62.56 M	$19.87 M	$41.20 M	$24.98 M
Rental	$14.03 M	$8.54 M	$78.08 M	$20.38 M	$50.20 M	$35.78 M
Relocation	$33.89 M	$18.11 M	$195.82 M	$49.96 M	$119.09 M	$93.39 M
Income Losses (subtotal)	***$72.65 M***	***$41.42 M***	***$415.51 M***	***$118.50 M***	***$257.31 M***	***$189.49 M***
Structural	$50.36 M	$25.68 M	$339.00 M	$77.01 M	$180.95 M	$139.18 M
Non-Structural	$157.53 M	$80.45 M	$1.093 B	$233.18 M	$542.11 M	$391.32 M
Content	$62.01 M	$29.34 M	$341.03 M	$101.35 M	$194.90 M	$122.50 M
Inventory	$0.95 M	$0.37 M	$4.63 M	$2.72 M	$3.08 M	$2.05 M
Capital Stock Losses (subtotal)	***$270.84 M***	***$135.85 M***	***$1.778 B***	***$414.26 M***	***$921.04 M***	***$655.04 M***
Total Estimated Building-Related Losses	**$343.49 M**	**$177.27 M**	**$2.193 B**	**$532.76 M**	**$1.178 B**	**$844.53 M**
Total Estimated Utility System Losses	**$0.00 M**	**$0.00 M**	**$15.90 M**	**$0.00 M**	**$1.27 M**	**$0.00 M**
Total Estimated Transportation System Losses	**$3.90 M**	**$4.70 M**	**$26.43**	**$4.70 M**	**$8.20 M**	**$8.00 M**
Personal Injury Estimates	**90-155**	**60-84**	**734-1,177**	**125-175**	**281-421**	**460-596**

Flood

Spatial analysis was performed to identify potential critical facility flood vulnerabilities. This analysis was conducted by intersecting the State's critical facilities with FEMA's Flood Insurance Rate Map's (FIRM) Special Flood Hazard Areas (SFHA). It should be noted that the SFHA could only be utilized when it has been mapped and is available digitally, as either an Effective or Preliminary 1% annual-chance flood event floodplain. The following Figure 6-10 presents an overview of available digital SFHA floodplains.

This best available analysis only identifies a single State correctional facility within a digitally mapped SFHA. Additional details can be found in that respective Preparedness Area's Vulnerability Assessment sub-section that follows.

Figure 6-10 Digital SFHA Availability by Preparedness Area

	PA 1	PA 2	PA 3	PA 4	PA 5	PA 6
Counties	9	5	4	3	5	7
Counties Having a Digital FIRM	6	2	4	3	4	4

Base Level Engineering

Another potential tool for evaluating flood vulnerabilities within areas that currently do not have existing or accurate floodplains involves the use of Base Level Engineering (BLE). More description of BLE is found in the Capabilities Section, Base Level Engineering (BLE) subsection. This tool is being utilized as part of FEMA's Risk MAP program in selected watersheds to provide flooding depth grids and floodplains for non-regulatory use by local communities. A case study for how this BLE product is being leveraged in the State can be found within Preparedness Area 1's Vulnerability Assessment, *Case Study: Rio Hondo Watershed Discovery* subsection that follows.

Acequias

Acequias and ditches have played an important role in the settlement of New Mexico and today remain an integral part of community life. The words "acequia" and "ditch" can defined in both a physical and political context. As a physical structure, an acequia or ditch is typically man-made earthen channel that conveys water to individual tracts of land. As a political organization, a community ditch or acequia is a public entity that functions to allocate and distribute irrigation water to the landowners who are its members.

The physical characteristics of an acequia or ditch typically include a diversion dam and headgate, a main ditch channel commonly called the *acequia madre*, lateral ditches leading from the main channel to irrigate individual leading from the main channel to irrigate individual parcels of land, and wasteway channel that returns surplus water from the acequia or ditch system back to the stream. Occasionally, the works include a storage reservoir or transbasin ditch. The diversion structures can be built or readily available materials, such as timber, bush and rocks, or consist of concrete and masonry. The channels are usually unlined, open and operate by gravity flow.

The community acequia or ditch association is composed of owners of the lands irrigated by a ditch. Landowners are assessed dues by the acequia association for the operation and maintenance of, and improvements to the ditch systems. Three commissioners and a mayordomo, elected by association members, manage the allocation and distribution of irrigation water, and all members participate in acequia maintenance.

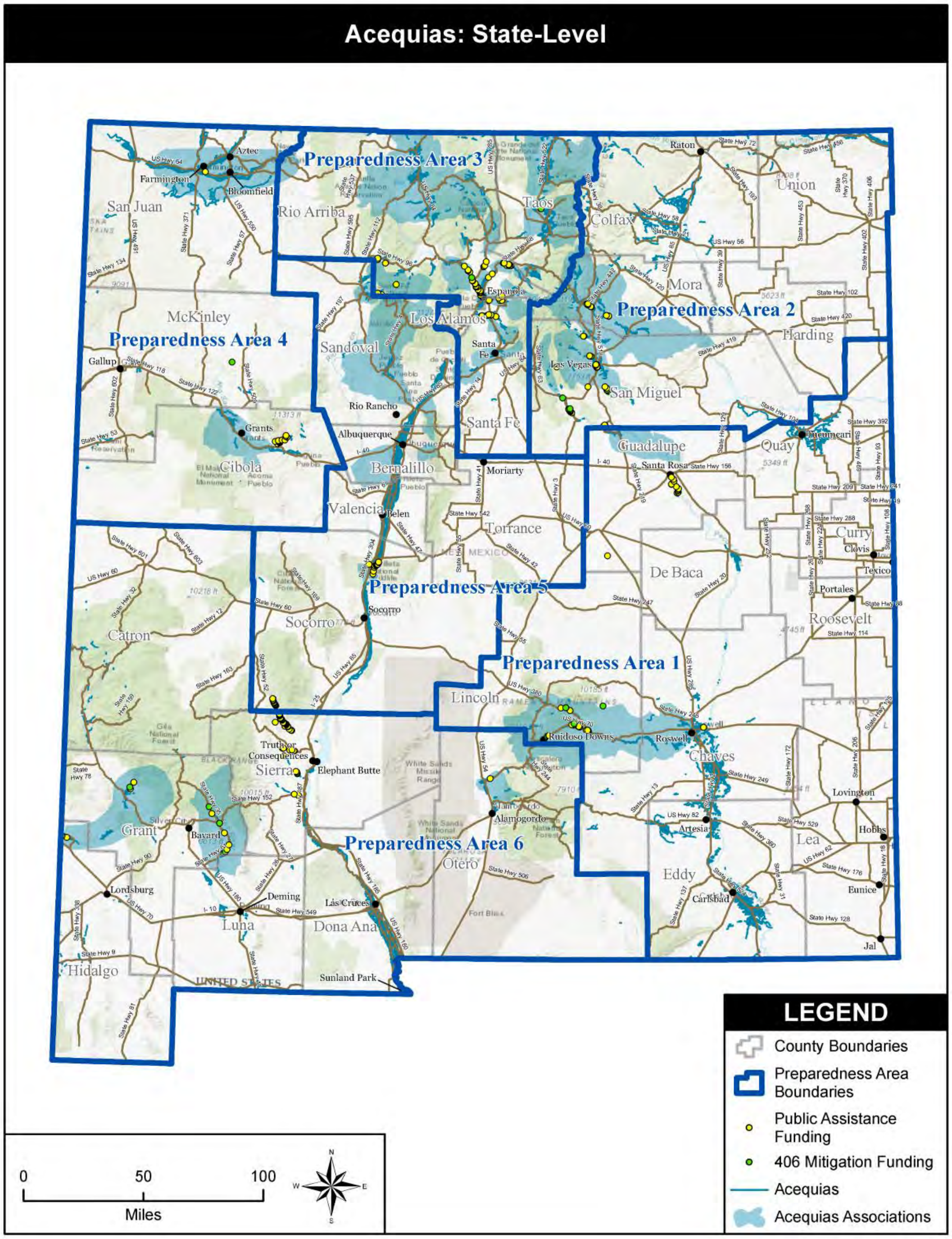
It is estimated that New Mexico has approximately 9,000 acequia miles. Preparedness Area 1 has the most miles of acequias, with 2,487. The farms served by acequias range in size from less than one acre to more than 500 acres; the majority are less than 20 acres.

Acequias are vulnerable to flooding, which can damage the acequia itself as well as cause property damage surrounding the acequia. Flood waters can damage culverts and diversion dams, and fill acequias with silt, requiring extensive restoration efforts. All acequias and acequia associations were mapped for each Preparedness Area, and are displayed in each Preparedness Area vulnerability section below. Figure 6-11 shows a State-wide summary of acequia data, and Figure 6-12 shows acequia information on a State-wide map.

Figure 6-11 State-wide Acequia Summary

		Preparedness Areas					
	Total	**1**	**2**	**3**	**4**	**5**	**6**
Acequia Miles	9,126	2,487	1,038	1,958	1,006	1,413	1,224
DR Claims	353	44	95	81	16	30	85
Flood Risk Miles	4,721	930	455	1,056	508	1,098	674
# of Acequia Associations	32	2	4	15	2	5	4

Figure 6-12 Acequias and Acequia Associations State-wide



Landslide

State-wide mapping was conducted to identify areas susceptible to deep-seated landslides and rockfall (both subsumed into the 'Landslide' hazard type for the purposes of this Plan Update). The mapping project is described in more detail in the Landslide Profile in the HIRA Section, Hazard Characteristics subsection (4.5.8). The landslide susceptibility mapping used the logistic regression method, which models landslide susceptibility by statistically correlating previously mapped landslides with various landscape features (such as slope steepness, rock type, and slope aspect[181]). Two rockfall maps were constructed[182]. One utilizes a kernel-function contouring of previously mapped rockfall density. The other rockfall map establishes slope bins from statistical analyses of slopes associated with the previously mapped rockfalls, and uses these slopes as proxies for rockfall susceptibility. The results of this mapping are shown in Figure 4-128Figure 4-127 through 4-131 in the Landslide Profile in the HIRA Section. Areas likely susceptible to landslides are mostly located in the western and northern regions of the State, however, the south-central region also has significant areas likely susceptible to landslides. Generally, steep slopes, mountainous regions, canyon sides, and mesa flanks are mapped as having higher susceptibilities. For more information on deep-seated landslide susceptibility, go to: http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=594, and for more information on rockfall susceptibility, go to: http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=595.

Land Subsidence

In New Mexico, common causes of land subsidence from human activity are pumping of water, oil, and gas from underground reservoirs; dissolution of limestone, gypsum, or other soluble rocks to form sinkholes; collapse of underground mines; drainage of organic soils; and initial wetting of dry soils under load (hydro compaction). A State-wide mapping effort was conducted to identify areas susceptible to collapsible soils (hydro compaction), which compact and collapse after they get wet. This effort relied on expert-driven spatial weighted average of multiple indirect proxies. The mapping methodology and is briefly discussed in the Land Subsidence HIRA Section, Hazard Characteristics subsection of this Plan Update. The results are shown in Figure 4-168 through Figure 4-174.

Collapsible soil susceptibility varies across the State of New Mexico. The flanks of the Rio Grande valley and closed basins, alluvial fans, and areas with windblown sediment in the San Juan basin and along the Canadian river have high to extreme susceptibilities. Most of the remaining State has moderate susceptibilities—this is likely an overestimate to compensate for the map coarseness and the general arid conditions of the State. Wetlands and mountain uplands have low susceptibilities. For more information on collapsible soils susceptibility mapping, go to: http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=593

Wildland/Wildland-Urban Interface

There are a number of existing products and efforts underway to assess wildland fire risk at various scales and for different purposes.

The US Forest Service's Southwest Region is finalizing a regional Wildfire Risk Assessment. The models will help managers in New Mexico and Arizona identify and understand the risks posed by wildland fire and develop cost-effective mitigation strategies. The assessment uses a process for assessing wildfire risk for land and resource management based on the framework laid out in USFS Rocky Mountain Research Station General Technical Report 315 https://www.nrs.fs.fed.us/pubs/44723.

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[181] Cikoski, C.T., and Koning, D.J., 2017, Deep-seated landslide susceptibility map of New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 594, 84 p. and 1 plate.

[182] Koning, D.J., and Mansell, M., 2017, Rockfall susceptibility maps for New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-file Report 595, 41 p. and 2 plates.

At a broader scale, the 2013 West Wide Wildfire Risk Assessment produced a wildfire risk assessment and report for the 17 western states, http://www.odf.state.or.us/gis/data/Fire/West_Wide_Assessment/WWA_FinalReport.pdf. It allows comprehensive comparisons between regional geographic areas and can assist in quantifying risk and fire effects to aid in the mitigation of wildfire risks across the western United States. West Wide Wildfire Risk Assessment results are not intended to replace Local and State products as a decision-making tool.

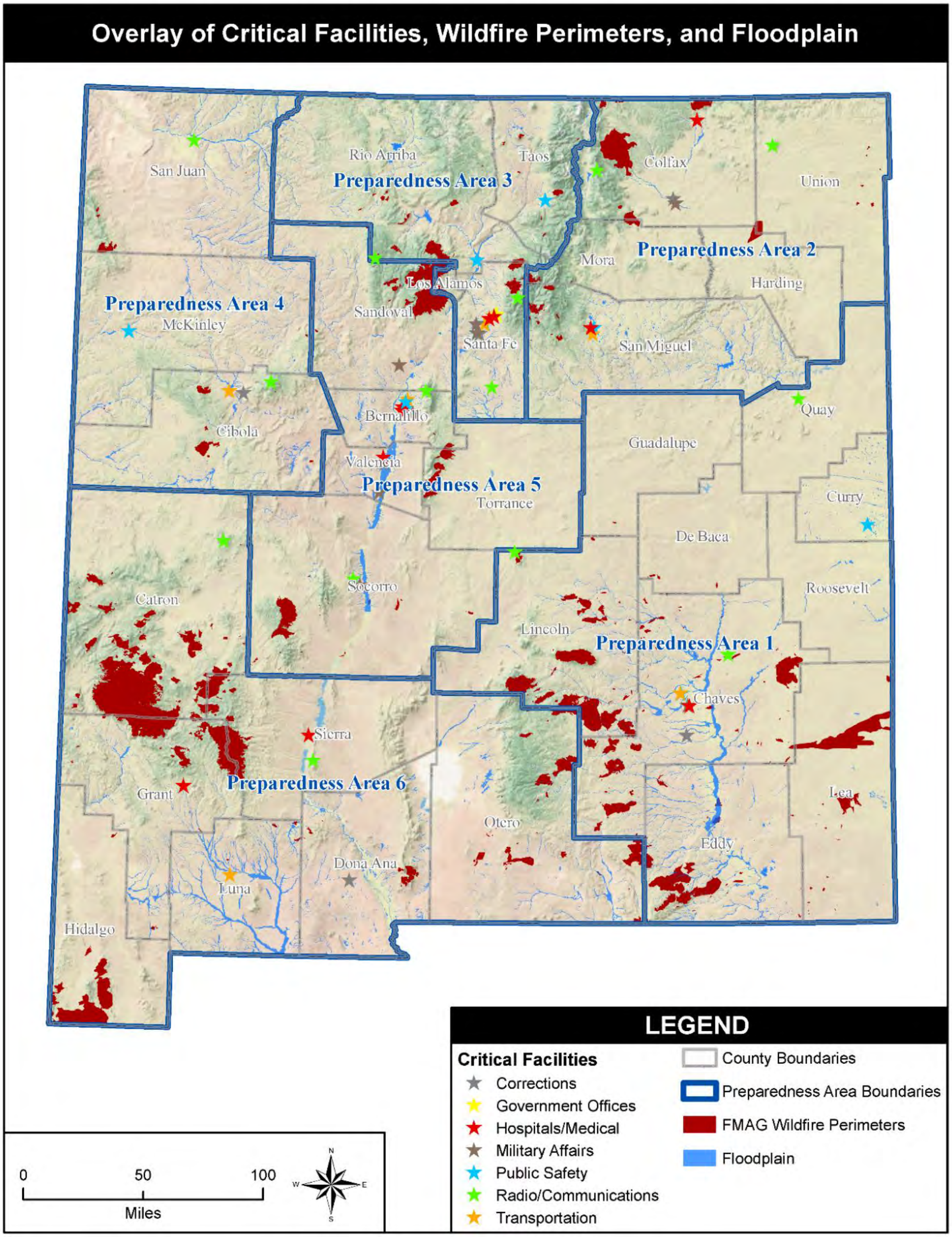
The US Forest Service Wildfire Hazard Potential Map (https://firelab.org/project/wildfire-hazard-potential) depicts the relative potential for wildfire that would be difficult for suppression resources to contain. Areas mapped with higher Wildfire Hazard Potential values represent fuels with a higher probability of experiencing torching, crowning, and other forms of extreme fire behavior under conducive weather conditions, based primarily on 2010 landscape conditions. On its own, Wildfire Hazard Potential is not an explicit map of wildfire threat or risk, but when paired with spatial data depicting highly valued resources and assets such as communities, structures, or powerlines, it can approximate relative wildfire risk to those resources and assets. Wildfire Hazard Potential is also not a forecast or wildfire outlook for any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions. It is instead intended for long-term strategic planning and fuels management. State-wide maps showing Wildland Urban Interface and Wildfire Potential locations are shown in Figure 4-235 and Figure 4-244 in the HIRA Section of the Plan Update.

Summary

Overall, the State has made a number of successful advances since 2013, in analyzing and identifying potential vulnerabilities to a number of hazards profiled within this Plan Update. The following Figure 6-13 presents an overview of this best available data at a State-wide scale. This same information is also presented and mapped in the newly updated Preparedness Area Vulnerability Assessments in this Plan Section.

It is important to note that climate change impacts will increase vulnerability to several natural hazards, including drought and wildland fire. Increased warming, drought, and insect outbreaks, all caused by or linked to climate change, have increased wildfires and impacts to people and ecosystems in the southwest. Fire models project more wildfire and increased risks to communities across extensive areas.

Figure 6-13 Statewide Risk and Vulnerability Assessment



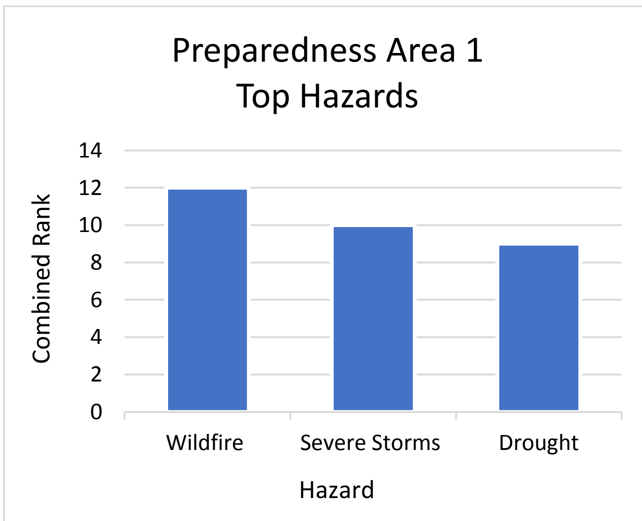
6.5 Vulnerability Assessment – Preparedness Area 1

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 1. Local jurisdictions within the Preparedness Area identified the following three hazards as being top priority planning concerns:

- Drought
- Severe Winter Storms
- Wildfire

Figure 6-14 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]).

Figure 6-14 Preparedness Area 1 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquake, floods/flash floods, landslide, or land subsidence were not identified as primary hazard concerns for the region, vulnerability analysis is included for those hazards as that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Exposure – Preparedness Area 1

Preparedness Area 1 has a total population of 288,670 people and there are over 107,000 households in the Area. Additionally, there are an estimated 128,000 buildings in Preparedness Area 1. Approximately 93% of the buildings and 78% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 1, wood frame construction makes up 58% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are nine State critical facilities located with Preparedness Area 1. This includes the following facility types: corrections (1), hospitals/medical (1), military affairs (1), public safety (2), radio/communications (3), and transportation (1).

The transportation and utility lifeline inventory within Preparedness Area 1 includes over 2,504 miles of highways, 315 bridges, and 14,716 miles of pipes.

Changes in Development – Preparedness Area 1

The following Figure 6-15 presents population counts and projections for those counties included in Preparedness Area 1. Overall the area has seen gradual growth, but this is being entirely driven by three of the Area's nine counties. Mitigation efforts in Preparedness Area 1 should focus on these particular growth areas, as encouraging development outside of hazard areas is one of the most effective tools to help reduce risk and vulnerability.

Figure 6-15 Preparedness Area 1 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Chaves County	65,645	65,282	-0.55%
Curry County	48,376	50,280	3.94%
De Baca County	2,022	1,793	-11.33%
Eddy County	53,829	57,621	7.04%
Guadalupe County	4,687	4,376	-6.64%
Lea County	64,727	69,749	7.76%
Lincoln County	20,497	19,429	-5.21%
Quay County	9,041	8,365	-7.48%
Roosevelt County	19,846	19,082	-3.85%
Preparedness Area 1	**288,670**	**295,977**	**2.53%**

Steady population growth in the region amid persistent drought conditions will further exacerbate the impacts of drought on communities within Preparedness Area 1. In the future, the need to acquire additional sources of water may create competition for diminishing supply of water. Groundwater shortages are projected in much of Curry and Roosevelt Counties, due to over-pumping of the High Plains Aquifer, which will exasperate water supply problems.[183]

In many parts of the State, the potential for residential development along the wildland-urban interface is limited due to restrictive land use regulations. However, many of the most populated Preparedness Areas (including Preparedness Area 1) are experiencing an increase in residential growth in or near the forest boundary. This development trend significantly increases the risk of catastrophic structure losses from wildfires as well as increased exposure of humans, livestock and wildlife to wildfire related deaths.

[183] Rawling, G.C., 2016, A hydrogeologic investigation of Curry and Roosevelt Counties, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Report 580, 48 p.; and Rawling, G.C., and Rinehart, A.J., 2017, Lifetime projections for the High Plains Aquifer in east-central New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Report 591, 39 p.

Critical Facilities – Preparedness Area 1

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought or severe winter storm events. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, do not expect any critical facilities to suffer at least moderate damage. There are no State critical facilities currently mapped as being in the floodplain. All critical facilities in Preparedness Area 1 are located in areas with very low wildfire hazard potential, as described in Figure 6-16 and Figure 6-17, and no critical facilities are located in the WUI (Figure 6-18).

Figure 6-16 Preparedness Area 1 Critical Facility and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
ROSWELL CORRECTIONAL CENTER	Corrections	Very Low
ROSWELL RC & FMS#1	Military Affairs	Very Low
New Mexico Department of Transportation - District 2	Transportation	Very Low
New Mexico State Police - District 3 - Roswell (Main)	Public Safety	Very Low
High Lonesome	Radio/Communications	Very Low
SOCORRO READINESS CENTER	Military Affairs	Very Low
New Mexico State Police - District 9 - Clovis (Main)	Public Safety	Very Low
CENTRAL NEW MEXICO CORRECTIONAL FACILITY	Corrections	Very Low
New Mexico Department of Transportation - District 6	Transportation	Very Low

Figure 6-17 Preparedness Area 1 Critical Facilities Wildfire Hazard Potential

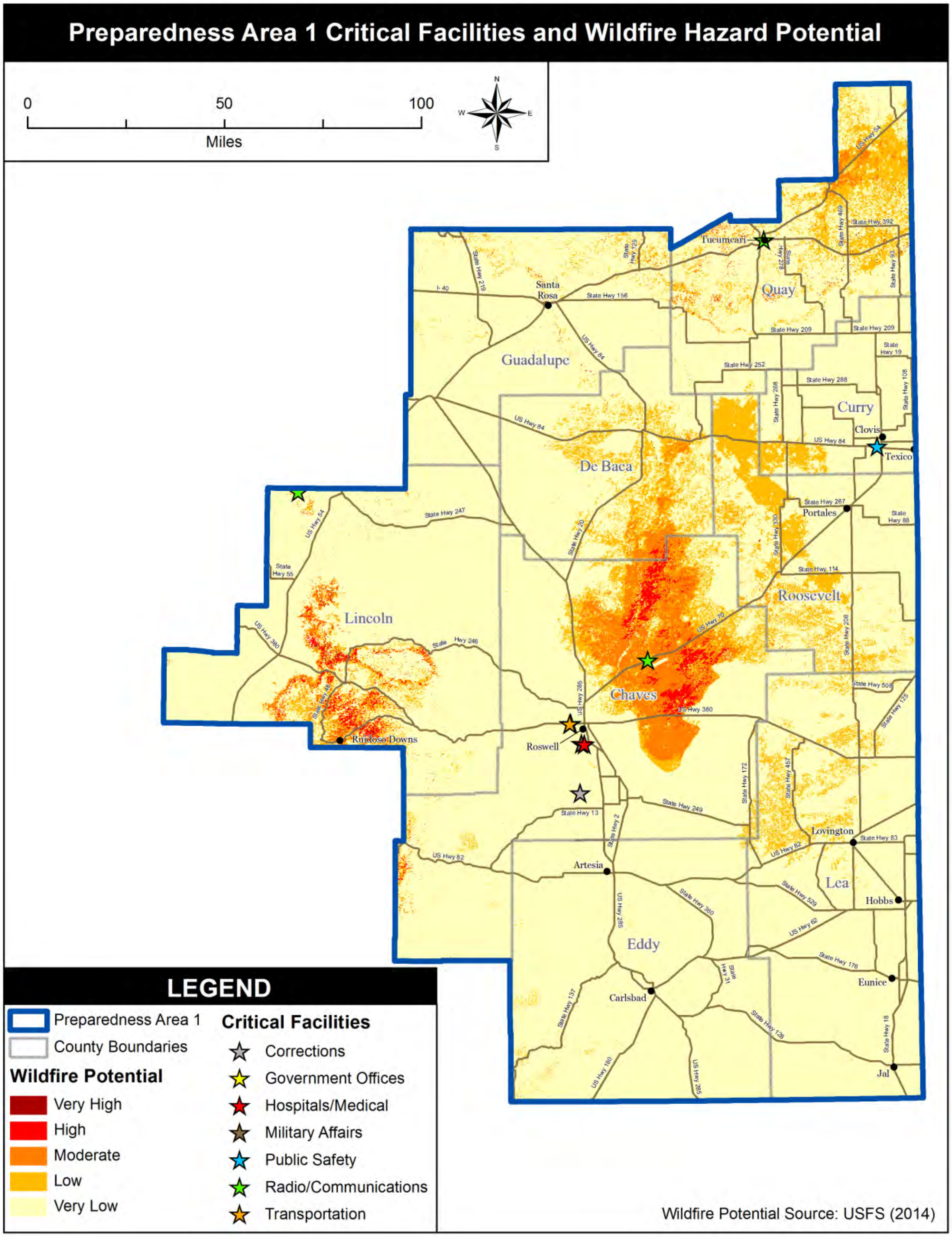
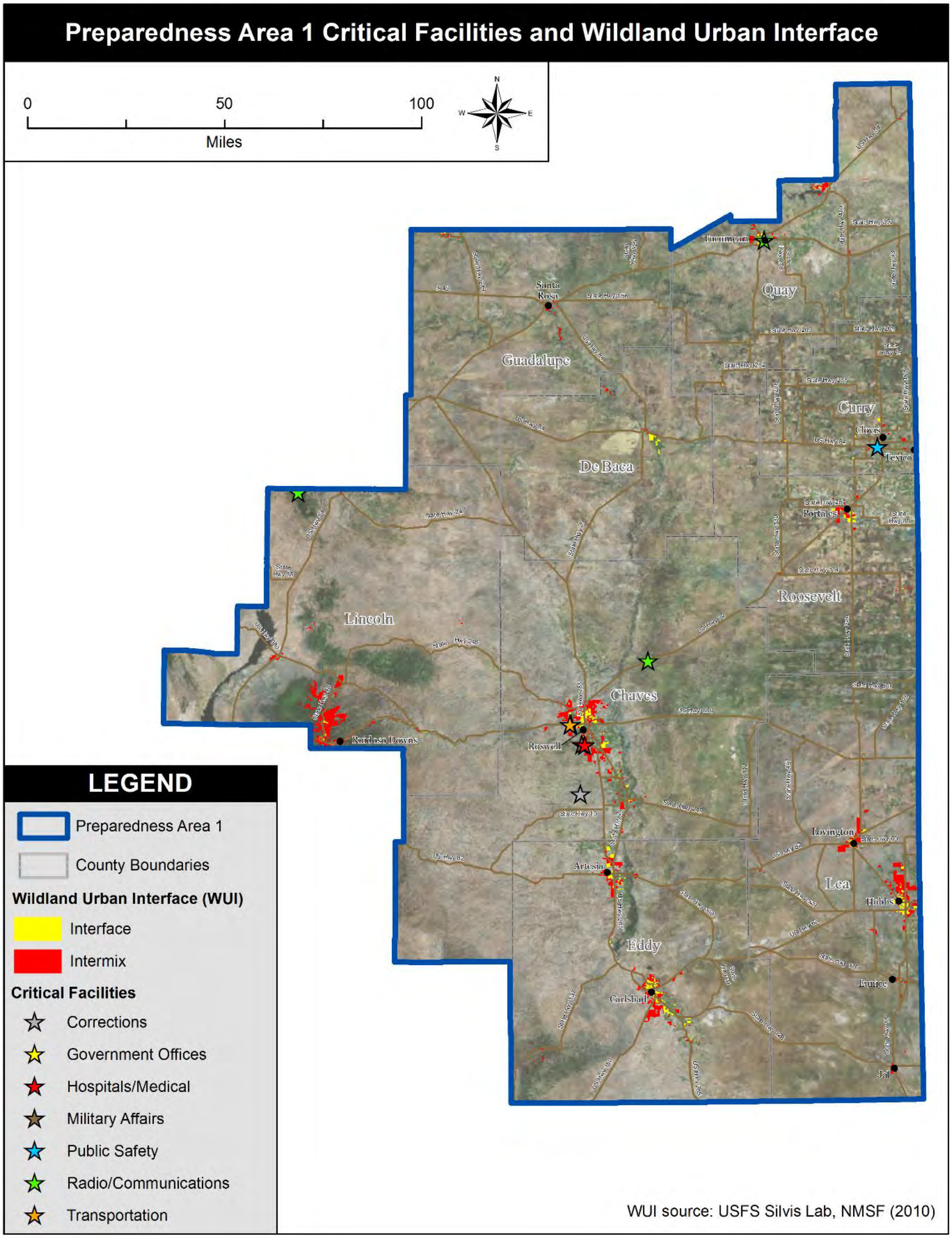


Figure 6-18 Preparedness Area 1 Critical Facilities and Wildland Urban Interface



Drought – Preparedness Area 1

Drought was ranked below flooding in a number of local hazard mitigation plans in Preparedness Area 1. However, the monetary loss estimates for drought far exceed those for flooding. A large portion of the land mass of Preparedness Area 1 is experiencing extended extreme drought conditions. The region is also vulnerable to extreme heat conditions. Together, these conditions elevate regional wildfire vulnerability and create high estimated potential losses for future wildfire disasters. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event.

Reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s and drought has a high risk, high vulnerability rating in Preparedness Area 1. A number of counties located in Preparedness Area 1 are home to generational ranching operations. In the last decade, an influx of entrepreneurs has led to the diversification of agriculture and horticulture in this region of the State. These agricultural and ranching sectors are highly vulnerable to drought.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems. Of these, the only system that has any quantifiable loss information relates to funding from the USDA's disaster related assistance funding. The following Figure 6-19 presents the best available Farm Service Agency's recent Emergency Loan program funding to the State.

Figure 6-19 Preparedness Area 1 FSA Disaster Assistance Funding

FY 2010	FY 2011	FY 2012	FY 2013
$418,000	$76,000	$307,000	$1,374,420

Earthquake – Preparedness Area 1

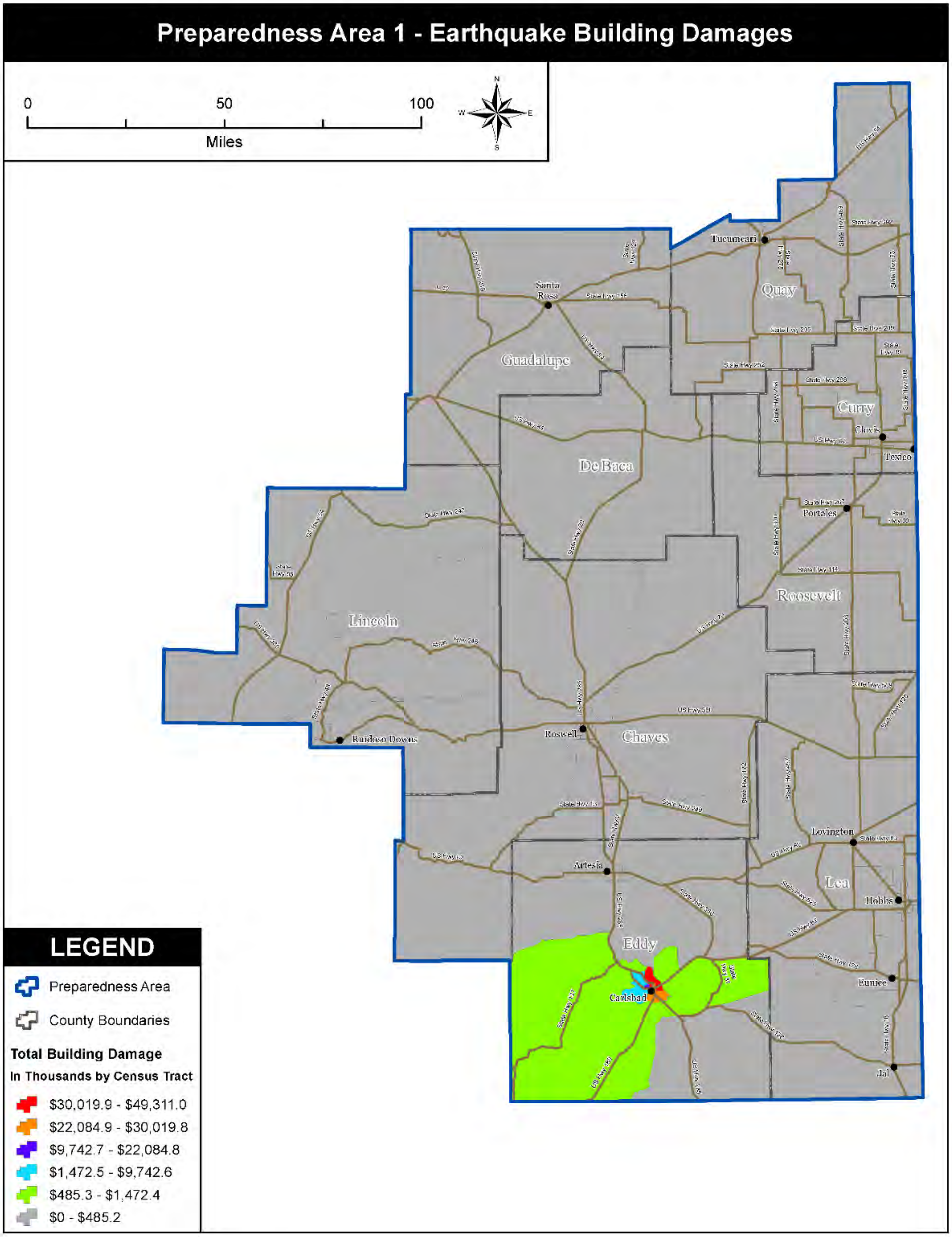
The following Figure 6-20 presents the expected building-related economic loss estimates for the most probable maximum magnitude earthquake event modeled in the southwest part of Preparedness Area 1. Figure 6-21 shows building damages by census tract on a map. The southwest corner of the Preparedness Area would experience the most in building damages as a result of the modeled earthquake.

Figure 6-20 Hazus Earthquake Building-Related Loss Estimates (Preparedness Area 1)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$2.19 M	$10.88 M	$0.15 M	$0.82 M	$14.03 M
Capital-Related	$0.00 M	$0.93 M	$9.43 M	$0.10 M	$0.24 M	$10.70 M
Rental	$5.58 M	$2.97 M	$4.97 M	$0.06 M	$0.45 M	$14.03 M
Relocation	19.60 M	$2.33 M	$7.79 M	$0.41 M	$3.76 M	$33.89 M
Income Losses (subtotal)	***$25.18 M***	***$8.43 M***	***$33.06 M***	***$0.72 M***	***$5.26 M***	***$72.65 M***

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Structural	$28.08 M	$5.06 M	$11.63 M	$1.12 M	$4.47 M	$50.36 M
Non-Structural	$94.64 M	$21.32 M	$28.65 M	$3.17 M	$9.74 M	$157.53 M
Content	$34.25 M	$5.47 M	$14.80 M	$2.03 M	$5.46 M	$62.01 M
Inventory	$0.00 M	$0.00 M	$0.46 M	$0.33 M	$0.16 M	$0.95 M
Capital Stock Losses (subtotal)	***$156.97 M***	***$31.85 M***	***$55.54 M***	***$6.65 M***	***$19.84 M***	***$270.84 M***
Total Estimated Losses	**$182.15 M**	**$40.28 M**	**$88.60 M**	**$7.36 M**	**$25.10 M**	**$343.49 M**

Figure 6-21 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA1)



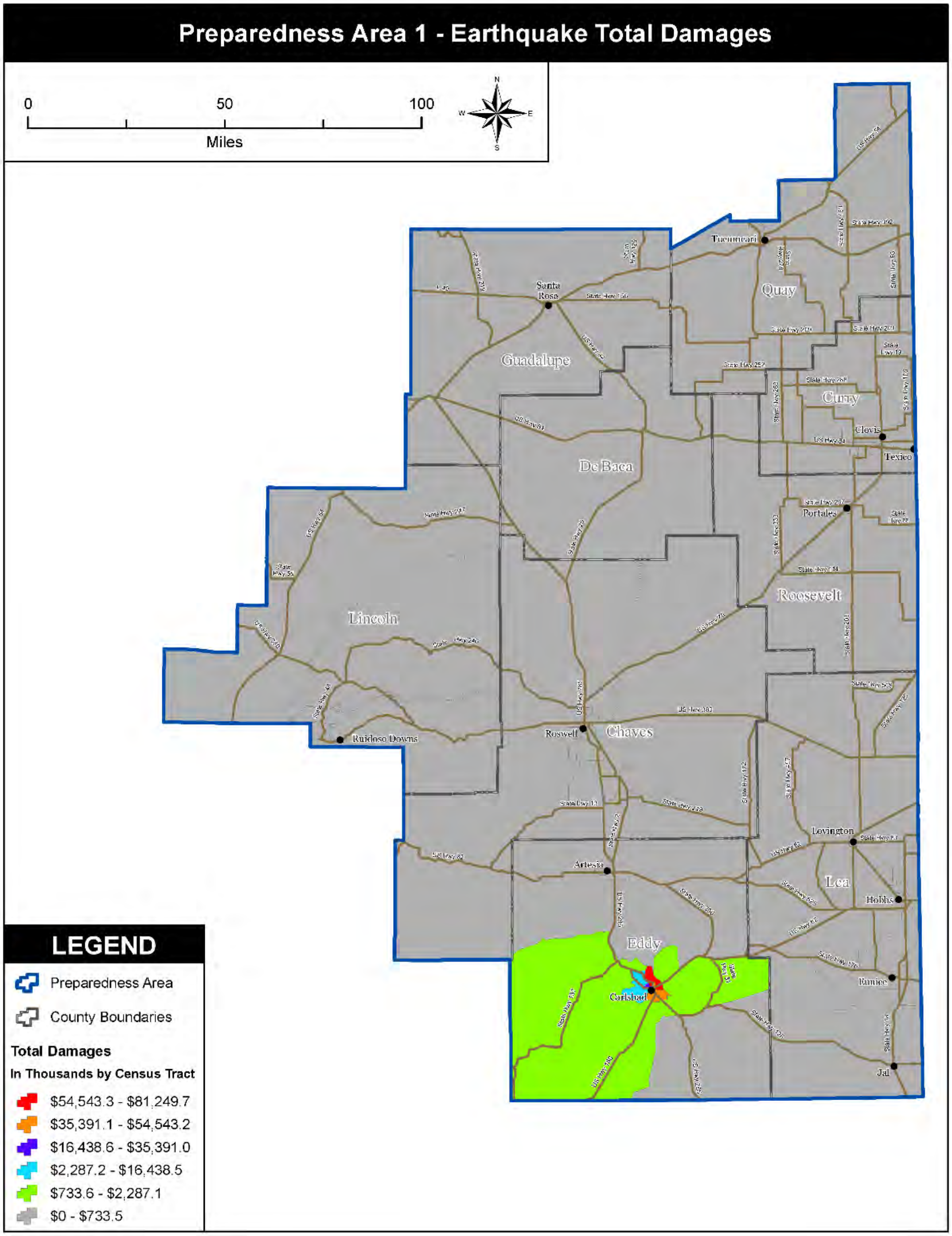
The following Figure 6-22 presents additional modeled impacts from this same modeled event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-22 Hazus Earthquake Impacts and Loss Estimates (PA 1)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 3,466
	Moderate: 2,498
	Extensive: 1,012
	Complete: 185
Total Economic Losses (includes building and lifeline losses)	$347.35 million
Damage to Schools	0 with at least moderate damage
Damage to Medical Facilities	0 with at least moderate damage
Damage to Fire Stations	0 with at least moderate damage
Damage to Transportation Systems	0 highway bridges, at least moderate damage
	0 highway bridges, complete damage
	0 railroad bridges, moderate damage
	0 airport facilities, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	248
Shelter Requirements	168 people out of 288,670 total population
Debris Generation	0.14 million tons

Figure 6-23 shows total damages resulting from an earthquake in Preparedness Area 1 by census tract. Similar to building damages, the southwest corner of the Preparedness Area would experience the most total damages as a result of an earthquake.

Figure 6-23 Total Earthquake Damages by Census Tract (– Preparedness Area 1)



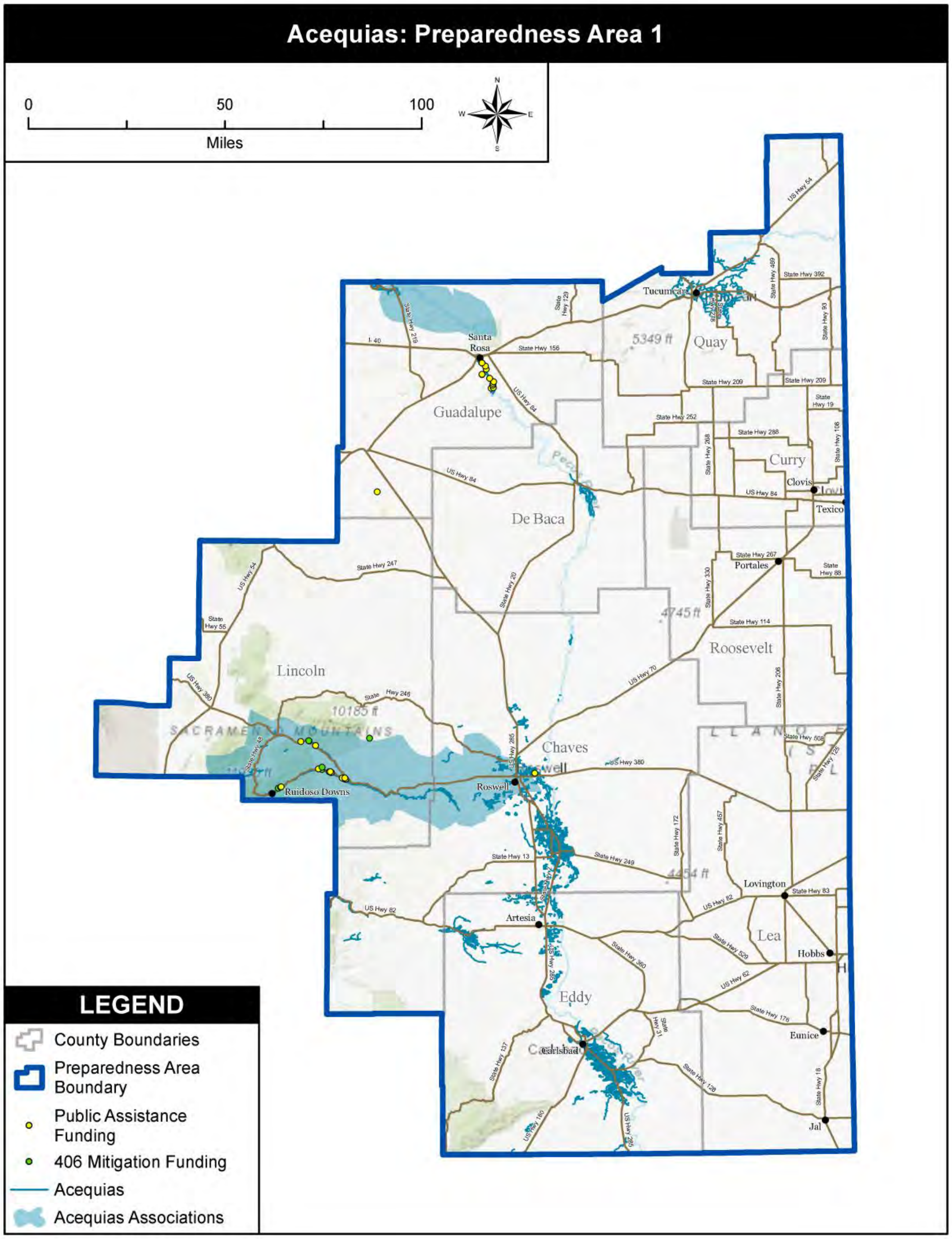
Floods/Flash Floods – Preparedness Area 1

Under the right conditions, virtually every Preparedness Area in the State of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including mudslides. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September.

The map below shows locations of acequias in Preparedness Area 1. There is a concentration of acequias in the south-central region along the Pecos River. There are also a number of acequias in the northeast region of the Preparedness Area. The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 1, there are an estimated 2,487 miles of acequia infrastructure identified from existing datasets. There are two known Acequia Associations in the region, as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 930 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 44 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within the Preparedness Area (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

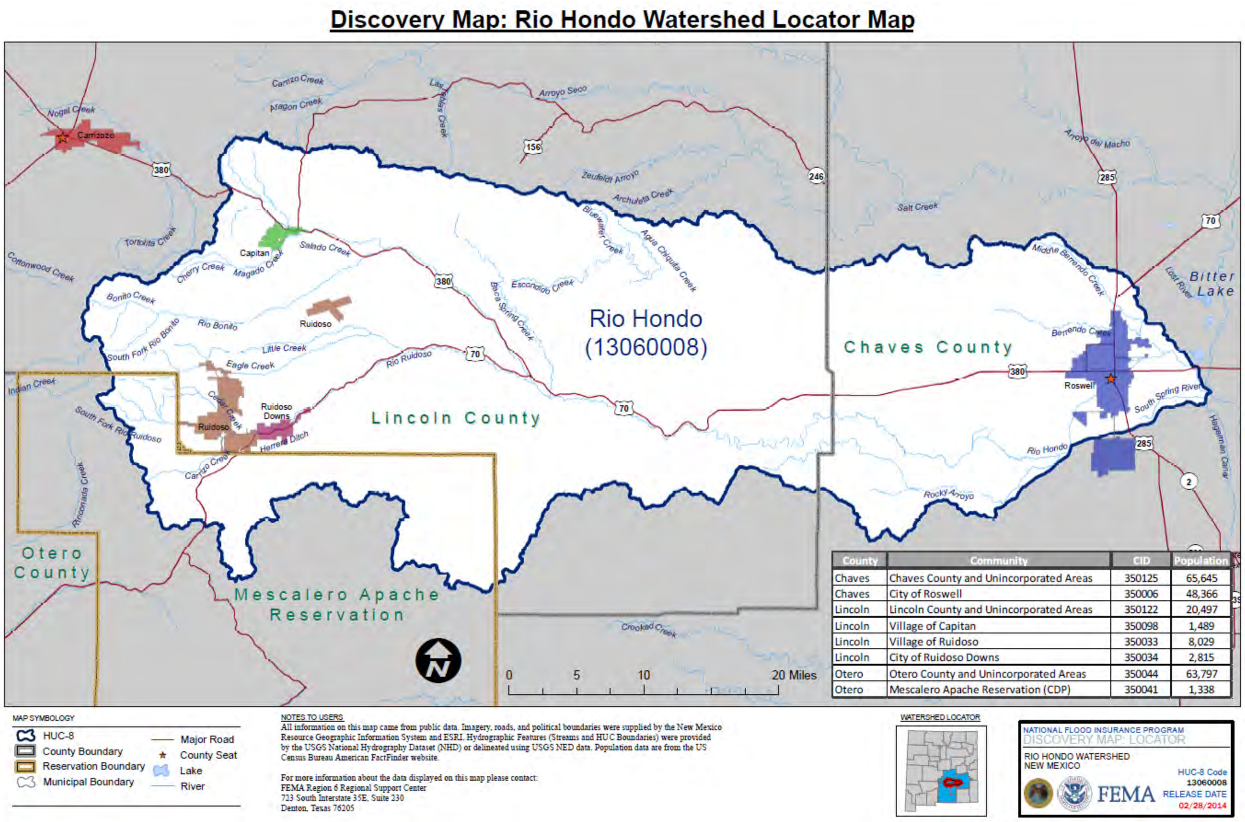
Figure 6-24 Acequias in Preparedness Area 1



Case Study: Rio Hondo Watershed Discovery

The Rio Hondo watershed (see Figure 6-25) was selected to participate in FEMA's Discovery process. The ultimate goal of this process is for FEMA to closely coordinate with communities to better understand local flood risk, mitigation efforts, and to spark watershed-wide discussions about increasing resilience to flooding. The Discovery process of FEMA's Risk MAP program helps communities identify areas at risk for flooding and solutions for reducing that risk. As part of the Discovery process a Base Level Engineering analysis was conducted for the watershed.

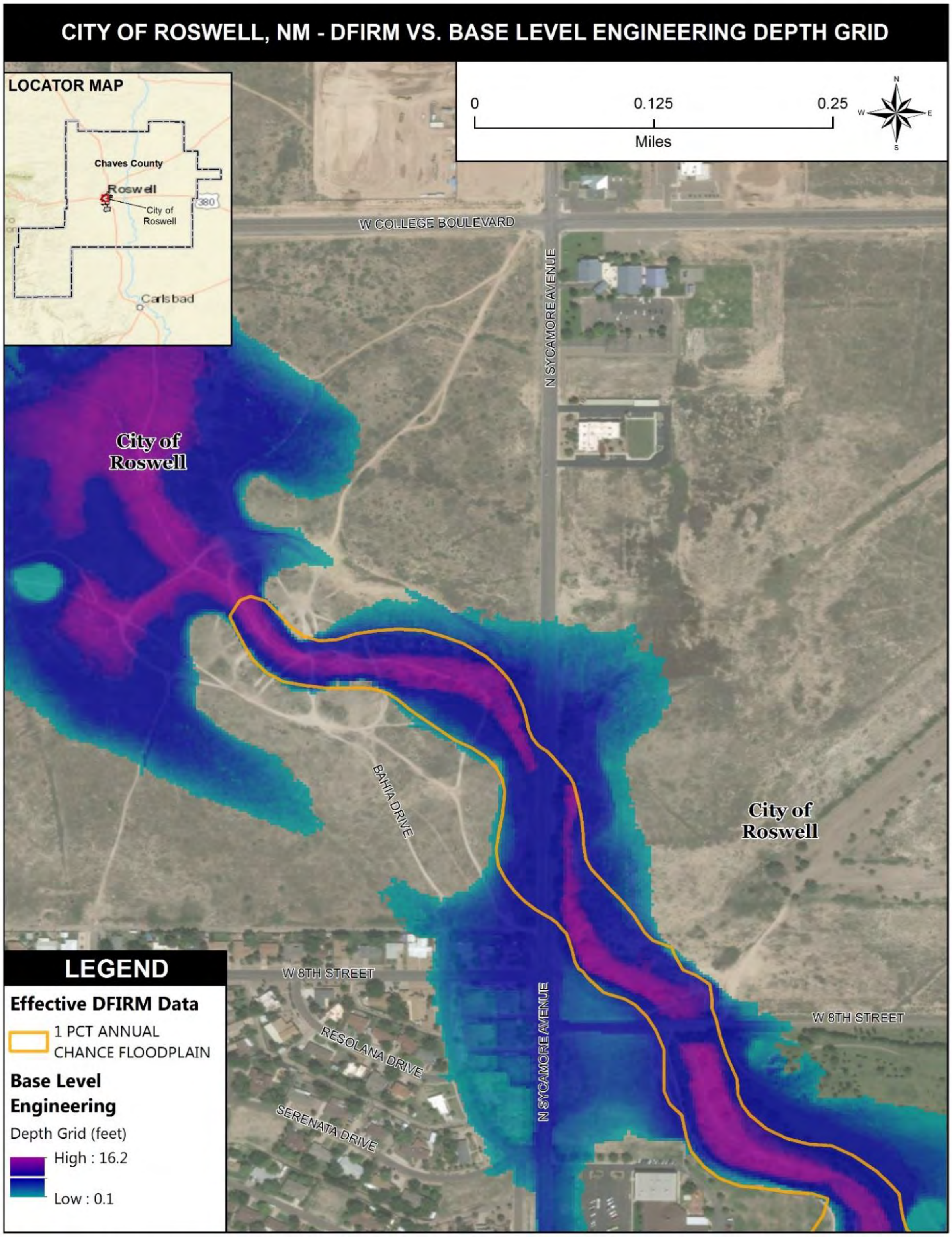
Figure 6-25 Rio Hondo Watershed



County	Community	CID	Population
Chaves	Chaves County and Unincorporated Areas	350125	65,645
Chaves	City of Roswell	350006	48,366
Lincoln	Lincoln County and Unincorporated Areas	350122	20,497
Lincoln	Village of Capitan	350098	1,489
Lincoln	Village of Ruidoso	350033	8,029
Lincoln	City of Ruidoso Downs	350034	2,815
Otero	Otero County and Unincorporated Areas	350044	63,797
Otero	Mescalero Apache Reservation (CDP)	350041	1,338

As part of that process, Base Level Engineering (BLE) was conducted for the watershed which resulted in the creation of flooding depth grids. These depth grids and associated BLE floodplain boundaries can serve as a useful tool for local communities in areas where detailed floodplain maps do not exist (for example, those areas that have approximate floodplains [Zone A] or no mapped floodplains). The following Figure 6-26 presents a snapshot of the BLE depth grid as compared to the current regulatory Zone A approximate floodplain (shown in orange) for an area within the City of Roswell, located in Chaves County. A community can use this BLE information as 'best available data' for permitting and planning. Regulating to the BLE depths can be required if the community enacts regulations adopting the BLE data for use in local permitting and regulation. This demonstrates the potential value that BLE data can provide to communities, when detailed floodplain mapping is not available.

Figure 6-26 BLE and DFIRM Floodplains

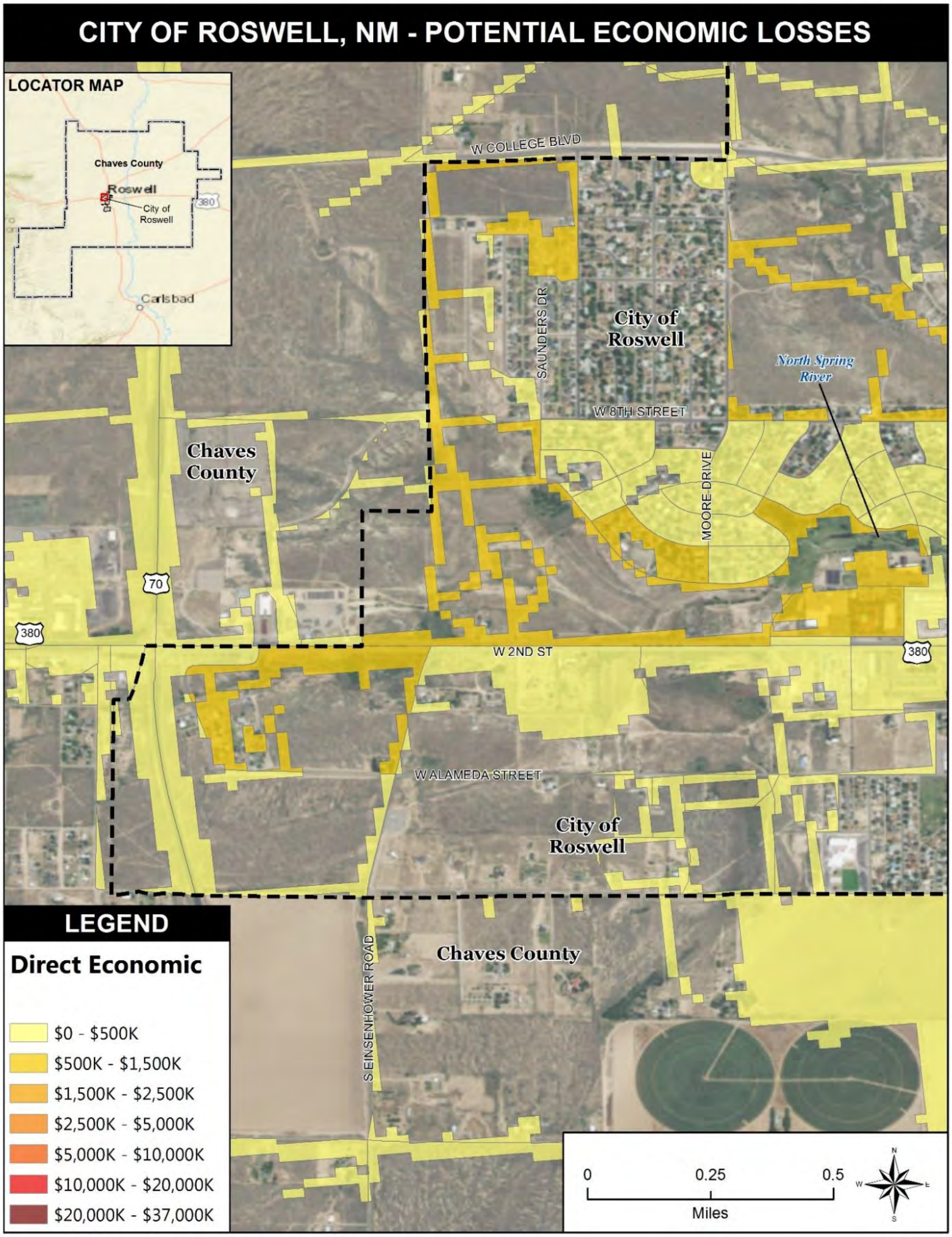


It should be noted that BLE depth grids and associated floodplains are non-regulatory mapping products. Their main intent is to assist communities in understanding, planning for, and addressing flooding issues in areas where no existing regulatory floodplains exist. While BLE content can be useful, it is known that the underlying floodplain modeling does not take into account structures, culverts, channels, bridges, and other associated flood mitigation infrastructure. Where no Federal regulatory floodplains exist, communities can adopt local regulations relating to BLE mapping to help with floodplain management.

The BLE depth grid is also a useful input into FEMA's Hazus flood loss estimation software. Recently, FEMA Region VI and the State's Cooperating Technical Partner (CTP), Earth Data Analysis Center, conducted Hazus flood analysis for Chaves County and its communities. The flooding depth grid input into the software was the BLE depth grid that was created through the FEMA Discovery process.

The following Figure 6-27 present a snapshot of one of the main Hazus flood event loss estimation outputs, Direct Economic Losses, on a census block level. This estimation was for a flood event mirroring the BLE flooding depth grids in a neighborhood that previously was not fully mapped by FEMA. Other potentially useful outputs from Hazus include essential facilities and the estimated damages that they would experience during modeled flood events. For example, light yellow show areas that are anticipated to received up to $500,000 of economic losses in the 1% annual chance flood event while dark yellow areas are anticipated to receive between $500,000 and $1,500,000 of economic losses in the 1% annual chance flood event.

Figure 6-27 BLE Depth Grid Expected Flooding Losses



Landslide and Rockfall - Preparedness Area 1

Within Preparedness Area 1 there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Susceptibility is commonly associated with mesa flanks in Preparedness Area 1, However, steep slopes associated with mountains are correlated with likely susceptibility in Preparedness Area 1 in the Guadalupe and Capitan Mountains. Lea, Roosevelt and Curry counties possess unlikely susceptibilities for landslide and rockfall hazard. The remaining counties in Preparedness Area 1 (Chaves, DeBaca, Eddy, Guadalupe, Lincoln, Quay) have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 1

In Preparedness Area 1, there are limited regions mapped with high to extreme collapsible soil susceptibility. These regions are limited to eolian sediments, young alluvial fan and river deposits. The highly to extremely susceptible areas in eolian sediments occur in a north-south band east of the Pecos River in Chaves, Eddy, Lea and Roosevelt counties. Much of Quay and Guadalupe Counties have highly to extremely susceptible soils in clay-rich badland areas, and in regions neighboring the Pecos and Canadian Rivers. A trend of highly to extremely susceptible collapsible soils continues along the Pecos River south through De Baca, Chaves and Eddy counties, with tributary catchments sometimes also having high likelihoods. Lincoln County has highly to extremely hydrocompaction susceptible soils on the medial and distal portions of alluvial fans coming off the Capitan Mountains, Oscura Mountains and other solitary peaks.

Severe Winter Storms – Preparedness Area 1

The entire State of New Mexico is susceptible to severe winter storms. One of the primary concerns with winter storm events is that severe storms often knock out heat, power and communications services to homes and offices, sometimes for days at a time. For this reason, heavy snowfall and extreme cold have the potential to immobilize entire Preparedness Areas for extended periods of time.

Although the mountainous areas of the State are more likely to face heavy snow and extreme cold temperatures, residents living in the plains and desert are often unaccustomed to winter weather and are less likely to be prepared for a surprise winter event. Major population centers are most at risk to the impacts of severe winter weather and most of these communities are not located in the mountains. Highly vulnerable populations include people who live in mobile home parks, recreational vehicles, and aged or inadequately weatherized buildings. Moreover, the impacts associated with severe winter storms and freezes can affect wide areas of agricultural land and livestock habitat depending on the time of year when it occurs. Future expected losses are expected to remain consistent to historical event losses.

Wildfire – Preparedness Area 1

Preparedness Area 1 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought conditions, and high fuel loads due to pine beetle kill. However, vegetation treatments have been ongoing and are planned to continue to mitigate the high fuel loads in Preparedness Area 1. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-28 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 1. A total of 1,880,799 acres of vegetation have been treated and an additional 1,002,482 are planned for treatment, totaling 2,883,281 acres of treated vegetation. This equates to approximately 14% of Preparedness Area 1's total land area. Figure 6-29 shows the breakdown of planned, completed, and historic treatments. Treatment on private land show the most acres of historic treatments, while the BLM completed the most acres of treatment since 1996 and will complete the majority of acres of planned treatments. Figure 6-30 shows the percent of total acres treated by land ownership. Overall, the BLM will treat the most acres of vegetation.

Figure 6-28 Preparedness Area 1 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	**Land Owner**	**Acres**	**Percent**
1,002,482 (5.0% of PA 1 land area)	BLM	992,162	98.97%
	Private	396	0.04%
	Private, Municipal	28	0.00%
	State	80	0.01%
	Tribal: Mescalero Apache	508	0.05%
	USFS	9,290	0.93%
	Village of Ruidoso	18	0.00%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
1,600,891 (7.9% of PA 1 land area)	BLM	927,929	57.96%
	BLM, Private	7,318	0.46%
	BOR	4,090	0.26%
	DOE	6,916	0.43%
	Municipal	107	0.01%
	NM Game and Fish	946	0.06%
	Private	310,577	19.40%
	State	165,850	10.36%
	State Park	130	0.01%
	Tribal: Mescalero Apache	395	0.02%
	USFS	176,632	11.03%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
279,908 (1.4% of PA 1 land area)	BLM	118,000	42.16%
	Private	191,147	68.29%
	State	31,071	11.10%
	USFS	45,890	16.39%

Figure 6-29 Preparedness Area 1 Total Acres of Vegetation Treatment

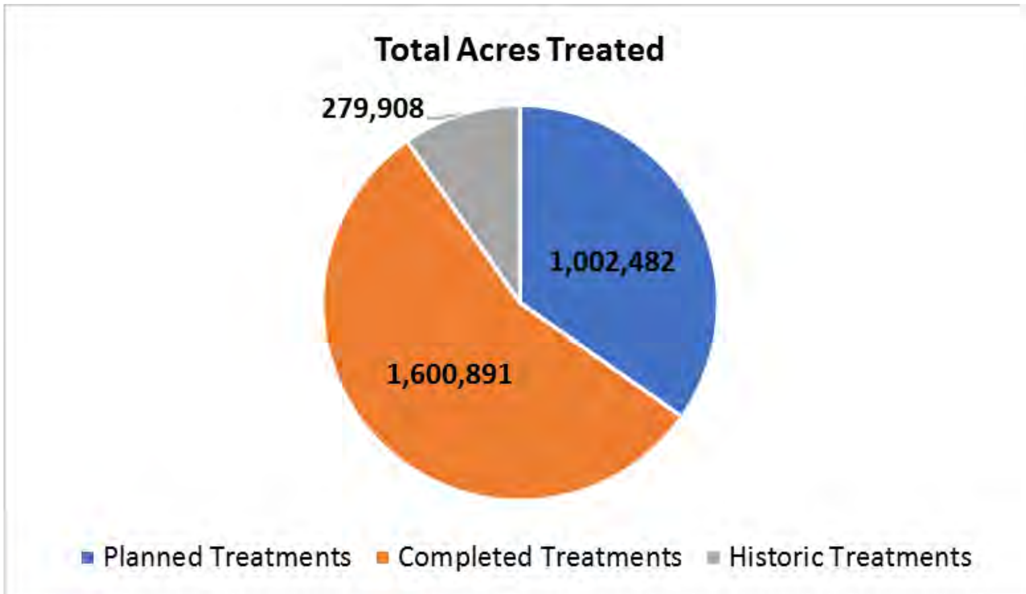
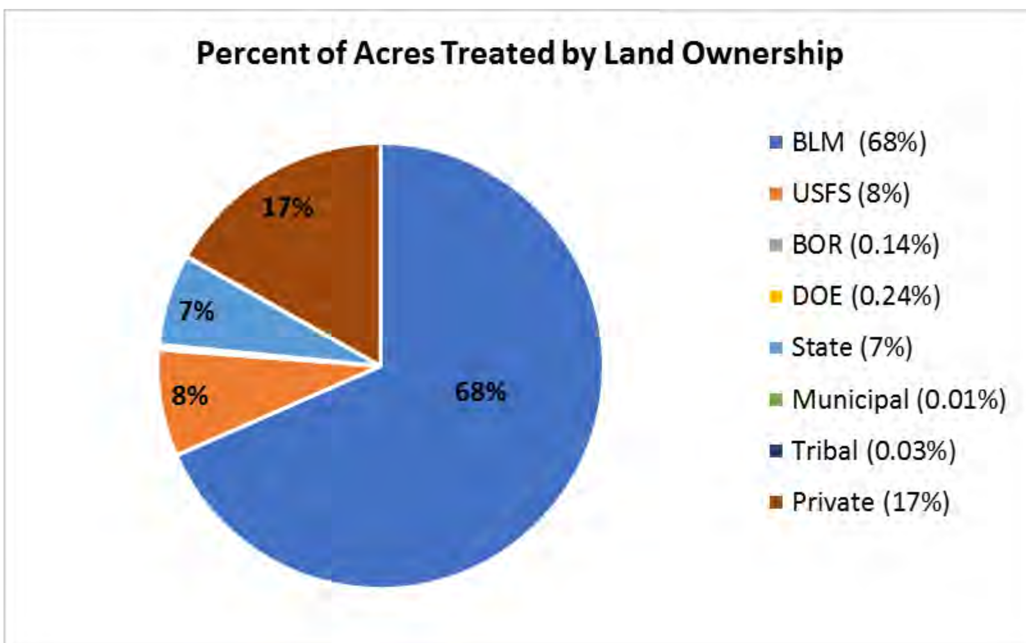


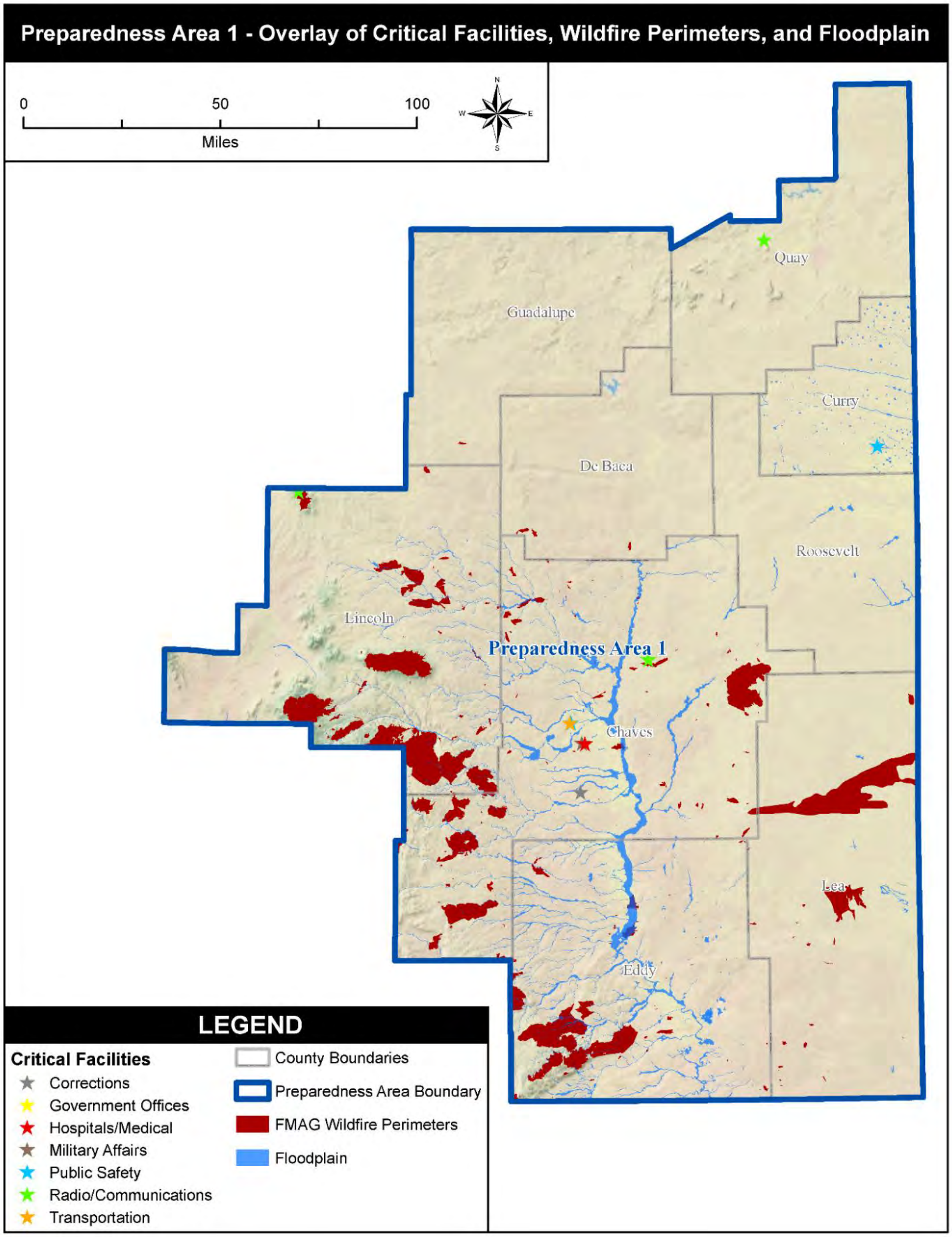
Figure 6-30 Preparedness Area 1 Percent of Total Acres Treated by Land Ownership



Summary – Preparedness Area 1

The following Figure 6-31 presents an overview of the best available mapping data for Preparedness Area 1. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 1 has experienced several past wildfires, and areas in the central and southern portions of the Preparedness Area are within the floodplain. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, with Preparedness Area 1 experiencing population growth, it is important to continue to reduce its vulnerabilities to natural hazards.

Figure 6-31 Preparedness Area 1 Risk and Vulnerability Summary



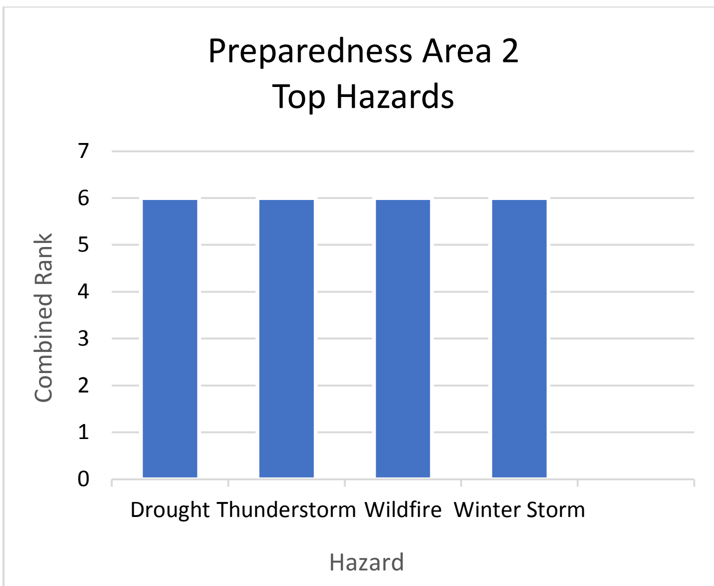
6.6 Vulnerability Assessment – Preparedness Area 2

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 2. Local jurisdictions within the Preparedness Area identified the following four hazards as equally being top priority planning concerns:

- Drought
- Severe Winter Storm
- Thunderstorm
- Wildfire

Figure 6-29 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]). Preparedness Area 2's local hazard mitigation plans collectively rated drought, thunderstorm, wildfire, and winter storms as equally top hazards that their communities are currently facing.

Figure 6-32 Preparedness Area 2 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquake, floods/flash floods, landslides, or land subsidence were not identified as primary hazard concerns for the region, vulnerability analysis is included for those hazards as that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Additionally, although not profiled in this Plan, Preparedness Area 2 local mitigation plans profiled hazardous materials (HAZMAT) as a top planning priority. The State Plan focuses on natural hazards exclusively.

Exposure – Preparedness Area 2

Preparedness Area 2 has a total population of 53,268 people and there are over 22,000 households in the Area. Additionally, there are an estimated 31,000 buildings in Preparedness Area 2. Approximately 95% of the buildings and 83% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 2, wood frame construction makes up 52% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are eight State critical facilities located with Preparedness Area 2. This includes the following facility types: corrections (1), hospitals/medical (2), military affairs (1), public safety (1), radio/communications (2), and transportation (1).

The transportation and utility lifeline inventory within Preparedness Area 2 includes over 1,184 miles of highways, 304 bridges, and 2,675 miles of pipes.

Changes in Development – Preparedness Area 2

The following Figure 6-33 presents population counts and projections for those counties included in Preparedness Area 2. Overall the area has experienced a decline in population across all counties.

Figure 6-33 Preparedness Area 2 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Colfax County	13,750	12,253	-10.89%
Harding County	695	665	-4.32%
Mora County	4,881	4,504	-7.72%
San Miguel County	29,393	27,760	-5.56%
Union County	4,549	4,183	-8.05%
Preparedness Area 2	**53,268**	**49,365**	**-7.33%**

Although Preparedness Area 2 has experienced a decline in population, a large amount of the building stock is made up of more vacation homes than most other parts of the state. Larger than average numbers of unoccupied structures require management to mitigate and respond to hazards.

Critical Facilities – Preparedness Area 2

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought, thunderstorm, or severe winter storm events. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, do not expect any critical facilities suffer at least moderate damage. There are no State critical facilities currently mapped as being in the floodplain. All critical facilities in Preparedness Area 2 are in areas with very low or low wildfire hazard potential, as described in Figure 6-34 and Figure 6-35. Two critical facilities, including one public safety facility and one hospital/medical facility, are located in the WUI as described in Figure 6-36 and Figure 6-37.

Figure 6-34 Preparedness Area 2 Critical Facilities and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
Department of Homeland Security and Emergency Management Emergency Operations Center	Public Safety	Very Low
SANTA FE AASF	Military Affairs	Very Low
New Mexico State Police - District 1 - Santa Fe (Main)	Public Safety	Very Low
Sierra Grande Mountain	Radio/ Communications	Very Low
Miners Colfax Medical Center	Hospitals/Medical	Very Low
New Mexico State Veterans Home	Hospitals/Medical	Low
Davenport Peak	Radio/ Communications	Low
Eureka Mesa	Radio/ Communications	Low

Figure 6-35 Preparedness Area 2 Critical Facilities Wildfire Hazard Potential

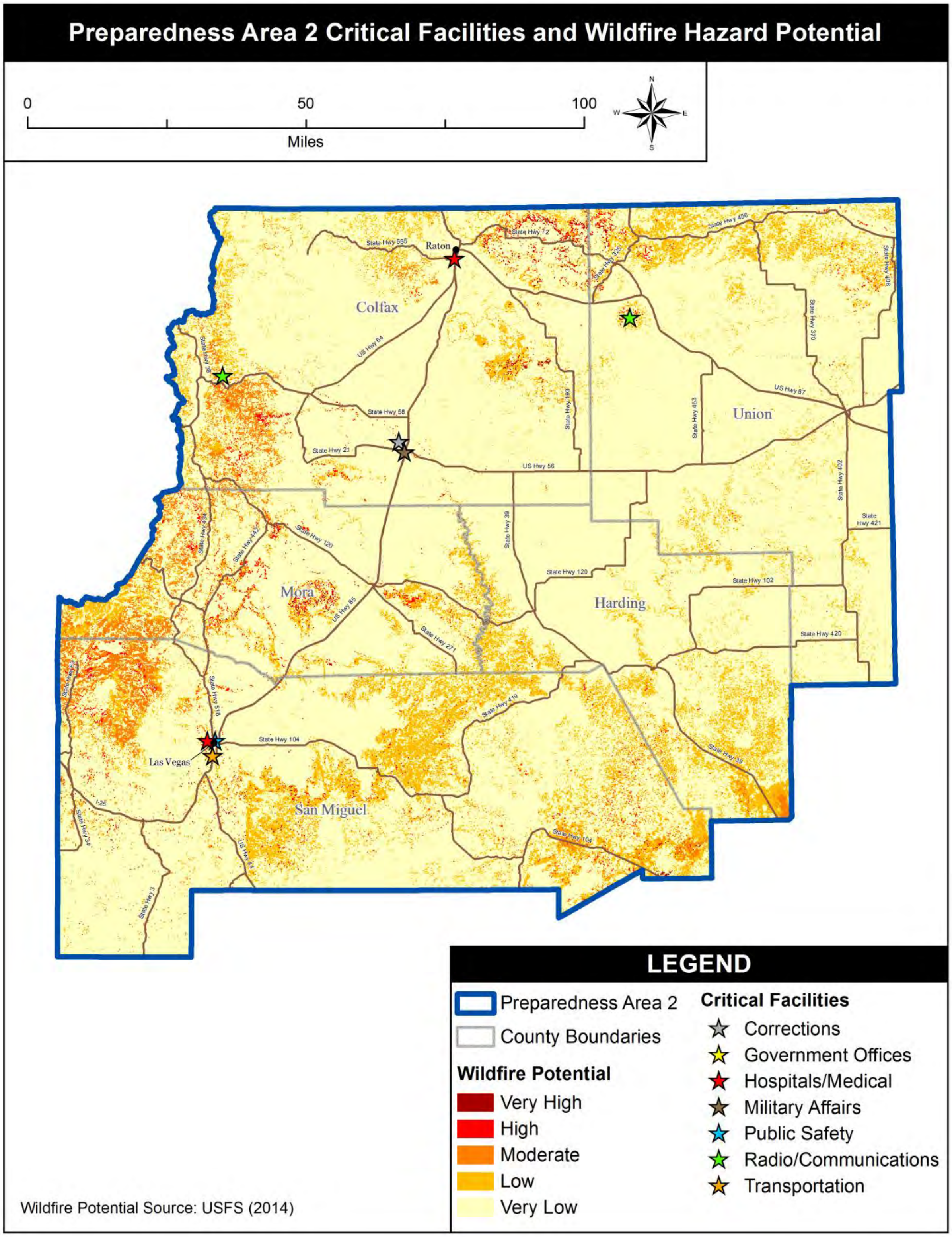
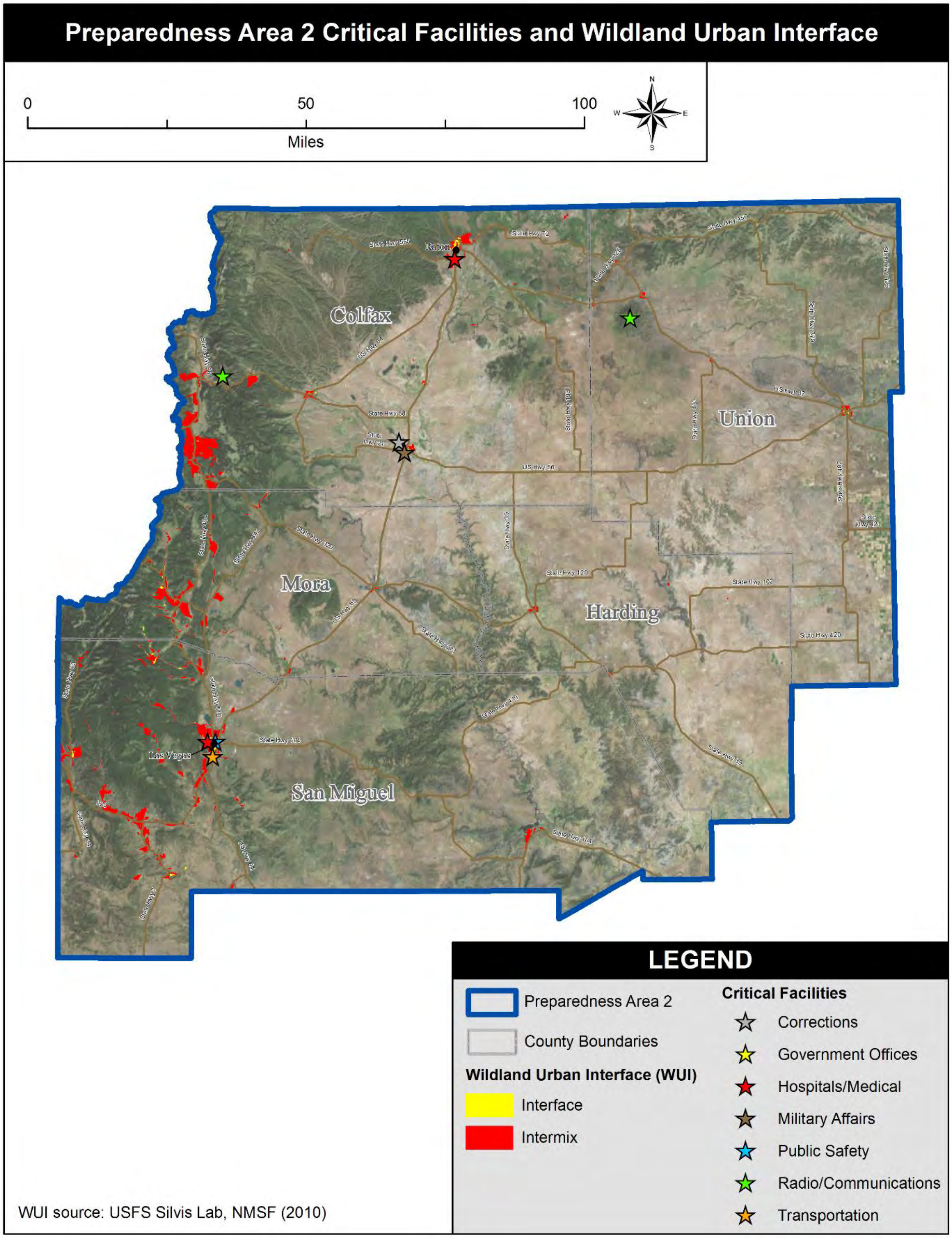


Figure 6-36 Preparedness Area 2 Critical Facilities Located in the WUI, 2010

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	2010 Wildland Urban Interface
New Mexico State Police - District 2 - Las Vegas (Main)	Public Safety	Medium Density Interface
Miners Colfax Medical Center	Hospitals/Medical	Low Density Intermix

Figure 6-37 Preparedness Area 2 Critical Facilities and WUI



Drought– Preparedness Area 2

Drought, thunderstorm, wildfire, and winter storms were all ranked equally as top hazards in Preparedness Area 2. Preparedness Area 2 is one of the most vulnerable Preparedness Areas to drought. This area reported drought conditions from 2003 to 2014. As drought conditions persist (coupled with the extreme heat events the region is susceptible to) wildfire risk also increases. In populated areas that are already struggling with limited water resources, fighting fires becomes more difficult. Additionally, in rural communities resources to fight wildfires may be limited. As a result, the vulnerability of people and structures within the region increase significantly. Wood frame construction makes up 52% of the Preparedness Area's building inventory, elevating vulnerability even further as well as the risk of catastrophic losses of life and property. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event. Additionally, reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems.

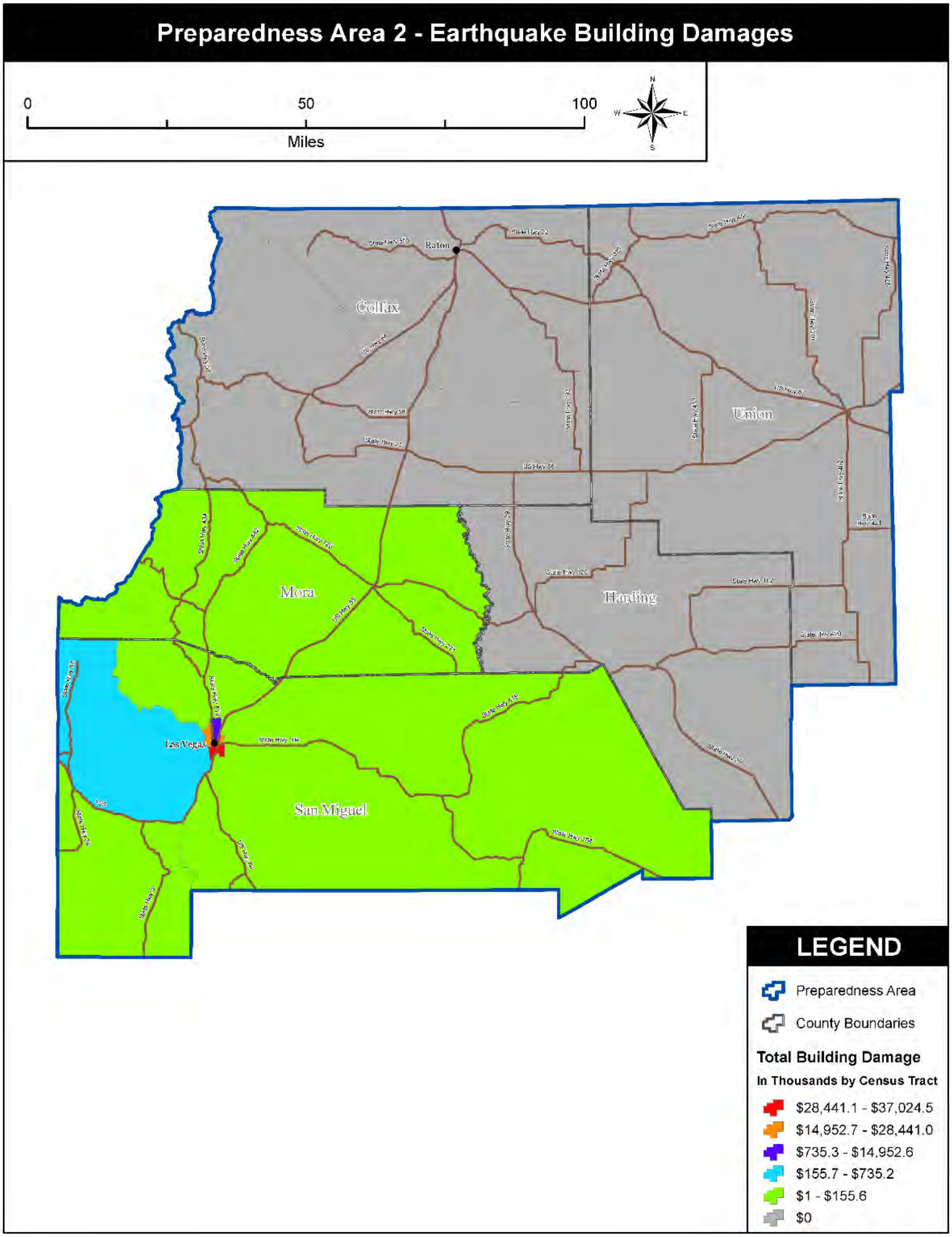
Earthquake – Preparedness Area 2

The following Figure 6-38 presents the expected building-related economic loss estimates for a probable maximum earthquake event modeled in Preparedness Area 2. The total building-related losses were $177.27 million; 23% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 63% of the total loss. As shown in Figure 6-39, the southwest portion of the Preparedness Area would experience the most in building damages as a result of the modeled earthquake.

Figure 6-38 Hazus Earthquake Building-Related Loss Estimates (PA 2)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$1.09 M	$6.71 M	$0.05 M	$0.74 M	$8.58 M
Capital-Related	$0.00 M	$0.47 M	$5.61 M	$0.03 M	$0.09 M	$6.19 M
Rental	$2.24 M	$3.08 M	$2.89 M	$0.01 M	$0.31 M	$8.54 M
Relocation	$7.87 M	$3.69 M	$4.62 M	$0.12 M	$1.82 M	$18.11 M
Income Losses (subtotal)	***$10.10 M***	***$8.32 M***	***$19.83 M***	***$0.20 M***	***$2.97 M***	***$41.42 M***
Structural	$9.61 M	$7.55 M	$6.56 M	$0.27 M	$1.68 M	$25.68 M
Non-Structural	$32.25 M	$26.21 M	$16.40 M	$0.80 M	$4.79 M	$80.45 M
Content	$11.65 M	$6.07 M	$8.66 M	$0.45 M	$2.52 M	$29.34 M
Inventory	$0.00 M	$0.00 M	$0.28M	$0.09 M	$0.01 M	$0.37 M
Capital Stock Losses (subtotal)	***$53.51 M***	***$39.82 M***	***$31.91 M***	***$1.61 M***	***$9.00 M***	***$135.85 M***
Total Estimated Losses	**$63.62 M**	**$48.14 M**	**$51.73 M**	**$1.81 M**	**$11.96 M**	**$177.27 M**

Figure 6-39 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA 2)



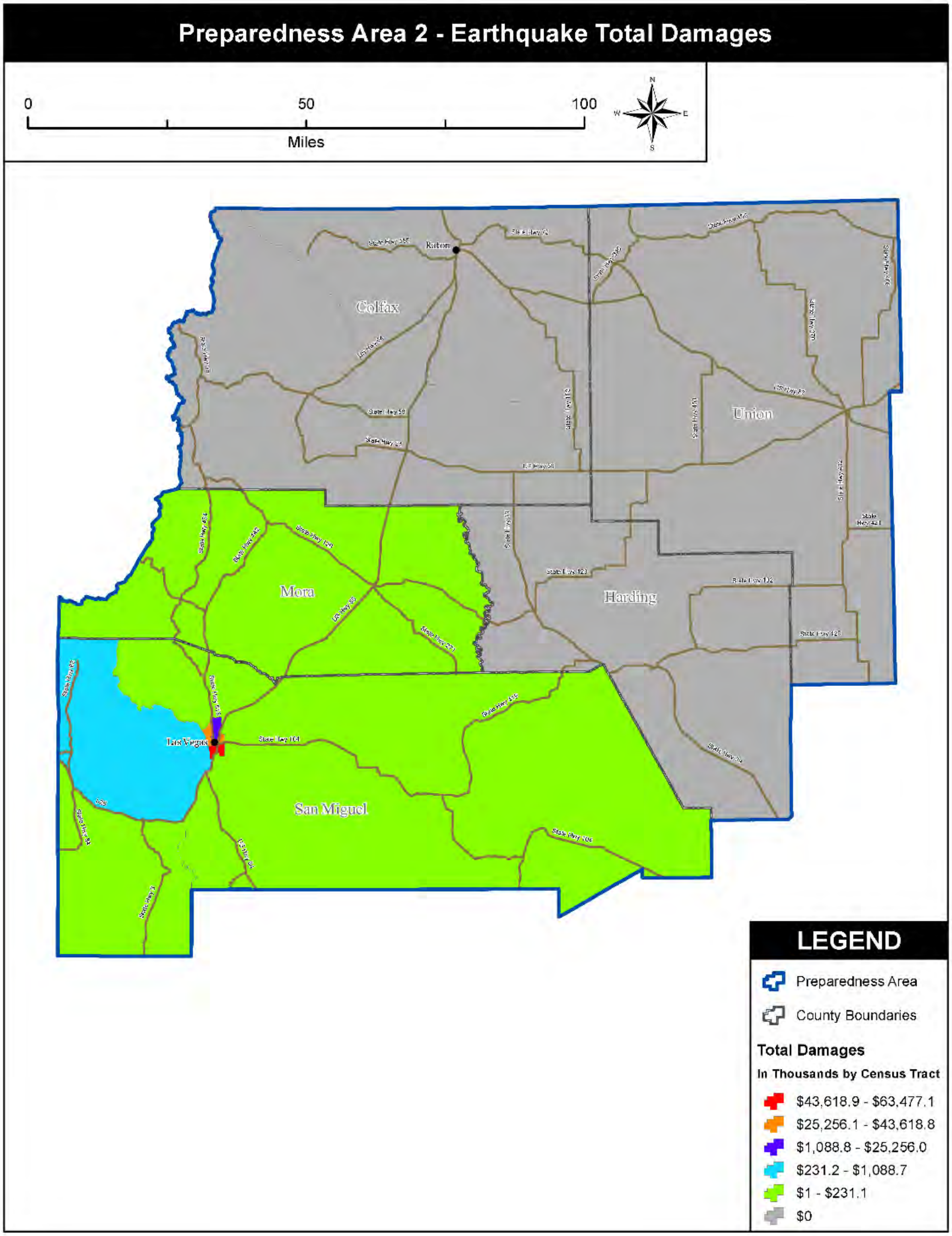
The following Figure 6-40 presents additional modeled impacts from this same event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-40 Hazus Earthquake Impacts and Loss Estimates (PA 2)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 2,044
	Moderate: 1,743
	Extensive: 829
	Complete: 174
Total Economic Losses (includes building and lifeline losses)	$182 million
Damage to Schools	0 with at least moderate damage
Damage to Medical Facilities	0 with at least moderate damage
Damage to Fire Stations	0 with at least moderate damage
Damage to Transportation Systems	0 highway bridges, at least moderate damage
	0 highway bridges, complete damage
	0 railroad bridges, moderate damage
	0 airport facilities, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	175
Shelter Requirements	148 people out of 53,268 total population
Debris Generation	0.08 million tons

Figure 6-41 shows total damages resulting from the modeled earthquake in Preparedness Area 2 by census tract. Similar to building damages, the southwest portion of the Preparedness Area would experience the most in total damages due to the modeled earthquake.

Figure 6-41 Total Earthquake Damages by Census Tract (PA 2)



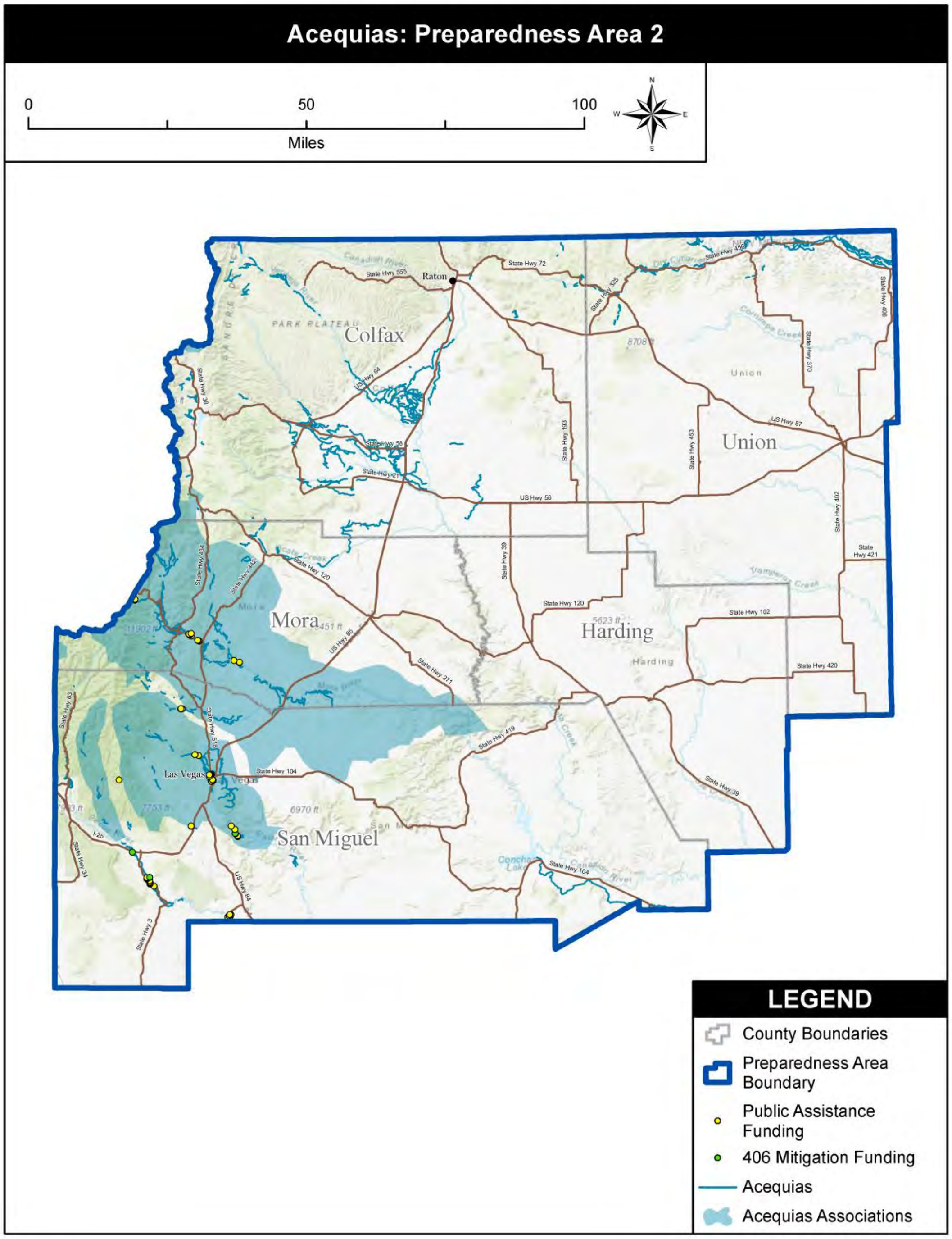
Floods/Flash Floods – Preparedness Area 2

Under the right conditions, virtually every Preparedness Area in the State of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including debris flow and mudslides. Monsoon season usually begins in June and can last through mid-September.

The map below shows locations of acequias in Preparedness Area 2. Preparedness Area 2 has acequias scattered throughout the western and northern region of the Preparedness Area (Figure 6-42). The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 2, there are an estimated 1,038 miles of acequia infrastructure identified from existing datasets. There are four known Acequia Associations in the region, as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 455 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 95 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within Preparedness Area 2 (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

Figure 6-42 Acequias in Preparedness Area 2



Landslide and Rockfall – Preparedness Area 2

Within Preparedness Area 2, there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Susceptibility is commonly associated with mesa flanks in Preparedness Area 2. However, steep slopes associated with mountains are correlated with likely susceptibility in Preparedness Area 2 in the eastern Sangre de Cristo Mountains. Somewhat higher susceptibilities could be expected locally in Union County. The remaining counties in Preparedness Area 2 (Colfax, Harding, Mora, San Miguel) have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 2

Preparedness Area 2 has high susceptibilities through much of its central and southern portions, with scattered extreme susceptibilities throughout. The high susceptibilities are commonly associated with fine-grained alluvial fan deposits to the east of the Sangre de Cristo Mountains and below other ridge lines and local peaks; this is the case in Colfax, Mora, Harding and San Miguel Counties. Other high and most of the extreme susceptibilities in these counties are associated with streams and creeks, likely from local incision and deposition of clay-rich sediments. In Union County, the relative restricted regions of high to extreme susceptibilities are associated with streams and rivers.

Severe Winter Storm – Preparedness Area 2

The entire State of New Mexico is susceptible to severe winter storms. However, Preparedness Area 2 experiences a relatively high number of days of snowfall every year compared to the rest of the State. One of the primary concerns with winter storm events is that severe storms often knock out heat, power and communications services to homes and offices, sometimes for days at a time. For this reason, heavy snowfall and extreme cold have the potential to immobilize entire Preparedness Areas for extended periods of time.

Although the mountainous areas of the State are more likely to face heavy snow and extreme cold temperatures, residents living in the plains and desert are often unaccustomed to winter weather and are less likely to be prepared for a surprise winter event. Major population centers (San Miguel County, for example) are most at risk to the impacts of severe winter weather and most of these communities are not located in the mountains. Highly vulnerable populations include people who live in mobile home parks, recreational vehicles, and aged or inadequately weatherized buildings. Moreover, the impacts associated with severe winter storms and freezes can affect wide areas of agricultural land and livestock habitat depending on the time of year when it occurs. Future expected losses are expected to remain consistent to historical event losses.

Thunderstorm – Preparedness Area 2

All areas of the State have thunderstorms. According to the National Weather Service (NWS), the thunderstorm season in New Mexico begins over the high plains in the eastern part of the State in mid- to late April, peaks in May and June, declines in July and August, and then drops sharply in September and October. Over the central mountain chain, thunderstorms occur almost daily during July and August, especially over the northwest and north central mountains. Thunderstorms and associated hail and lightning can cause damages such as building damage, utility disruption, and lightning-caused wildfire, as well as injury and death.

In Preparedness Area 2, there have been a few thunderstorms of notable concern. In June 2013, a thunderstorm produced hail with an intensity of H5 in addition to lightning. Additionally, in 2013, a lightning event caused a wildfire and utility disruption. Future expected losses are expected to remain consistent to historical event losses.

Wildfire – Preparedness Area 2

Preparedness Area 2 is highly vulnerable to wildfire due to multiple factors including prolonged drought conditions and high fuel loads due to pine beetle kill. However, vegetation treatments have been ongoing and are planned to continue to mitigate the high fuel loads in Preparedness Area 2. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan Update. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-43 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 2. A total of 165,569 acres of vegetation have been treated and an additional 12,355 are planned for treatment, totaling 177,924 acres of treated vegetation This equates to approximately 2% of Preparedness Area 2's total land area. Figure 6-44 shows the breakdown of planned, completed, and historic treatments. The USFS conducted the most acres of historic and completed treatments, while the State and private land owners will complete the majority of acres of planned treatments. Figure 6-45 shows the percent of total acres treated by land ownership. Overall, the USFS will treat the most acres of vegetation.

Figure 6-43 Preparedness Area 2 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	**Land Owner**	**Acres**	**Percent**
12,355 (0.1% of PA 2 land area)	BLM	10	0.08%
	Land Grant	20	0.17%
	Other	240	1.94%
	State	6,189	50.09%
	State, Private	5,310	42.98%
	USFS	586	4.74%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
141,282 (1.3% of PA 2 land area)	Bureau of Reclamation	82	0.06%
	DOD	35	0.02%
	Municipal	49	0.03%
	NM Game and Fish	806	0.57%
	Private	12,043	8.52%
	State	4,749	3.36%
	USFS	123,518	87.43%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
24,287	BLM	338	1.39%

(0.2% of PA 2 land area)	Private	3,071	12.65%
	USFS	20,877	85.96%

Figure 6-44 Preparedness Area 2 Total Acres of Vegetation Treatment

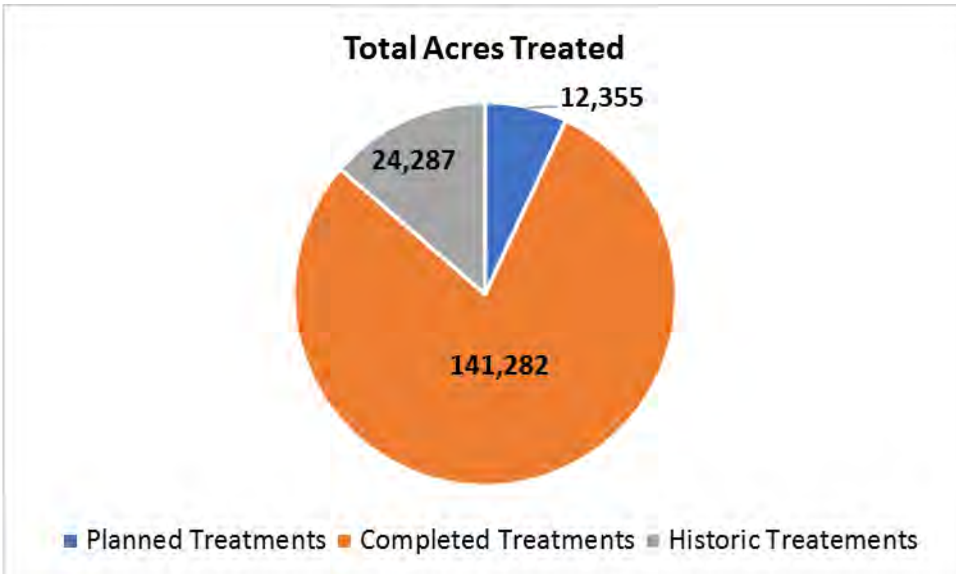
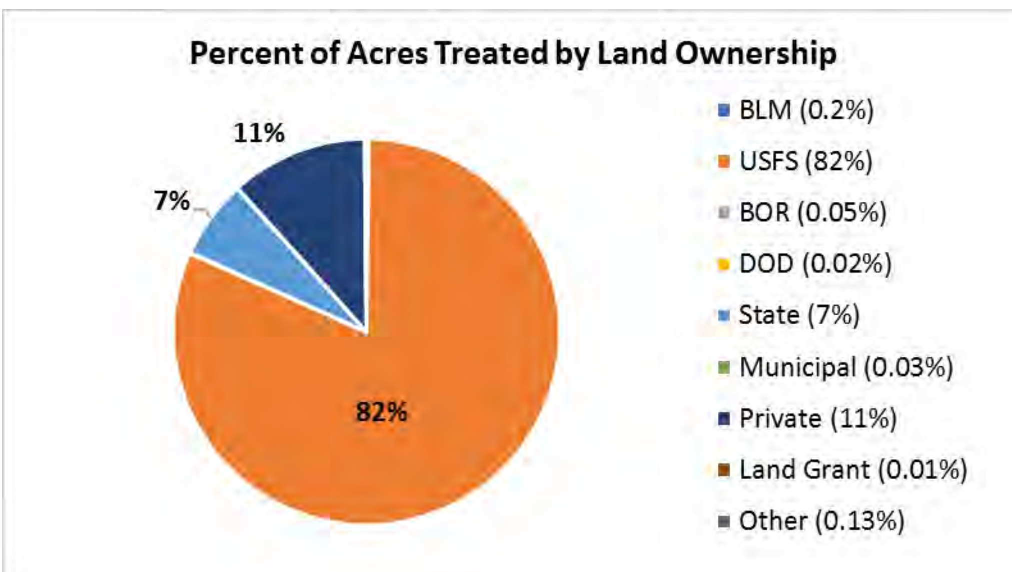


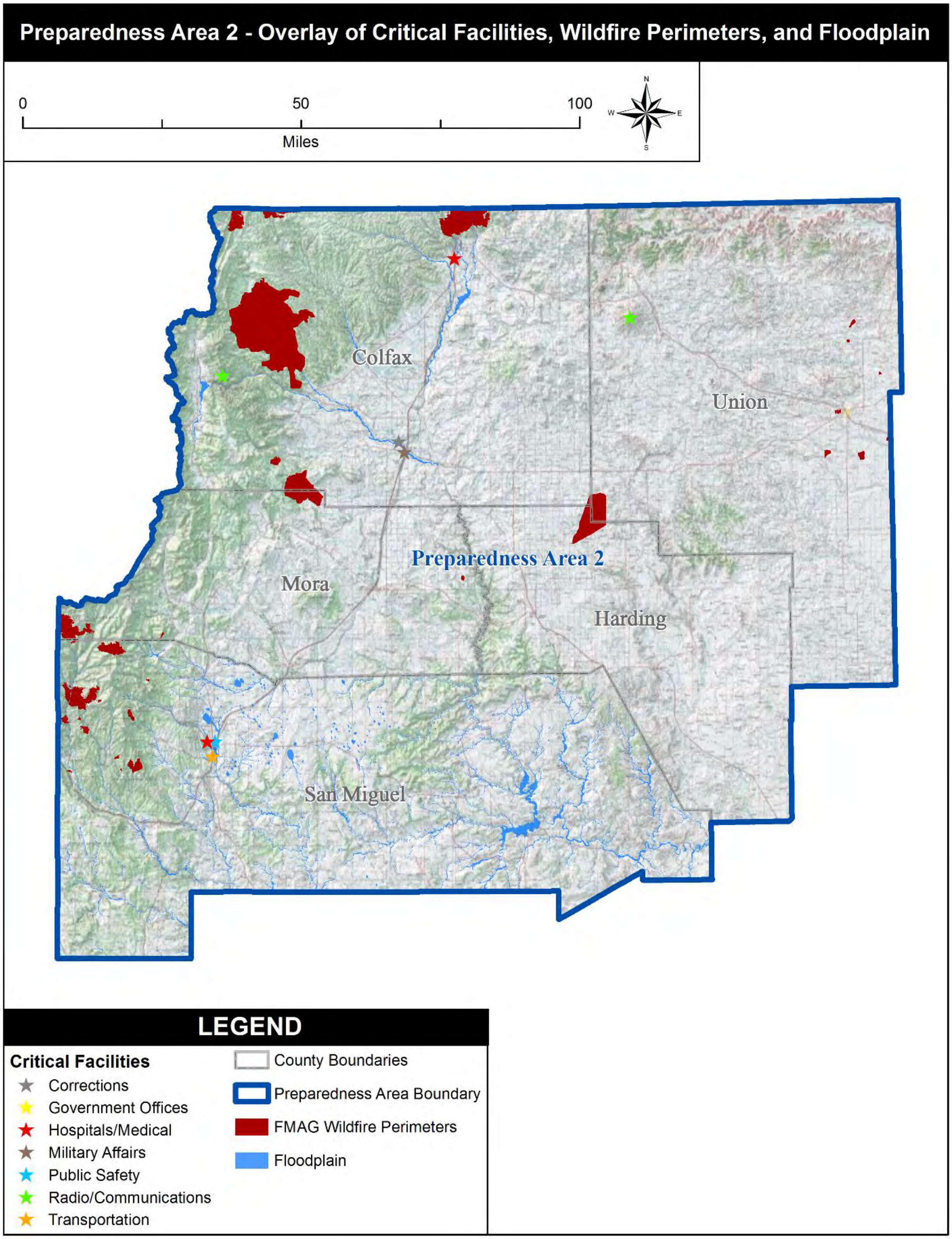
Figure 6-45 Preparedness Area 2 Percent of Total Acres Treated by Land Ownership



Summary – Preparedness Area 2

The following Figure 6-46 presents an overview of the best available mapping data for Preparedness Area 2. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 2 has experienced several past wildfires, and contains area within the floodplain. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, it is important to continue to reduce Preparedness Area 2's vulnerabilities to natural hazards.

Figure 6-46 Preparedness Area 2 Risk and Vulnerability Summary



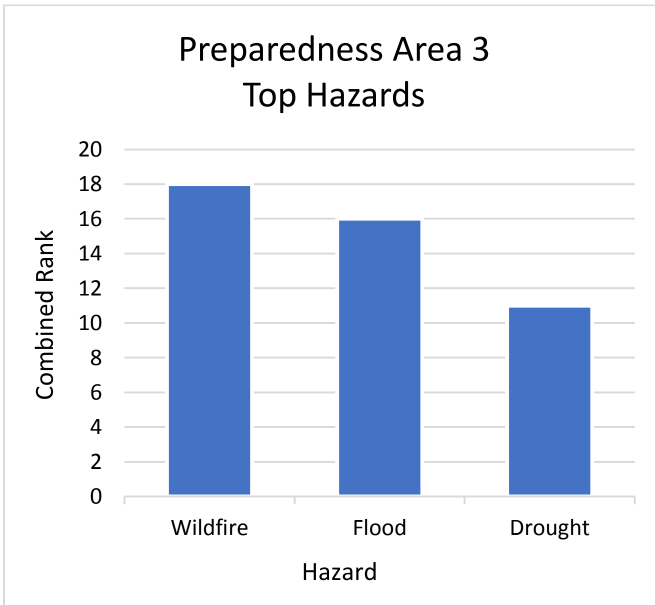
6.7 Vulnerability Assessment – Preparedness Area 3

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 3. Local jurisdictions within the Preparedness Area identified the following three hazards as being top priority planning concerns:

- Wildfire
- Flood/Flash Floods
- Drought

Figure 6-47 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]).

Figure 6-47 Preparedness Area 3 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquakes, landslide, or land subsidence were not identified as primary hazard concern for the region, vulnerability analysis is included for earthquakes as that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Exposure – Preparedness Area 3

Preparedness Area 3 has a total population of 235,303 people and there are over 100,000 households in the Area. Additionally, there are an estimated 113,000 buildings in Preparedness Area 3. Approximately 94% of the buildings and 82% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 3, wood frame construction makes up 57% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are 20 State critical facilities located with Preparedness Area 3. This includes the following facility types: corrections (1), government offices (5), hospitals/medical (3), military affairs (2), public safety (4), radio/communications (3), and transportation (2).

The transportation and utility lifeline inventory within Preparedness Area 3 includes over 1,064 miles of highways, 247 bridges, and 12,794 miles of pipes.

Changes in Development – Preparedness Area 3

The following Figure 6-48 presents population counts and projections for those counties included in Preparedness Area 3. Overall the area has seen gradual growth, and only one county has experienced a decline in population. Mitigation efforts in Preparedness Area 3 should focus on these particular growth areas, as encouraging development outside of hazard areas is one of the most effective tools to help reduce risk and vulnerability.

Figure 6-48 Preparedness Area 3 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Los Alamos County	17,950	18,147	1.10%
Rio Arriba County	40,246	40,040	-0.51%
Santa Fe County	144,170	148,651	3.11%
Taos County	32,937	33,065	0.39%
Preparedness Area 3	**235,303**	**239,903**	**1.95%**

A number of counties in Preparedness Area 3 are experiencing increases in population, especially in areas located in or near wildland-urban interface. In recent years wildland fires have been of major concern due to ongoing drought conditions. Additionally, increased development and population growth is leading to increased stress put on water resources. This leads to higher wildfire and drought vulnerability and risk across the region.

Critical Facilities – Preparedness Area 3

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, include the following counts expected to suffer at least moderate damage: hospitals (2), schools (15), EOCs (2), police stations (4), and fire stations (15). There are no State critical facilities currently mapped as being in the floodplain. All critical facilities in Preparedness Area 3 are in areas with very low wildfire hazard potential, as described in Figure 6-49 and Figure 6-50. Four critical facilities, including one transportation facility and three government offices, are located in the WUI as described in Figure 6-51 and Figure 6-52.

Figure 6-49 Preparedness Area 3 Critical Facilities and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
New Mexico Department of Transportation - District 4	Transportation	Very Low

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
New Mexico State Police - District 6 - Gallup (Main)	Public Safety	Very Low
New Mexico State Police - District 2 - Las Vegas (Main)	Public Safety	Very Low
New Mexico Behavioral Health Institute - Las Vegas	Hospitals/Medical	Very Low
New Mexico Department of Health - Epidemiology & Response Division - Bureau of Health Emergency Management	Hospitals/Medical	Very Low
New Mexico State South Complex - Harold L Runnels Building	Hospitals/Medical	Very Low
New Mexico State South Complex - John F Simms Junior Building	Government Offices	Very Low
New Mexico State South Complex - John F Simms Junior Building	Hospitals/Medical	Very Low
New Mexico Department of Transportation - Joe M Anaya Memorial Complex	Transportation	Very Low
New Mexico State Capitol Building	Government Offices	Very Low
New Mexico State East Complex - Lamy Building	Government Offices	Very Low
New Mexico State East Complex - Lew Wallace Building	Government Offices	Very Low
New Mexico State Central Complex - Bataan Memorial Building	Government Offices	Very Low
Tesuque Peak	Radio/Communications	Very Low
New Mexico State Police - District 7 - Espanola (Main)	Public Safety	Very Low
SPRINGER RC & FMS#4A	Military Affairs	Very Low
New Mexico State Police - District 7 - Taos	Public Safety	Very Low
SPRINGER CORRECTIONAL CENTER	Corrections	Very Low
Touch Me Not	Radio/Communications	Very Low
South Mesa	Radio/Communications	Very Low

Figure 6-50 Preparedness Area 3 Critical Facilities Wildfire Hazard Potential

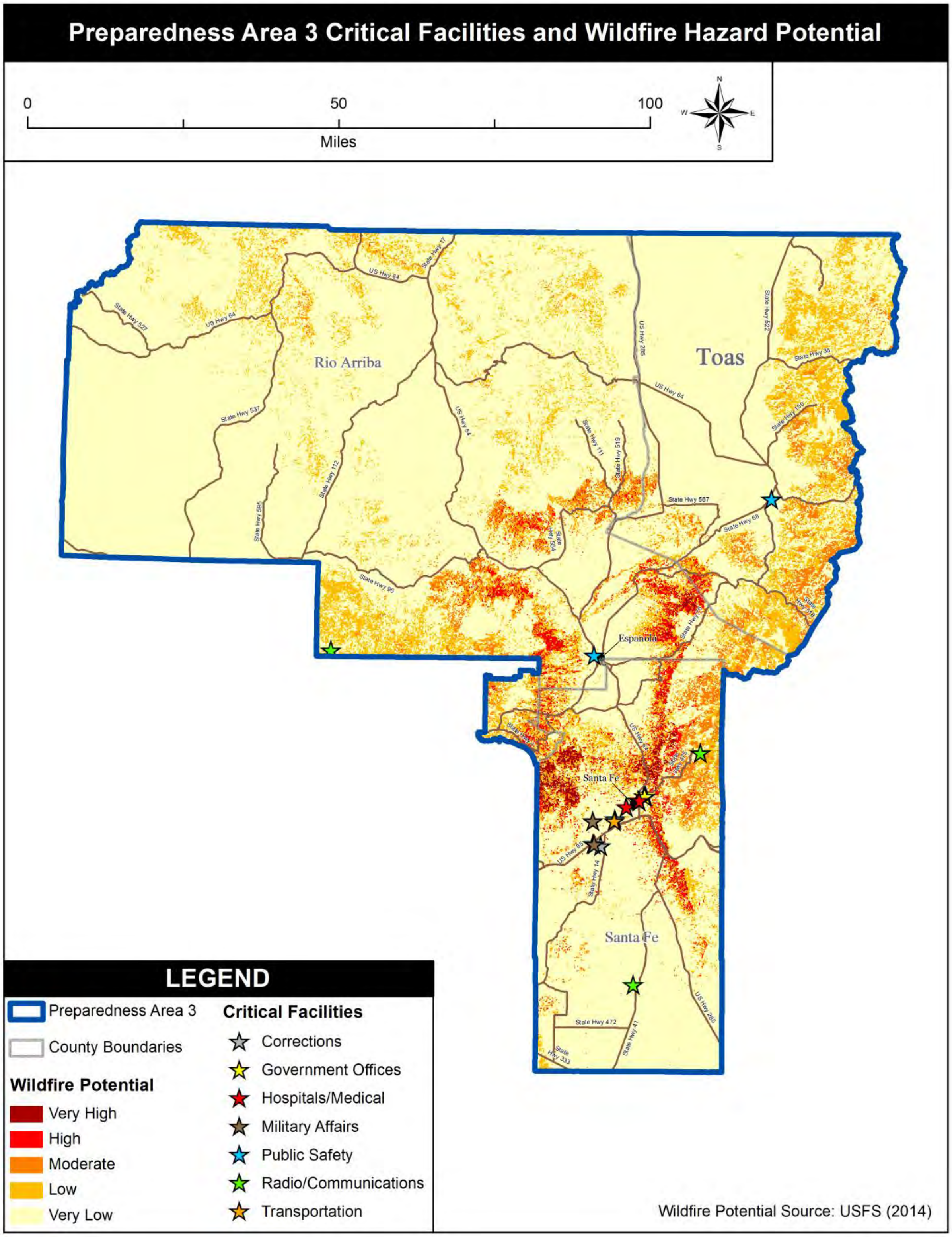
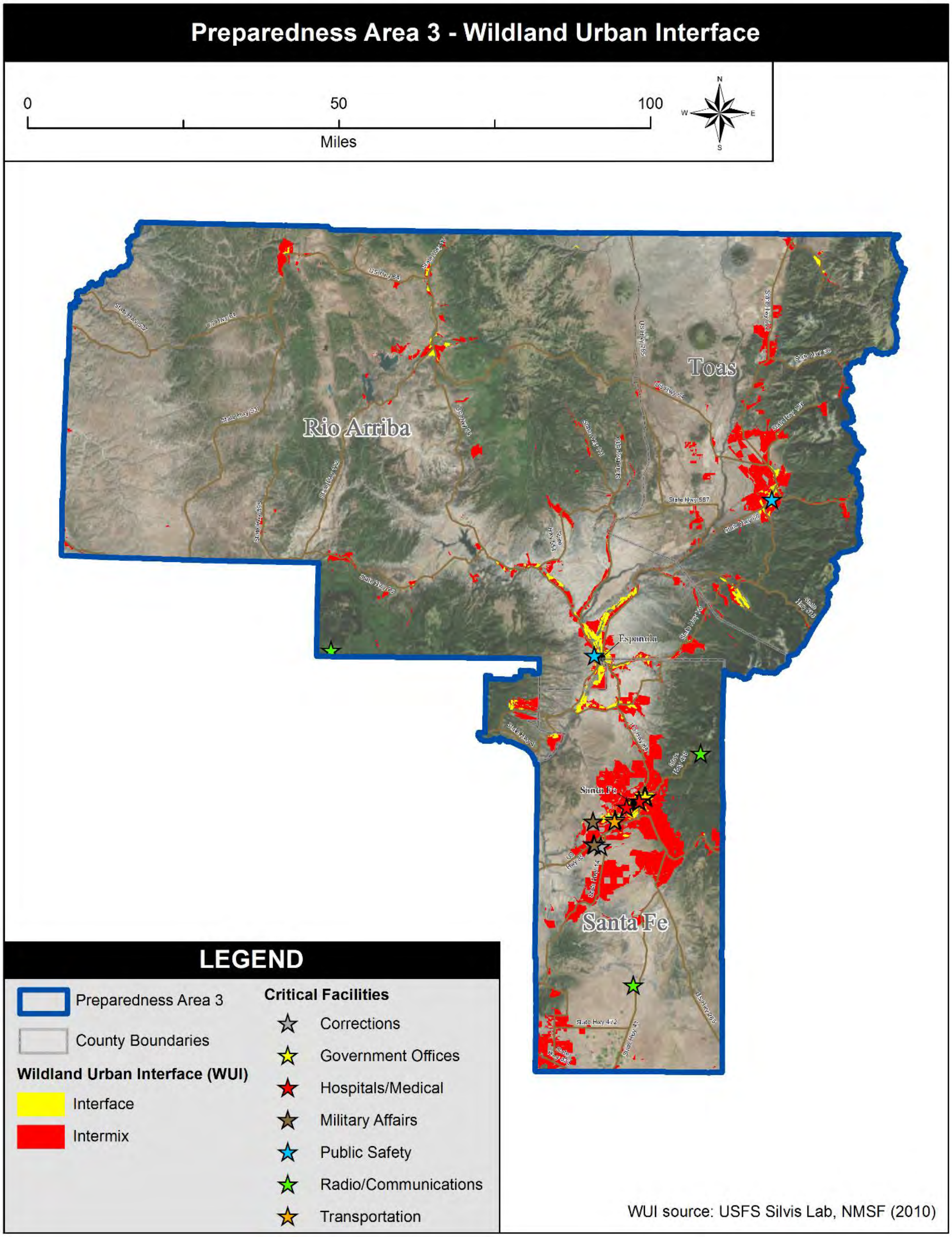


Figure 6-51 Preparedness Area 3 Critical Facilities Located in the WUI, 2010

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	2010 Wildland Urban Interface
New Mexico Department of Transportation - District 5	Transportation	Medium Density Intermix
New Mexico State Capitol Building	Government Offices	Medium Density Interface
New Mexico State East Complex - Lamy Building	Government Offices	Medium Density Interface
New Mexico State East Complex - Lew Wallace Building	Government Offices	Medium Density Interface

Figure 6-52 Preparedness Area 3 Critical Facilities and WUI



Drought – Preparedness Area 3

Based on local mitigation plans, drought ranked below both wildfire and flood in Preparedness Area 3. Areas of Preparedness Area 3 have experienced extended drought conditions, and at least one county has been experiencing drought conditions for the past 10 years. As drought conditions persist (coupled with the extreme heat events the region is susceptible to) wildfire risk also increases. In populated areas that are already struggling with limited water resources, fighting fires becomes more difficult. As a result, the vulnerability of people and structures within the region increases significantly. Wood frame construction makes up 57% of the Preparedness Area's building inventory, elevating vulnerability even further as well as the risk of catastrophic losses of life and property. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event. Additionally, reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems.

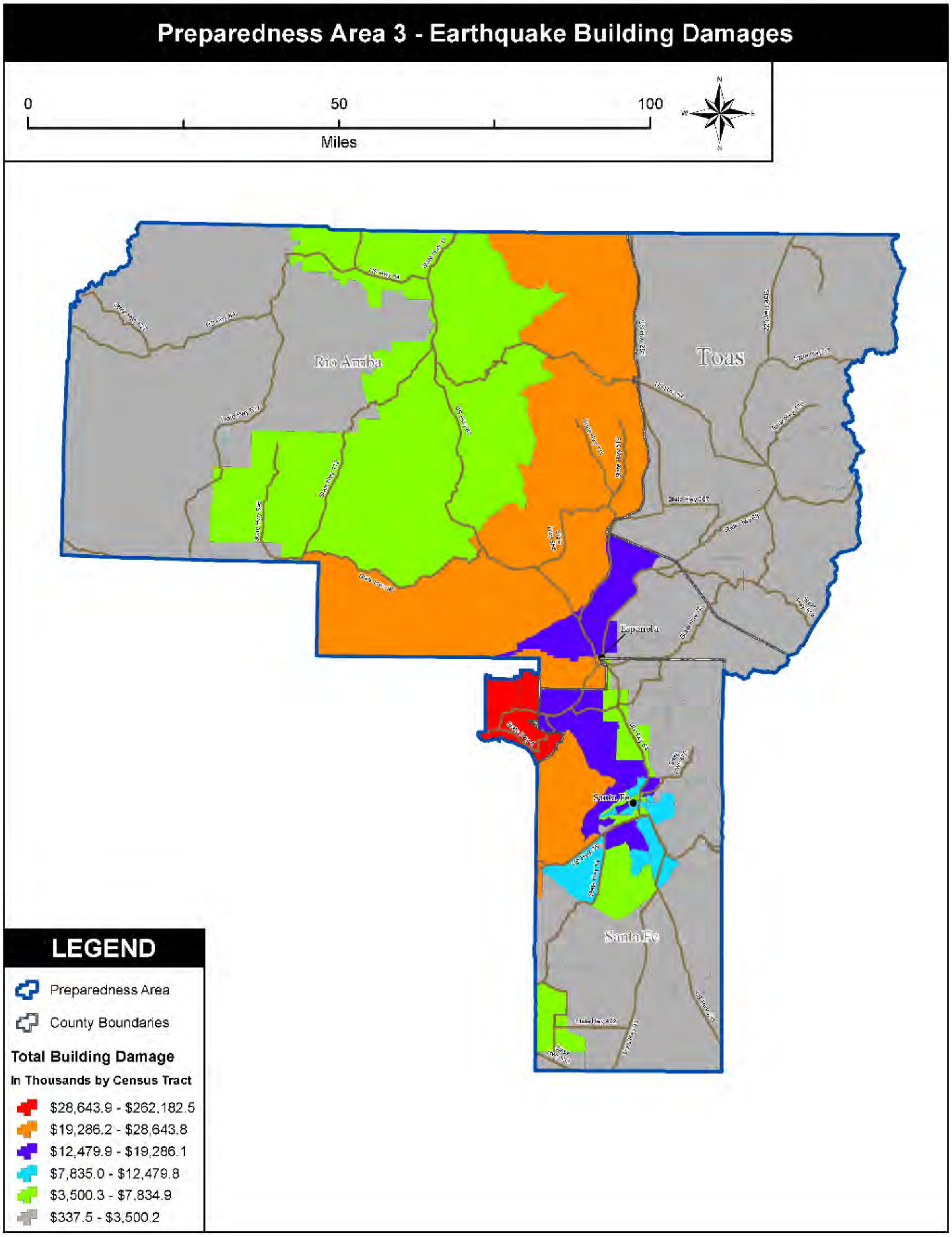
Earthquake – Preparedness Area 3

The following Figure 6-53 presents the expected building-related economic loss estimates for a modeled probable maximum earthquake event in Preparedness Area 3. As shown in Figure 6-54, the central portion of the Preparedness Area would experience the most in building damages as a result of this modeled earthquake.

Figure 6-53 Hazus Earthquake Building-Related Loss Estimates (PA 3)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$8.83 M	$62.49 M	$1.28 M	$6.45 M	$79.05 M
Capital-Related	$0.00 M	$3.77 M	$56.70 M	$0.77 M	$1.33 M	$62.56 M
Rental	$31.09 M	$18.58 M	$24.44 M	$0.50 M	$3.48 M	$78.08 M
Relocation	$106.33 M	$24.92 M	$38.27 M	$2.89 M	$23.40 M	$195.82 M
Income Losses (subtotal)	***$137.42 M***	***$56.10 M***	***$181.90 M***	***$5.44 M***	***$34.66 M***	***$415.51 M***
Structural	$205.13 M	$44.40 M	$59.77 M	$9.44 M	$20.26 M	$339.00 M
Non-Structural	$661.69 M	$161.66 M	$179.84 M	$29.37 M	$61.23 M	$1,093.78 M
Content	$178.18 M	$31.65 M	$83.54 M	$18.78 M	$28.89 M	$341.03 M
Inventory	$0.00 M	$0.00 M	$1.52 M	$2.99 M	$0.12 M	$4.63 M
Capital Stock Losses (subtotal)	***$1,045.00 M***	***$237.72 M***	***$324.67 M***	***$60.57 M***	***$110.50 M***	***$1,778.45 M***
Total Estimated Losses	**$1,182.42 M**	**$293.82 M**	**$506.57 M**	**$66.00 M**	**$145.15 M**	**$2,193.96 M**

Figure 6-54 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA 3)



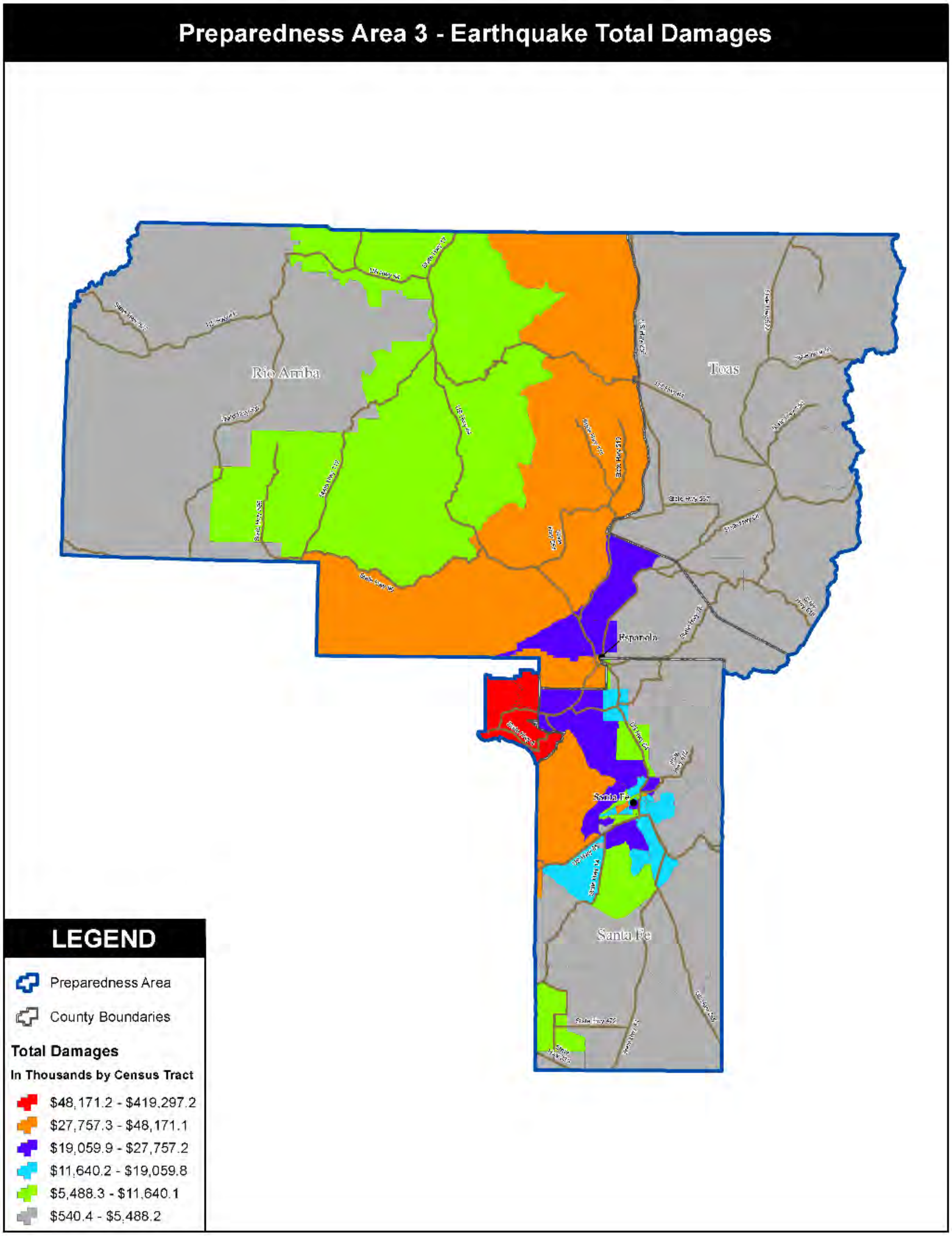
The following Figure 6-55 presents additional modeled impacts from this same event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-55 Hazus Earthquake Impacts and Loss Estimates (PA 3)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 17,296
	Moderate: 12,728
	Extensive: 5,239
	Complete: 2,224
Total Economic Losses (includes building and lifeline losses)	$2,236.33 million
Damage to Schools	15 with at least moderate damage
Damage to Medical Facilities	2 with at least moderate damage
Damage to Fire Stations	15 with at least moderate damage
Damage to Transportation Systems	5 highway bridges, at least moderate damage
	0 highway bridges, complete damage
	0 railroad bridges, moderate damage
	1 airport facilities, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	2,032
Shelter Requirements	999 people out of 235,303 total population
Debris Generation	0.74 million tons

Figure 6-56 shows total damages resulting from an earthquake in Preparedness Area 3 by census tract. Similar to building damages, the central portion of the Preparedness Area would experience the most in total damages due to an earthquake.

Figure 6-56 Total Earthquake Damages by Census Tract (PA 3)



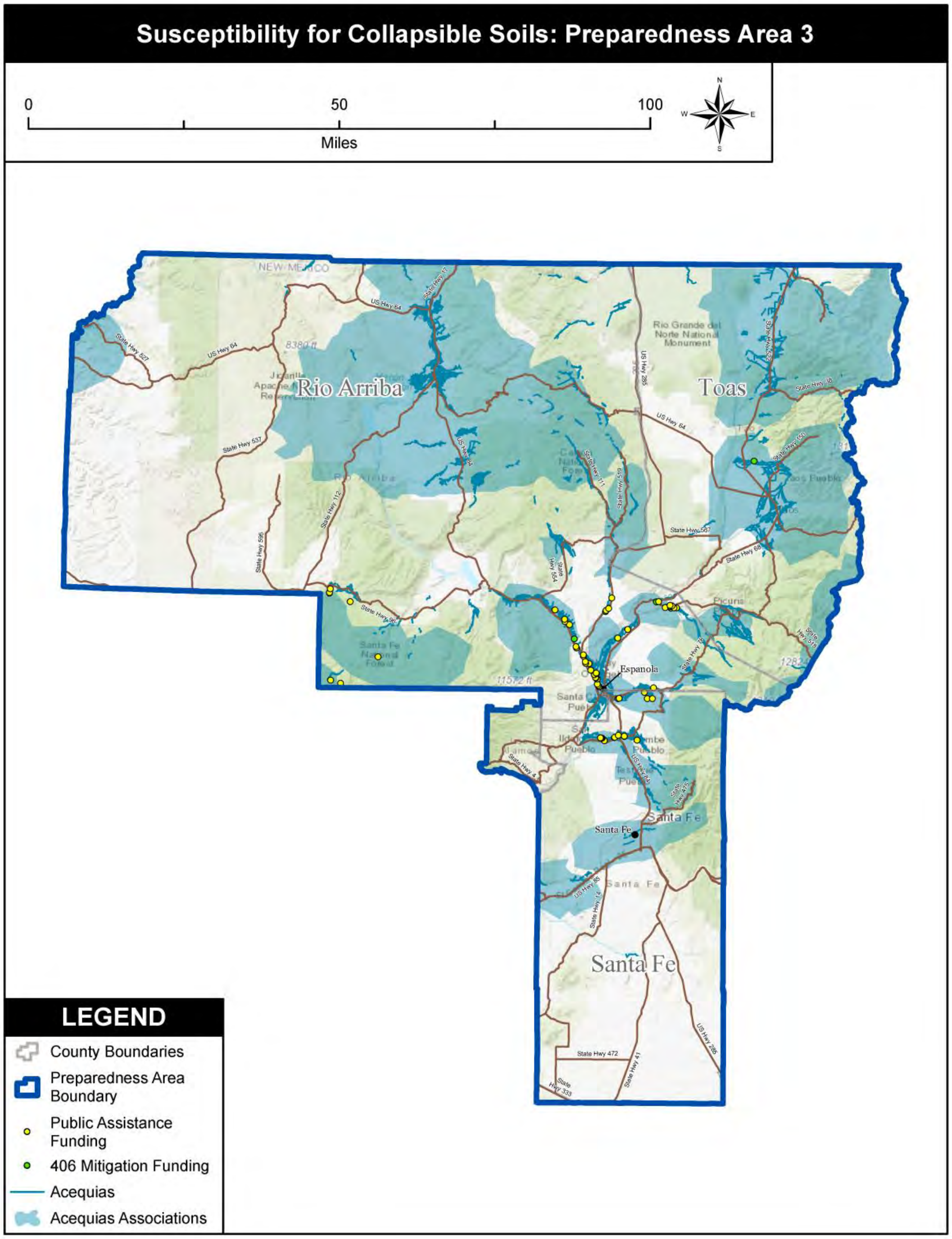
Flood/Flash Floods – Preparedness Area 3

Floods/flash floods were ranked the second top priority hazard in Preparedness Area 3, and many jurisdictions ranked it as their number one hazard. Preparedness Area 3 reported property damage and power outages due to the September 2013 flood events. Under the right conditions, virtually every Preparedness Area in the State of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including mudslides. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September.

The map below shows locations of acequias in Preparedness Area 3. Preparedness Area 3 has acequias concentrated throughout the entire Preparedness Area (Figure 6-57). The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 3, there are an estimated 1,958 miles of acequia infrastructure identified from existing datasets, and 15 known Acequia Associations in the region, as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 1,056 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 81 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within the Preparedness Area (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

Figure 6-57 Acequias in Preparedness Area 3



Landslide and Rockfall – Preparedness Area 3

Within Preparedness Area 3 there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Susceptibility is commonly associated with mesa flanks in Preparedness Area 3. However, steep slopes associated with mountains are correlated with likely susceptibility in

Preparedness Area 3 in the Sangre de Cristo, Tusas and northern Jemez Mountains. All counties in Preparedness Area 3 have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 3

Preparedness Area 3 has broad swathes of regions mapped as highly to extremely susceptible to collapsible soils. All of these regions are associated with alluvial fans, primarily flanking the north-south trending mountain trains in along the river valleys or closed-based margins in Taos, Sandoval, and Santa Fe Counties. Rio Arriba also has a significant proportion of highly susceptible soils and fewer extremely susceptible soils, mostly in canyon and valley bottoms of the mountains and badlands of the region. Extremely susceptible regions occur on alluvial fans in the western portion of Rio Arriba County.

Wildfire – Preparedness Area 3

Based on local mitigation plans, wildfire was ranked as the top priority hazard in Preparedness Area 3. Every jurisdiction ranked wildfire as a high priority hazard. Preparedness Area 3 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought, and high fuel loads due to pine beetle kill. Currently, drought conditions in Preparedness Area 3 can be described as severe to extreme. Across Preparedness Area 3, significant numbers of people are exposed to wildfire risks, especially populations living or working in close proximity to forested areas, residents with asthma or other respiratory sensitivity, and very young and elderly residents.

However, vegetation treatments have been ongoing and are planned to continue to mitigate the high fuel loads in Preparedness Area 3. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan Update. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-58 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 3. A total of 510,502 acres of vegetation have been treated and an additional 124,089 are planned for treatment, totaling 634,591 acres of treated vegetation. This equates to approximately 10% of Preparedness Area 3's total land area. Figure 6-59 shows the breakdown of planned, completed, and historic treatments. Historic treatments were completed primarily by the USFS, followed by both private land owners and the BLM. The USFS completed a higher percent of treatment acres of more recently completed treatments, however the BLM will complete 99% of the planned acres of treatment. Figure 6-60 shows the percent of total acres treated by land ownership. Overall, the USFS will treat the most acres of vegetation.

Figure 6-58 Preparedness Area 3 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	Land Owner	Acres	Percent
124,089 (1.9% of PA 3 land area)	BLM	123,295	99.36%
	Municipal	10	0.01%
	Private	51	0.04%
	SLO	10	0.01%
	State	10	0.01%

Planned Treatments			
Total Acres	Land Owner	Acres	Percent
	Tribal: BIA Jicarilla Trust	10	0.01%
	USFS	693	0.56%
	USFS, Private	10	0.01%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
387,825 (6.0% of PA 3 land area)	BLM	88,113	22.72%
	Bureau of Reclamation	14	0.00%
	NM Game and Fish	600	0.15%
	Private	19,610	5.06%
	State	7,347	1.89%
	State Park	8	0.00%
	Tribal	2,343	0.60%
	USFS	269,791	69.57%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
122,677 (1.9% of PA 3 land area)	BLM	30,265	24.67%
	NM Game and Fish	219	0.18%
	Private	30,725	25.05%
	State	2,509	2.05%
	Tribal	2,158	1.76%
	USFS	56,802	46.30%

Figure 6-59 Preparedness Area 3 Total Acres of Vegetation Treatment

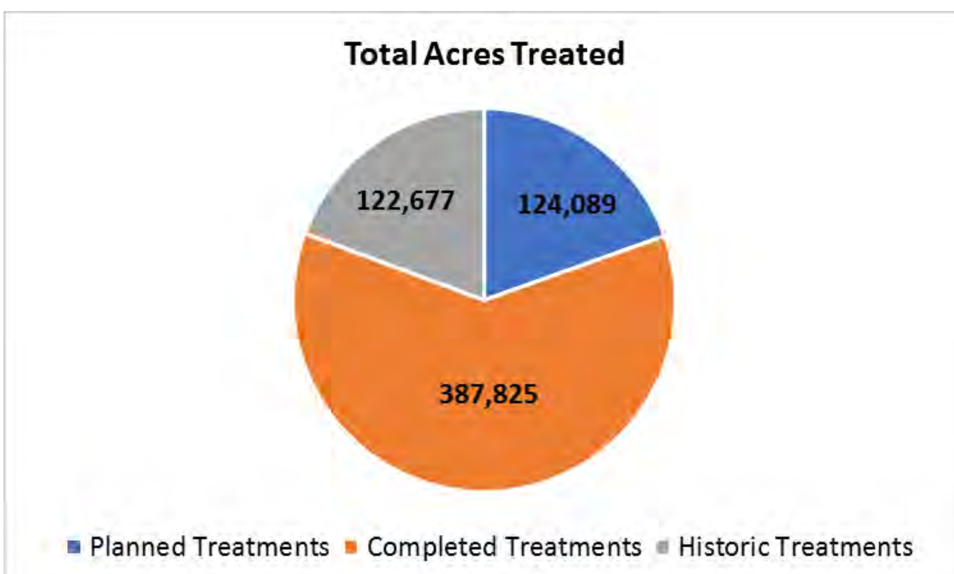
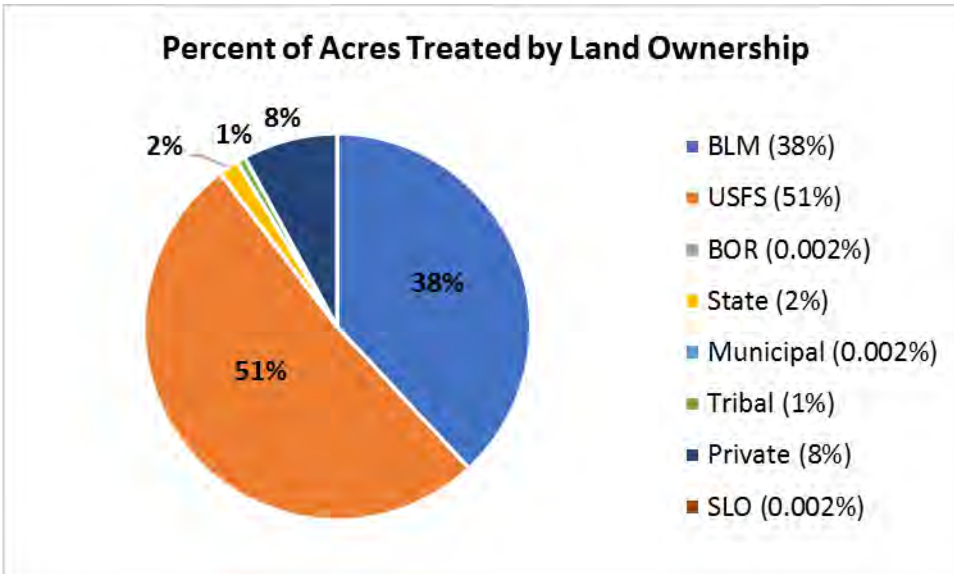


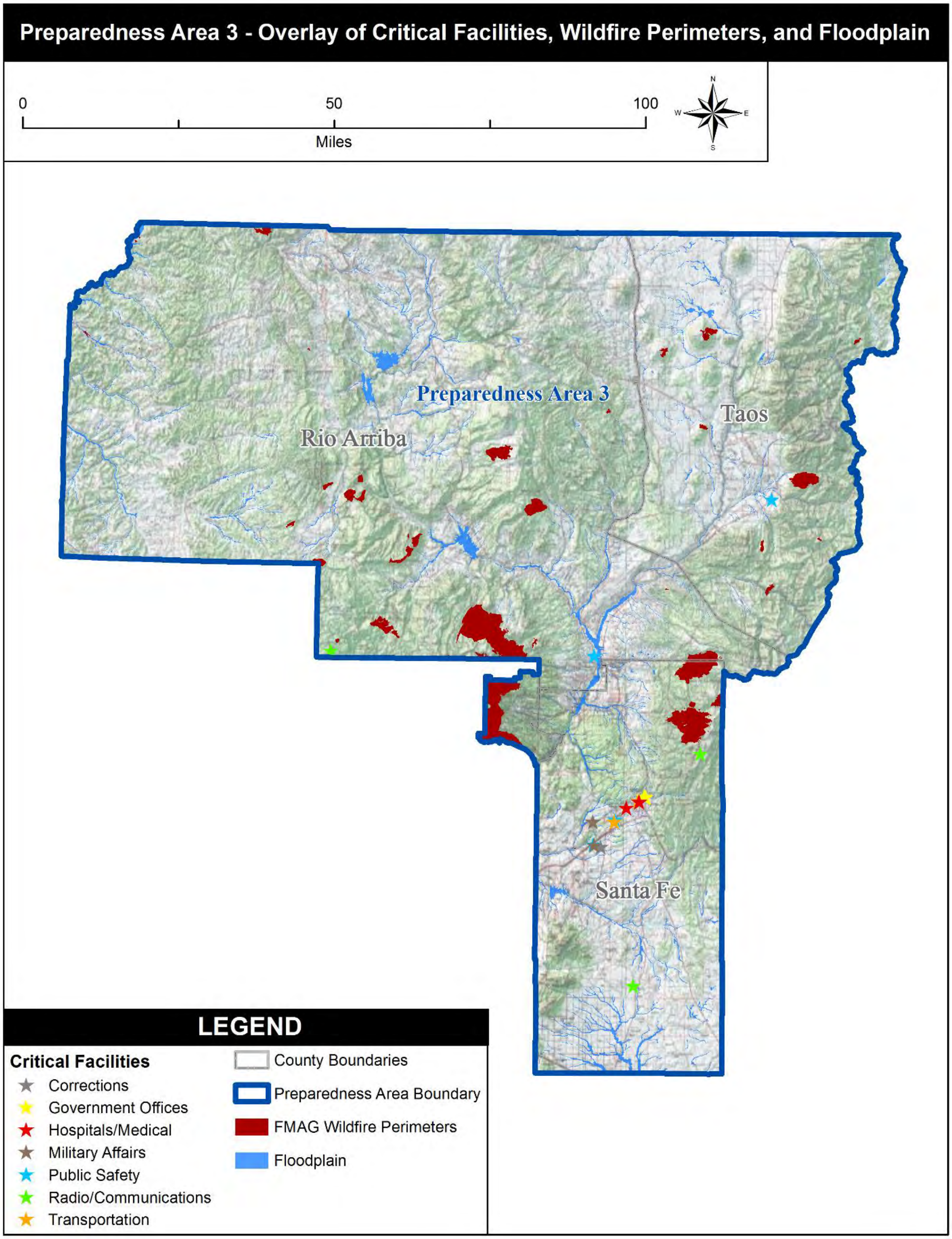
Figure 6-60 Preparedness Area 3 Percent of Total Acres Treated by Land Ownership



Summary – Preparedness Area 3

The following Figure 6-61 presents an overview of the best available mapping data for Preparedness Area 3. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 3 has experienced several past wildfires, and contains areas within the floodplain. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, with Preparedness Area 3 experiencing population growth, it is important to continue to reduce its vulnerabilities to natural hazards.

Figure 6-61 Preparedness Area 3 Risk and Vulnerability Summary



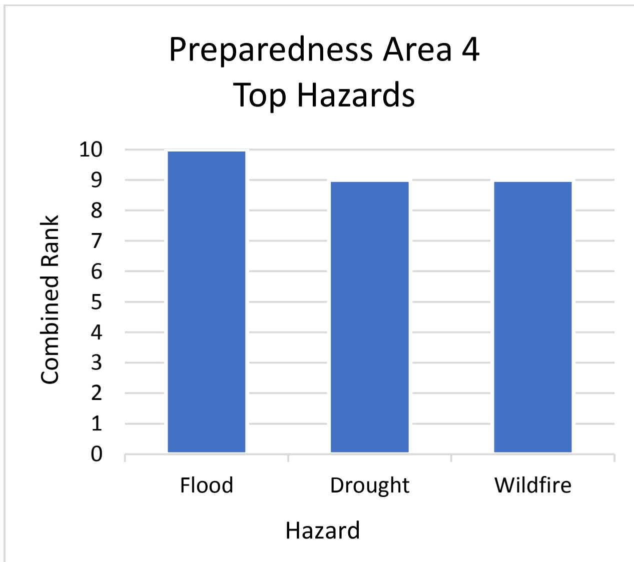
6.8 Vulnerability Assessment – Preparedness Area 4

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 4. Local jurisdictions within the Preparedness Area identified the following three hazards as being top priority planning concerns:

- Flood/Flash Floods
- Drought
- Wildfire

Figure 6-62 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]).

Figure 6-62 Preparedness Area 4 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquakes, landslide, or land subsidence were not identified as primary hazard concerns for the region, vulnerability analysis is included for those hazards as that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Exposure – Preparedness Area 4

Preparedness Area 4 has a total population of 228,749 people and there are over 75,000 households in the Area. Additionally, there are an estimated 85,000 buildings in Preparedness Area 4. Approximately 95% of the buildings and 79% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 4, wood frame construction makes up 50% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are five State critical facilities located with Preparedness Area 4. This includes the following facility types: corrections (1), public safety (1), radio/communications (2), and transportation (1).

The transportation and utility lifeline inventory within Preparedness Area 4 includes over 1,080 miles of highways, 319 bridges, and 11,590 miles of pipes.

Changes in Development– Preparedness Area 4

The following Figure 6-63 presents population counts and projections for those counties included in Preparedness Area 4. Overall the area has seen a decrease in population, but this is being entirely driven by only one of the area's three counties. Mitigation efforts in Preparedness Area 4 should focus on these particular growth areas, as encouraging development outside of hazard areas is one of the most effective tools to help reduce risk and vulnerability.

Figure 6-63 Preparedness Area 4 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Cibola County	27,213	27,487	1.01%
McKinley County	71,492	74,923	4.80%
San Juan County	130,044	115,079	-11.51%
Preparedness Area 4	**228,749**	**217,489**	**-4.62%**

Critical Facilities – Preparedness Area 4

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, do not expect any critical facilities suffer at least moderate damage. There are no State critical facilities currently mapped as being in the floodplain. All critical facilities in Preparedness Area 4 are located in areas with very low or low wildfire hazard potential, as described in Figure 6-64 and Figure 6-65. No critical facilities are located in the WUI as shown in Figure 6-66.

Figure 6-64 Preparedness Area 4 Critical Facilities and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
Galisteo Microwave Tower	Radio/Communications	Very Low
La Mosca	Radio/Communications	Very Low
PENITENTIARY OF NEW MEXICO	Corrections	Very Low
New Mexico Department of Transportation - District 5	Transportation	Very Low
Sandia Crest	Radio/Communications	Low

Figure 6-65 Preparedness Area 4 Critical Facilities Wildfire Hazard Potential

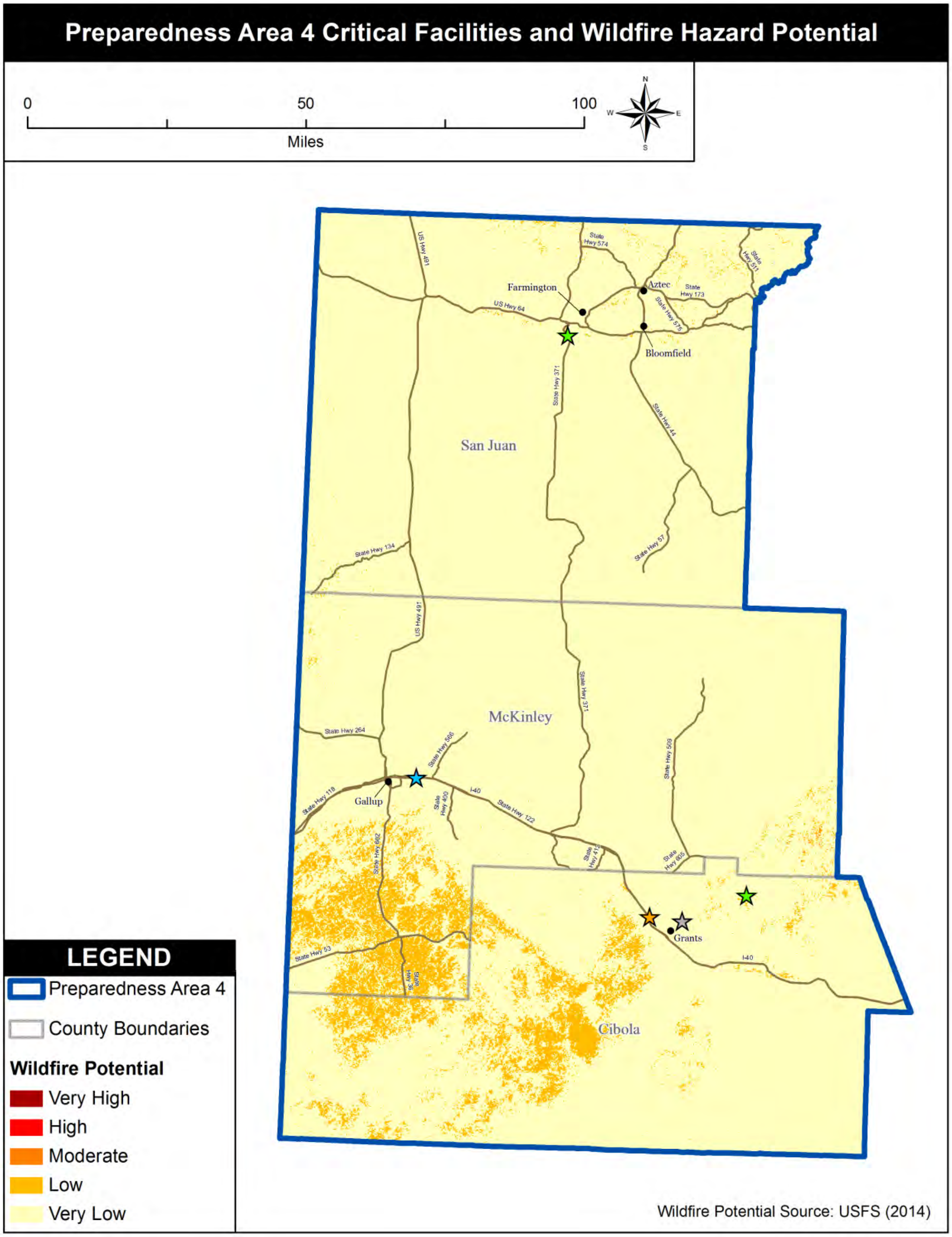
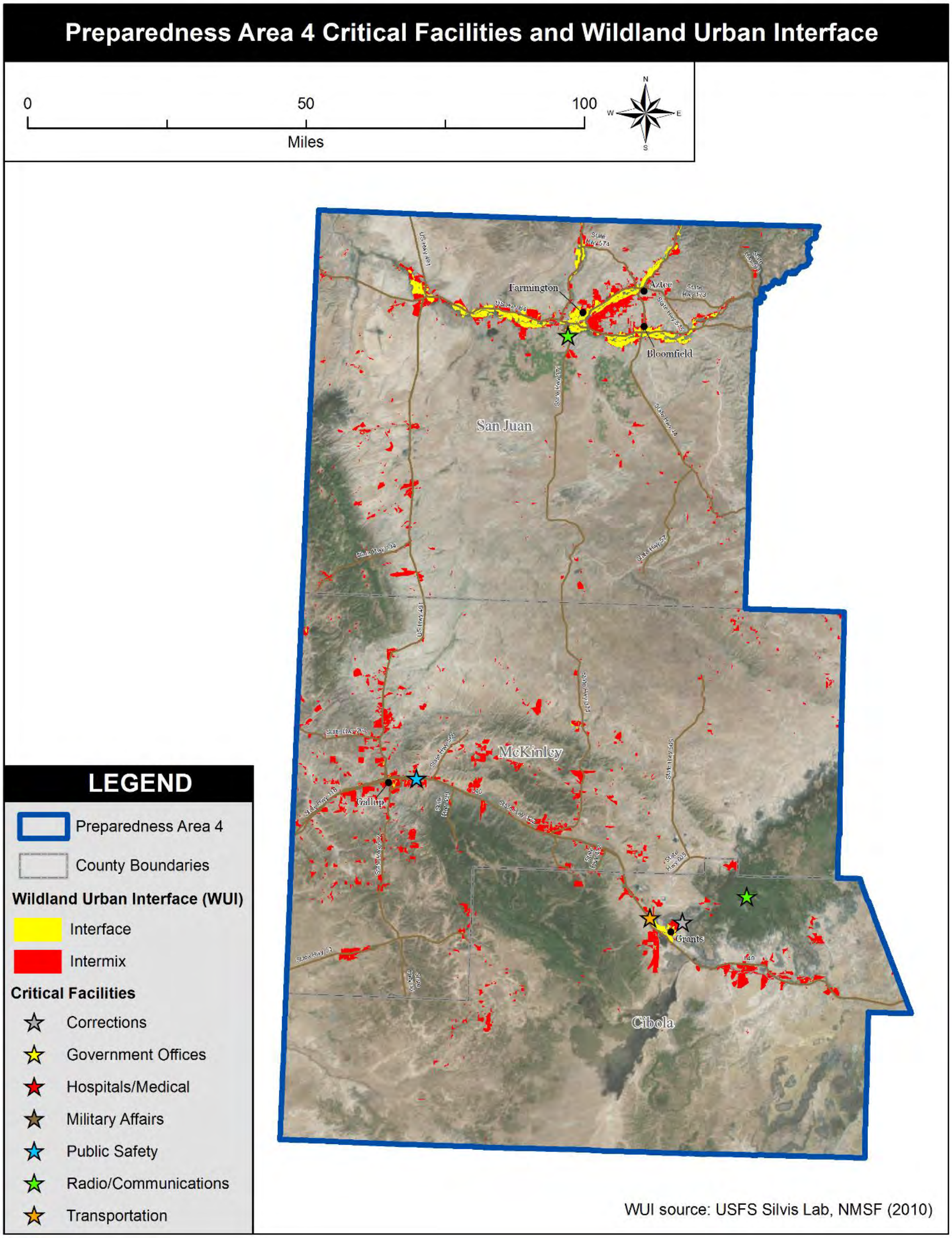


Figure 6-66 Preparedness Area 4 Critical Facilities and WUI



Drought – Preparedness Area 4

Drought was ranked equally with wildfire as the second top priority hazard in Preparedness Area 4. At least one county in Preparedness Area 4 has been experiencing drought since 2004, and one county declared extreme/severe drought conditions in June 2013. As drought conditions persist (coupled with the extreme heat events the region is susceptible to) wildfire risk also increases. In populated areas that are already struggling with limited water resources, fighting fires becomes more difficult. Additionally, in rural communities resources to fight wildfires may be limited. As a result, the vulnerability of people and structures within the region increase significantly. Wood frame construction makes up 50% of the Preparedness Area's building inventory, elevating vulnerability even further as well as the risk of catastrophic losses of life and property. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event. Drought also has contributed to reservoir levels throughout New Mexico being at their lowest levels since the mid-1970s.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems.

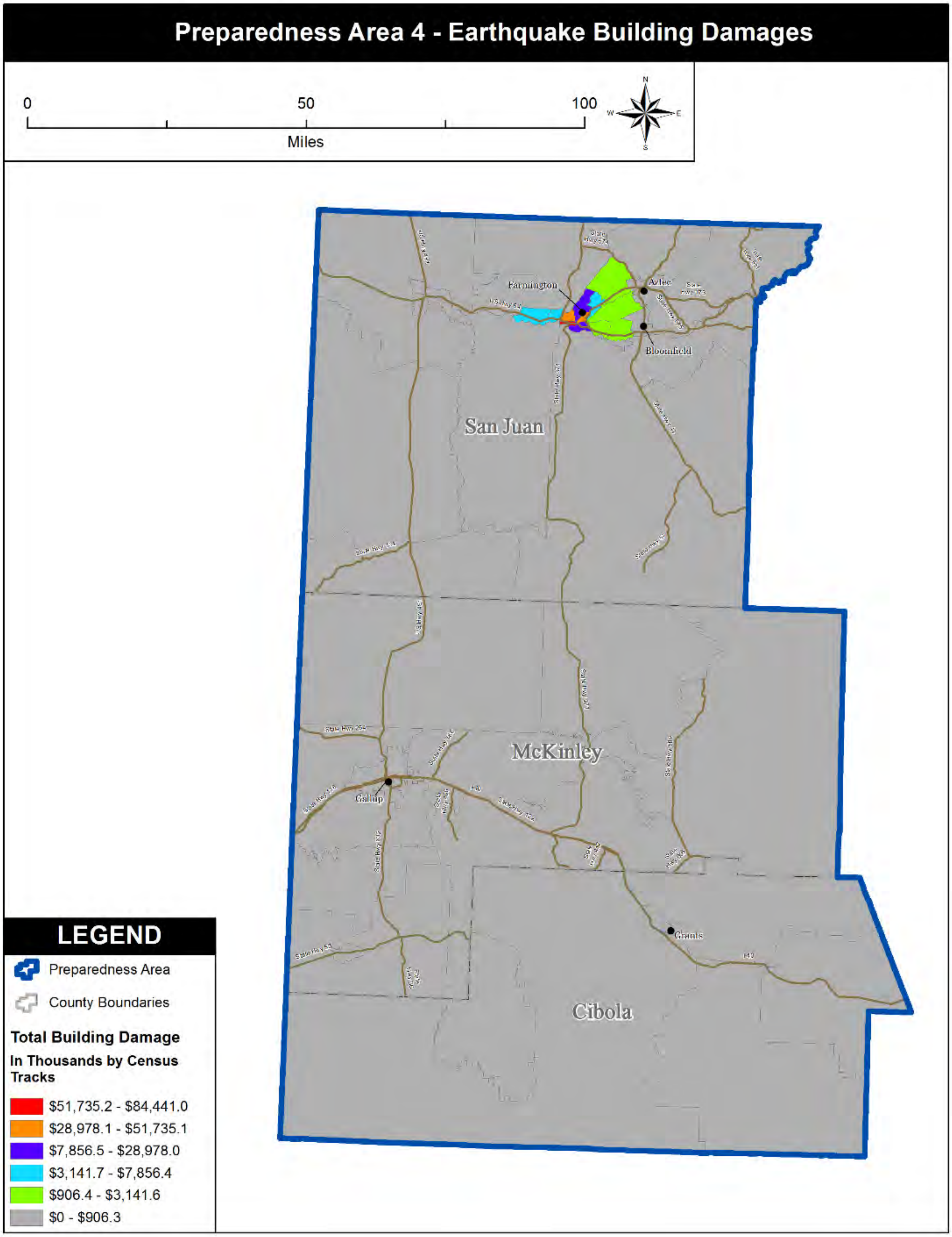
Earthquake – Preparedness Area 4

The following Figure 6-67 presents the expected building-related economic loss estimates for a probable maximum earthquake event modeled in Preparedness Area 4. Figure 6-68 shows this information by census tract on a map. Only a small portion of the north-central region of the Preparedness Area would account for the building damages experienced from this modeled earthquake.

Figure 6-67 Hazus Earthquake Building-Related Loss Estimates (PA 4)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$2.16 M	$24.08 M	$0.62 M	$1.42 M	$28.28 M
Capital-Related	$0.00 M	$0.92 M	$17.93 M	$0.69 M	$0.33 M	$19.87 M
Rental	$5.27 M	$4.66 M	$9.53 M	$0.37 M	$0.56 M	$20.38 M
Relocation	$18.57 M	$6.47 M	$17.36 M	$2.17 M	$5.40 M	$49.96 M
Income Losses (subtotal)	***$23.84 M***	***$14.20 M***	***$68.90 M***	***$3.85 M***	***$7.71 M***	***$118.50 M***
Structural	$29.40 M	$11.03 M	$24.14 M	$7.37 M	$5.07 M	$77.01 M
Non-Structural	$100.51 M	$38.70 M	$59.67 M	$20.34 M	$13.96 M	$233.18 M
Content	$36.98 M	$8.95 M	$33.25 M	$14.69 M	$7.49 M	$101.35 M
Inventory	$0.00 M	$0.00 M	$0.95 M	$1.73 M	$0.04 M	$2.72 M
Capital Stock Losses (subtotal)	***$166.90 M***	***$58.67 M***	***$118.01 M***	***$44.12 M***	***$26.56 M***	***$414.26 M***
Total Estimated Losses	**$190.73 M**	**$72.88 M**	**$186.91 M**	**$47.97 M**	**$34.27 M**	**$532.76 M**

Figure 6-68 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA 4)



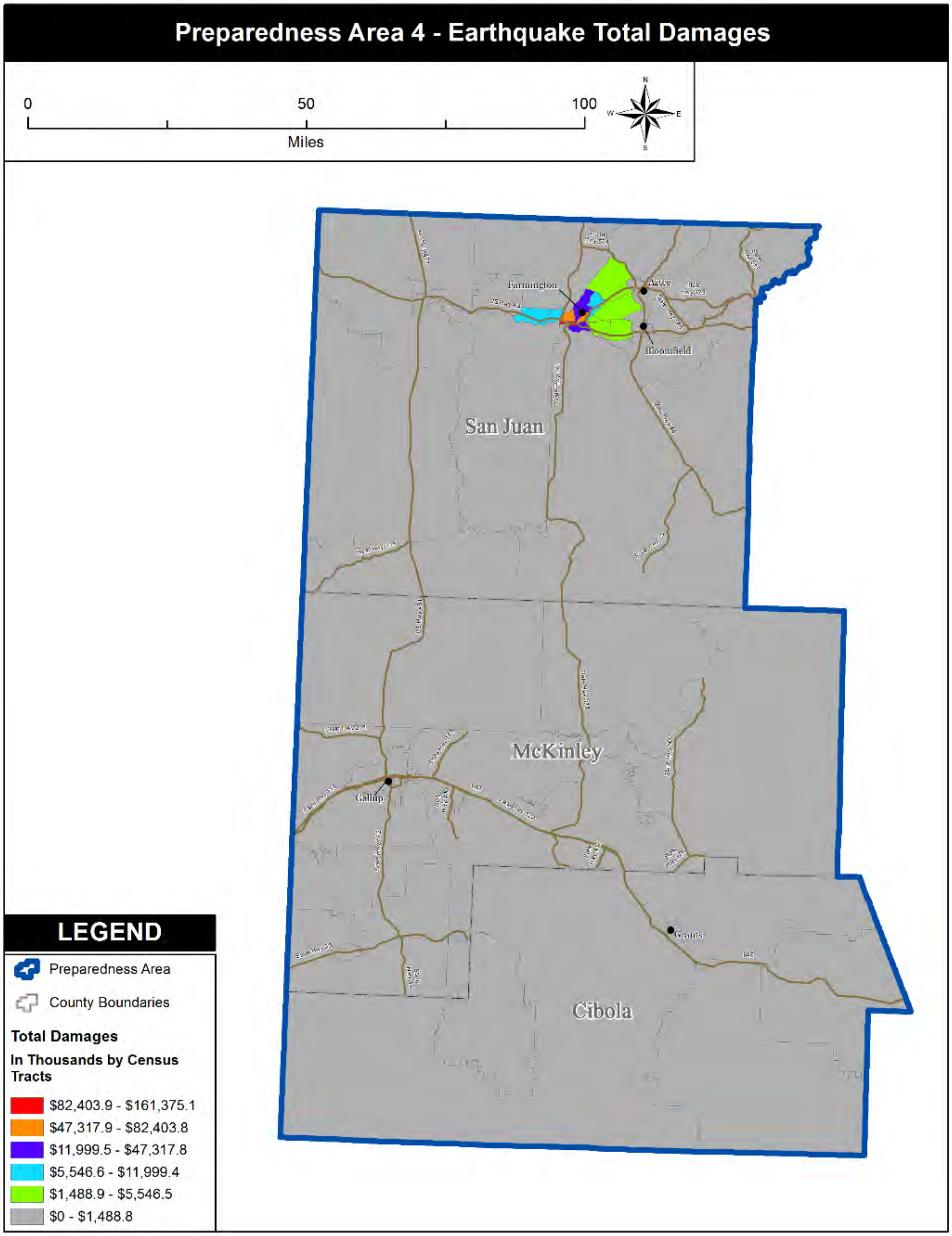
The following Figure 6-69 presents additional modeled impacts from this same event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-69 Hazus Earthquake Impacts and Loss Estimates (PA 4)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 6,087
	Moderate: 4,312
	Extensive: 1,384
	Complete: 221
Total Economic Losses (includes building and lifeline losses)	$537.50 million
Damage to Schools	0 with at least moderate damage
Damage to Medical Facilities	0 with at least moderate damage
Damage to Fire Stations	0 with at least moderate damage
Damage to Transportation Systems	0 highway bridges, at least moderate damage
	0 highway bridges, complete damage
	0 railroad bridges, moderate damage
	1 airport facility, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	312
Shelter Requirements	211 people out of 228,749 total population
Debris Generation	0.19 million tons

Figure 6-70 shows total damages resulting from an earthquake in Preparedness Area 4 by census tract. Similar to building damages, a small area of the north-central region of the Preparedness Area would experience the most in total damages due to the modeled earthquake.

Figure 6-70 Total Earthquake Damages by Census Tract (PA 4)



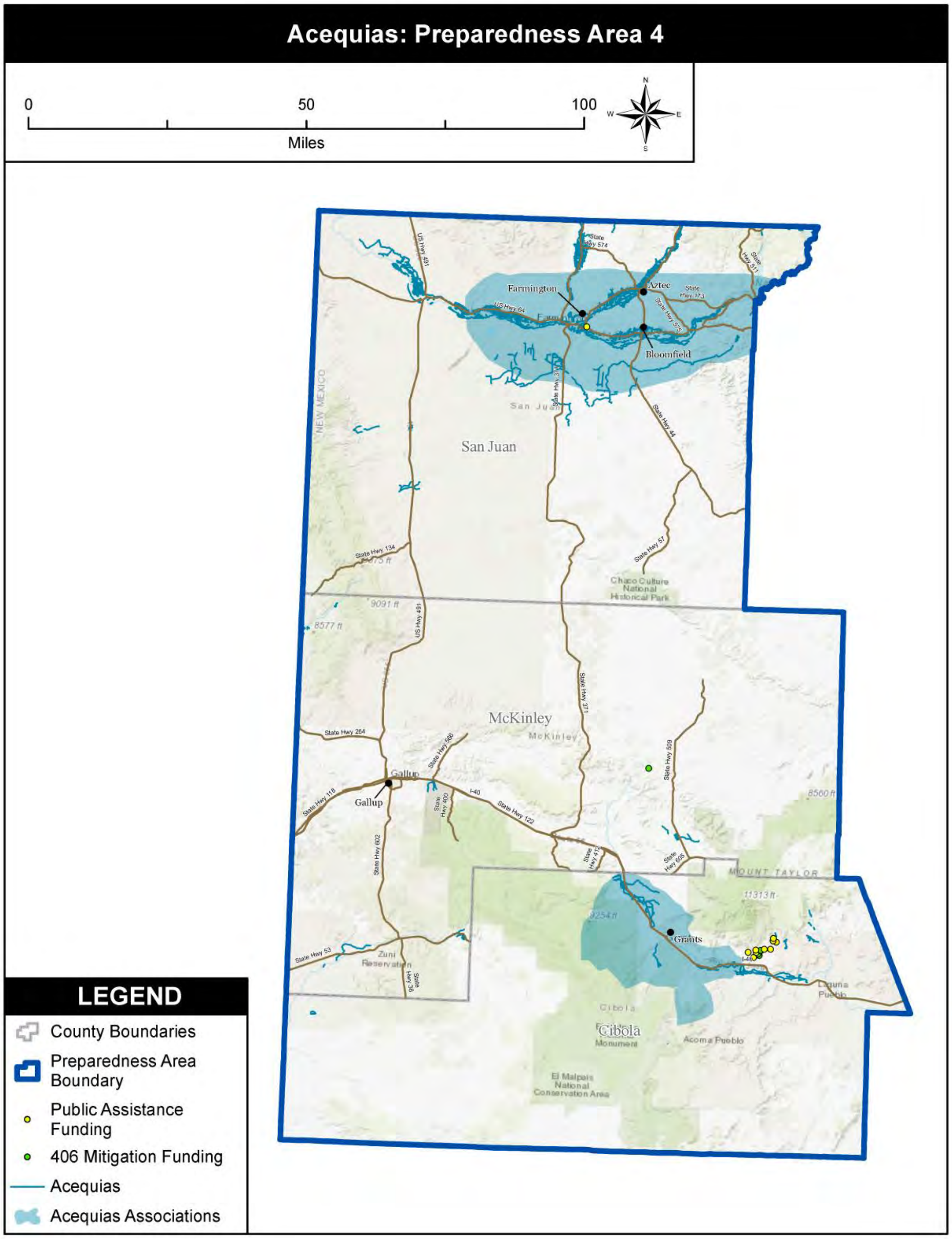
Floods/Flash Floods – Preparedness Area 4

Floods/flash floods was ranked as the top priority hazard in Preparedness Area 4. Under the right conditions, virtually every Preparedness Area in the State of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including mudslides. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September.

The map below shows locations of acequias in Preparedness Area 4. Preparedness Area 4 has acequias concentrated in the northern and southeast regions (Figure 6-71). The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 4, there are an estimated 1,006 miles of acequia infrastructure identified from existing datasets. There are two known Acequia Associations in the region, as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 508 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 16 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within the Preparedness Area (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

Figure 6-71 Acequias in Preparedness Area 4



Landslide and Rockfall – Preparedness Area 4

Within Preparedness Area 4, there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Susceptibility is commonly associated with mesa flanks in Preparedness Area 4. However, steep slopes associated with mountains are correlated with likely susceptibility in Preparedness Area 4 in the Chuska Mountains. All counties in Preparedness Area 4 have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 4

Preparedness Area 4 has much of the region mapped as highly to extremely susceptible to collapsible soils, particularly in San Juan County, in northern McKinley County, and along the I-40 corridor in McKinley and Cibola counties. In San Juan and northern McKinely County, the extremely susceptible regions are associated with badlands, broad ephemeral streams, clay-rich sedimentary rocks and extensive eolian deposits. Along the I-40 corridor, high to extreme susceptibilities are found in alluvial fans coming off of the Zuni Mountains, Mt. Taylor and from the canyon edges.

Wildfire – Preparedness Area 4

Wildfire was ranked equally with drought as the second top priority hazard in Preparedness Area 4. Preparedness Area 4 is in a medium to high priority wildfire risk zone, and is highly vulnerable to wildfire due to multiple factors including development near forested areas, prolonged drought conditions, and high fuel loads due to pine beetle kill. However, vegetation treatments have been ongoing and are planned to continue to mitigate the high fuel loads in Preparedness Area 4. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan Update. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-72 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 4. A total of 662,182 acres of vegetation have been treated and an additional 20,650 are planned for treatment, totaling 682,832 acres of treated vegetation. This equates to approximately 7% of Preparedness Area 4's total land area.

Figure 6-73 shows the breakdown of planned, completed, and historic treatments. Historically, most acres of treatment were completed by Tribal entities, followed by the BLM and the USFS. The majority of acres of completed treatments were performed by the BLM, followed by the USFS. The majority of acres of planned treatments will be completed by the USFS. Figure 6-74 shows the percent of total acres treated by land ownership. Overall, the BLM will treat the most acres of vegetation, followed closely by the USFS.

Figure 6-72 Preparedness Area 4 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	**Land Owner**	**Acres**	**Percent**
20,650 (0.2% of PA 4 land area)	BLM	4,126	19.98%
	State	1,243	6.02%
	USFS	15,282	74.00%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
392,969 (3.9 % of PA 4 land area)	BLM	198,802	50.59%
	BOR	25	0.01%
	Municipal	72	0.02%
	NM Game and Fish	99	0.03%
	Private	15,623	3.98%
	State	9,763	2.48%
	State Park	19	0.00%
	State, NM Game and Fish	148	0.04%
	Tribal	3,651	0.93%
	USFS	164,767	41.93%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
269,213 (2.7% of PA 4 land area)	BLM	64,585	23.99%
	Private	33,969	12.62%
	Tribal	115,269	42.82%
	USFS	55,389	20.57%

Figure 6-73 Preparedness Area 4 Total Acres of Vegetation Treatment

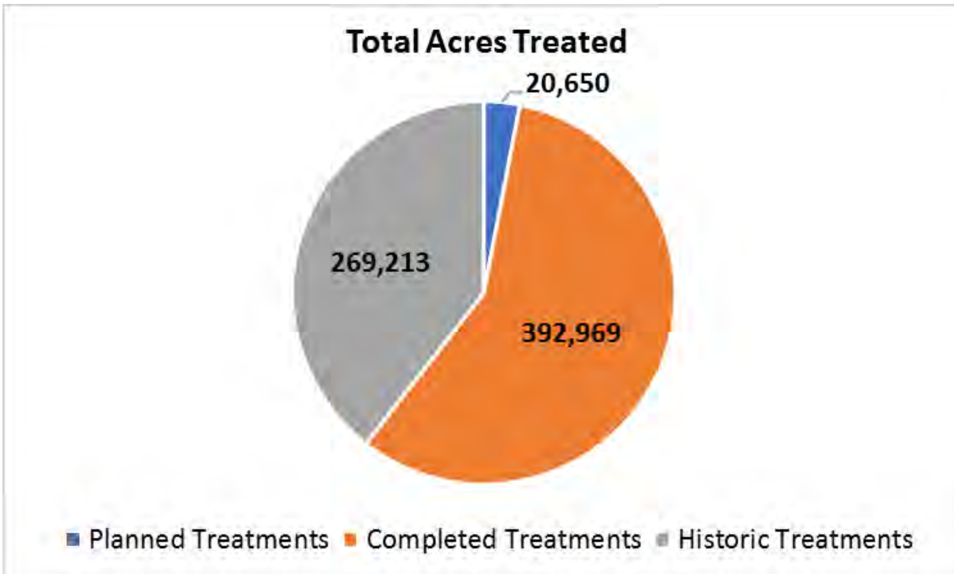
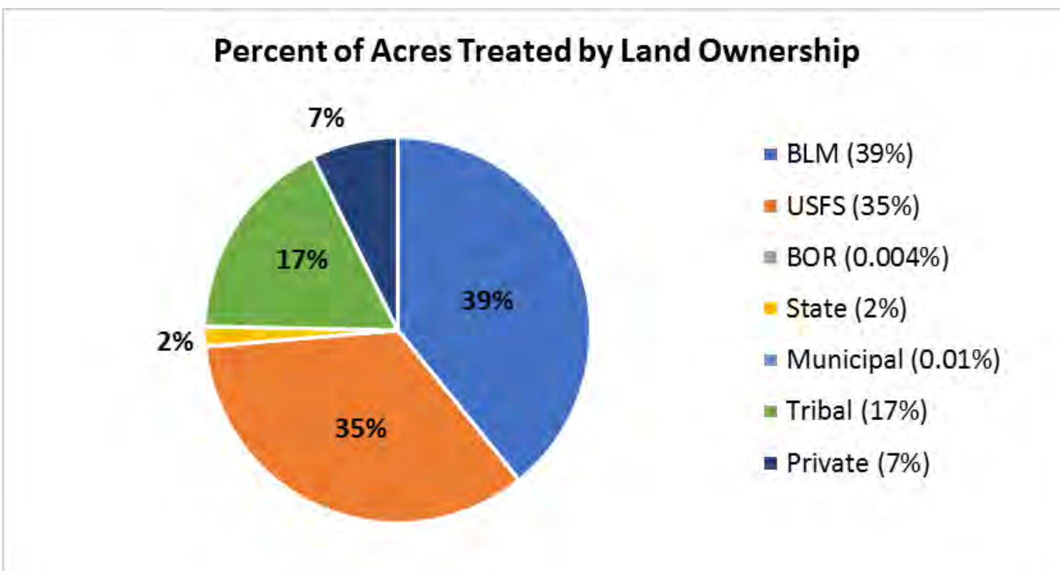


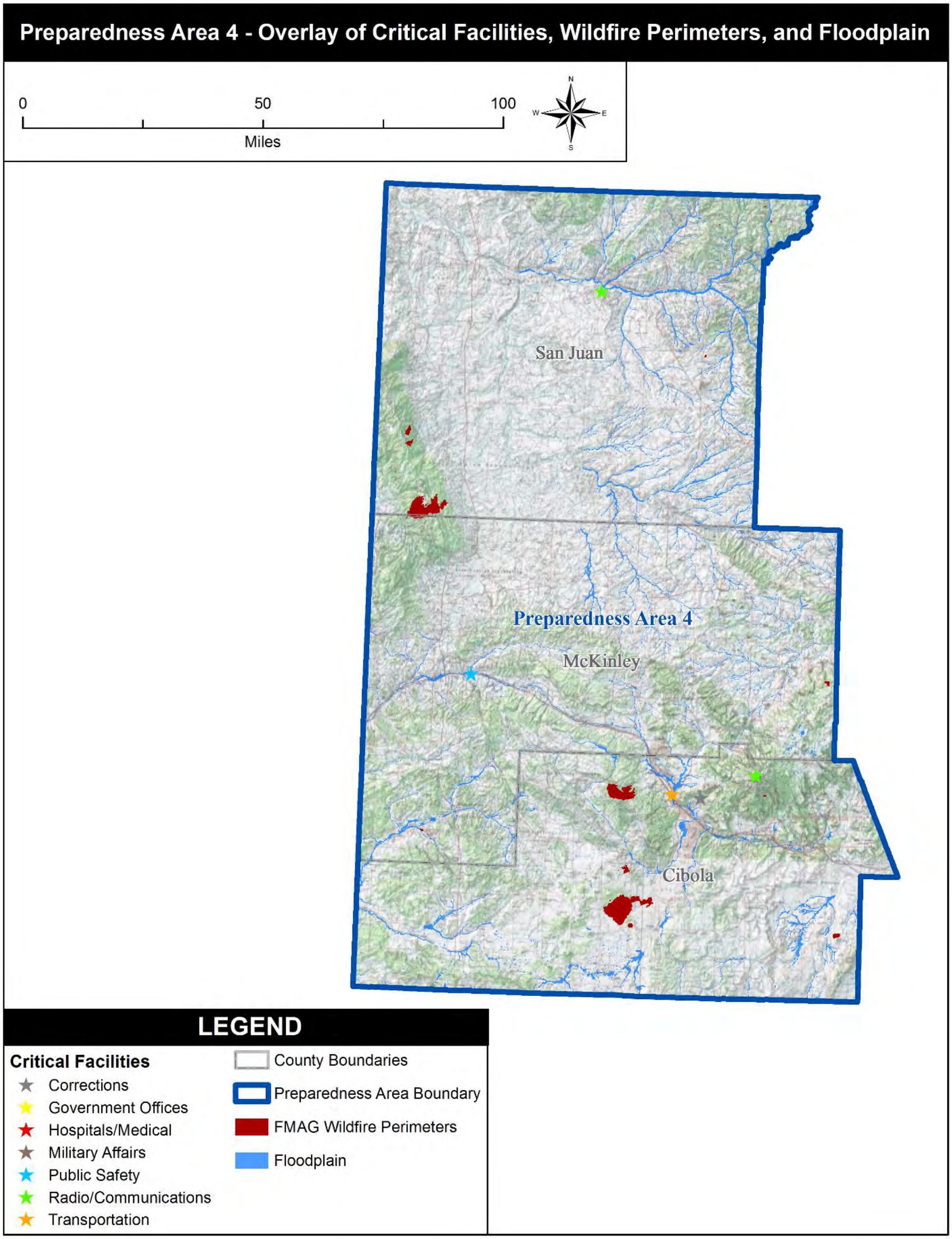
Figure 6-74 Preparedness Area 4 Percent of Total Acres Treated by Land Ownership



Summary – Preparedness Area 4

The following Figure 6-75 presents an overview of the best available mapping data for Preparedness Area 4. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 4 has experienced several past wildfires, and contains areas within the floodplain. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, it is important to continue to reduce Preparedness Area 4's vulnerabilities to natural hazards.

Figure 6-75 Preparedness Area 4 Risk and Vulnerability Summary



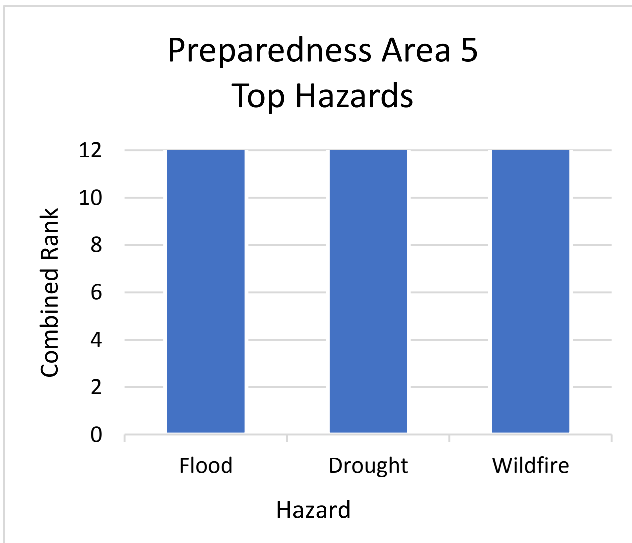
6.9 Vulnerability Assessment – Preparedness Area 5

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 5. Local jurisdictions within the Preparedness Area identified the following three hazards as equally being top priority planning concerns:

- Flood/Flash Floods
- Drought
- Wildfire

Figure 6-76 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]).

Figure 6-76 Preparedness Area 5 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquakes, landslides, or land subsidence were not identified as a primary hazard concern for the region, vulnerability analysis is included since that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Exposure – Preparedness Area 5

Preparedness Area 5 has a total population of 904,943 people and there are over 354,000 households in the Area. Additionally, there are an estimated 340,000 buildings in Preparedness Area 5. Approximately 94% of the buildings and 82% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 5, wood frame construction makes up 63% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are 15 State critical facilities located with Preparedness Area 5. This includes the following facility types: corrections (2), hospitals/medical (4), military affairs (4), public safety (2), radio/communications (2), and transportation (1).

The transportation and utility lifeline inventory within Preparedness Area 5 includes over 1,558 miles of highways, 561 bridges, and 44,467 miles of pipes.

Changes in Development – Preparedness Area 5

The following Figure 6-77 presents population counts and projections for those counties included in Preparedness Area 5. Overall the area has seen gradual growth, but this is being entirely driven by only two of the area's five counties. Mitigation efforts in Preparedness Area 5 should focus on these particular growth areas, as encouraging development outside of hazard areas is one of the most effective tools to help reduce risk and vulnerability.

Figure 6-77 Preparedness Area 5 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Bernalillo County	662,564	676,953	2.17%
Sandoval County	131,561	142,025	7.95%
Socorro County	17,866	17,027	-4.70%
Torrance County	16,383	15,302	-6.60%
Valencia County	76,569	75,626	-1.23%
Preparedness Area 5	**904,943**	**926,933**	**2.43%**

Preparedness Area 5 has the largest population of all of the Preparedness Areas in the State. Population growth is expected to increase across the region and, as a result, low density housing is booming. This growth trend, coupled with increasing development, exacerbates the risks associated with floods, drought, and wildfire. In many parts of the State, the potential for residential development along the wildland-urban interface is limited due to restrictive land use regulations. However, Preparedness Area 5 is experiencing an increase in residential growth in or near the forest boundary. This development trend significantly increases the risk of catastrophic structure losses from wildfires as well as increased exposure of people to wildfire related deaths.

Critical Facilities – Preparedness Area 5

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, include the following counts expected to suffer at least moderate damage: hospitals (18), schools (122), EOCs (1), police stations (17), and fire stations (4). There is one State critical facility currently mapped as being in the floodplain. All critical facilities in Preparedness Area 5 are located in areas with very low wildfire hazard potential, as described in Figure 6-78 and Figure 6-79. Two critical facilities, including one military affairs facility and one hospital/medical facility, are located in the WUI as described in Figure 6-80 and Figure 6-81.

Figure 6-78 Preparedness Area 5 Critical Facilities and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
Socorro Mountain	Radio/Communications	Very Low
Gallinas Peak	Radio/Communications	Very Low
CENTRAL NEW MEXICO CORRECTIONAL FACILITY	Corrections	Very Low
New Mexico Department of Health - Public Health Division - Metro Region - Los Lunas Public Health Office	Hospitals/Medical	Very Low
ALBUQUERQUE RC & FMS#3	Military Affairs	Very Low
University of New Mexico Hospital	Hospitals/Medical	Very Low
Tri-Service Building	Hospitals/Medical	Very Low
New Mexico State Police - District 5 - Albuquerque (Main)	Public Safety	Very Low
New Mexico Department of Health - Sequoyah Adolescent Treatment	Hospitals/Medical	Very Low
Department of Homeland Security And Emergency Management Emergency Operations Center - Alternate Location	Public Safety	Very Low
New Mexico Department of Transportation - District 3	Transportation	Very Low
Tucumcari RCB	Radio/Communications	Very Low
Western New Mexico Correctional Facility	Corrections	Very Low
RIO RANCHO TRAINING SITE, NM	Military Affairs	Very Low
Oñate COMPLEX TS	Military Affairs	Very Low

Figure 6-79 Preparedness Area 5 Critical Facilities Wildfire Hazard Potential

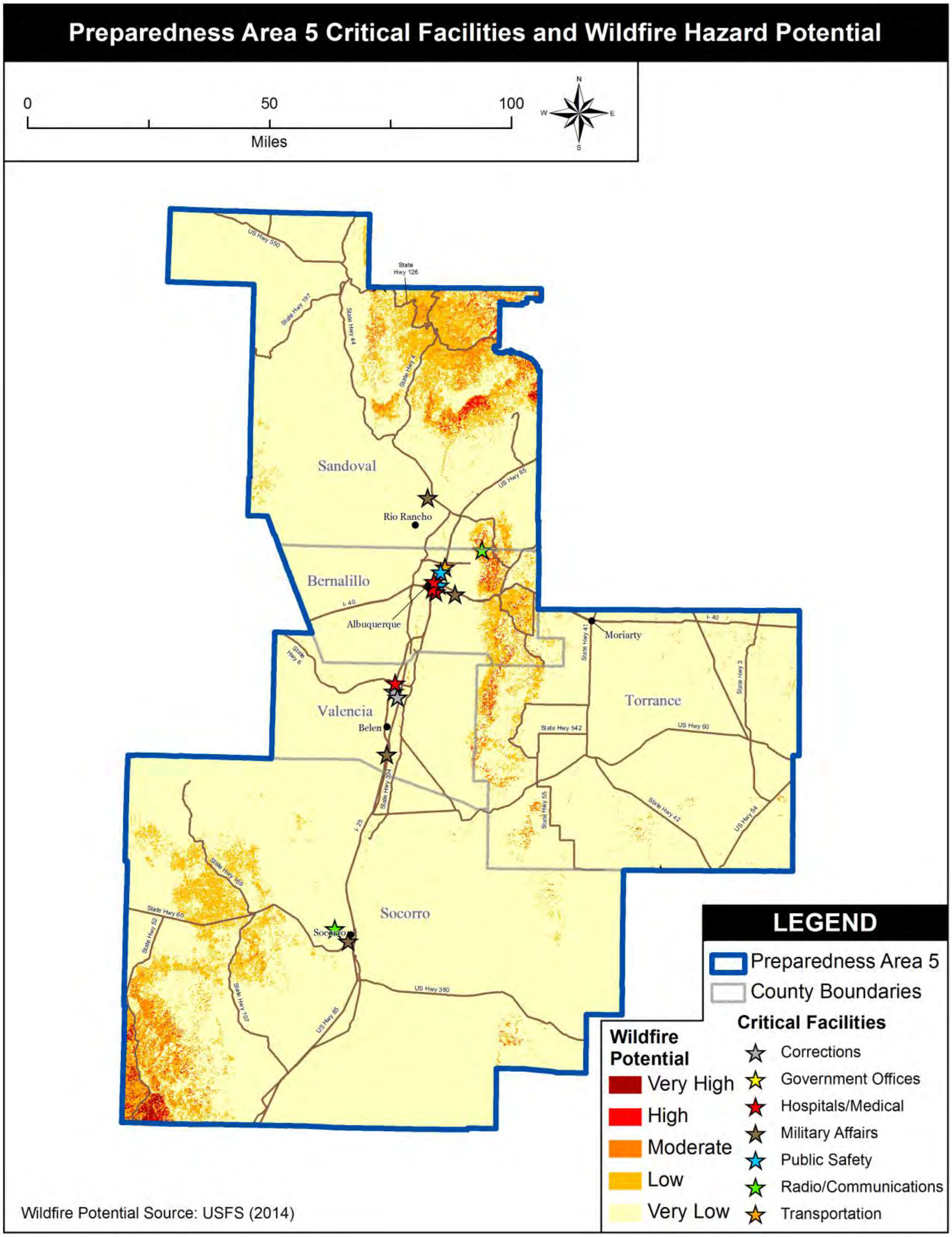
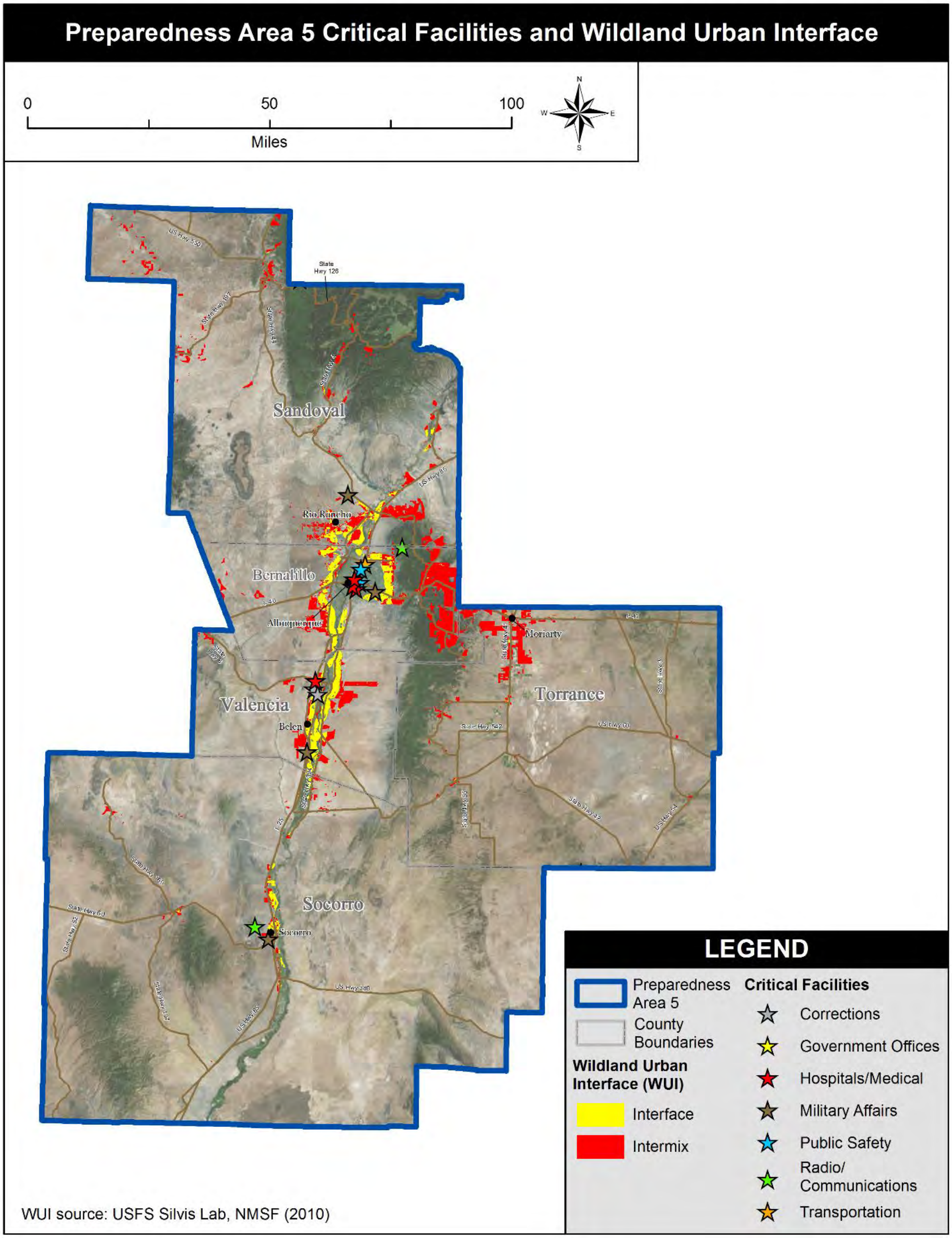


Figure 6-80 Preparedness Area 5 Critical Facilities Located in the WUI, 2010

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	2010 Wildland Urban Interface
BELEN READINESS CENTER	Military Affairs	Low Density Intermix
New Mexico Department of Health - Public Health Division - Metro Region - Los Lunas Public Health Office	Hospitals/Medical	Medium Density Interface

Figure 6-81 Preparedness Area 5 Critical Facilities and WUI



Drought– Preparedness Area 5

Drought, flood, and wildfire were ranked equally as the top priority hazards in local hazard mitigation plans in Preparedness Area 5. Portions of the region have been experiencing drought conditions since the early 2000s. These conditions elevate regional wildfire vulnerability and create a perfect storm for future wildfire disasters. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event. Additionally, reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems.

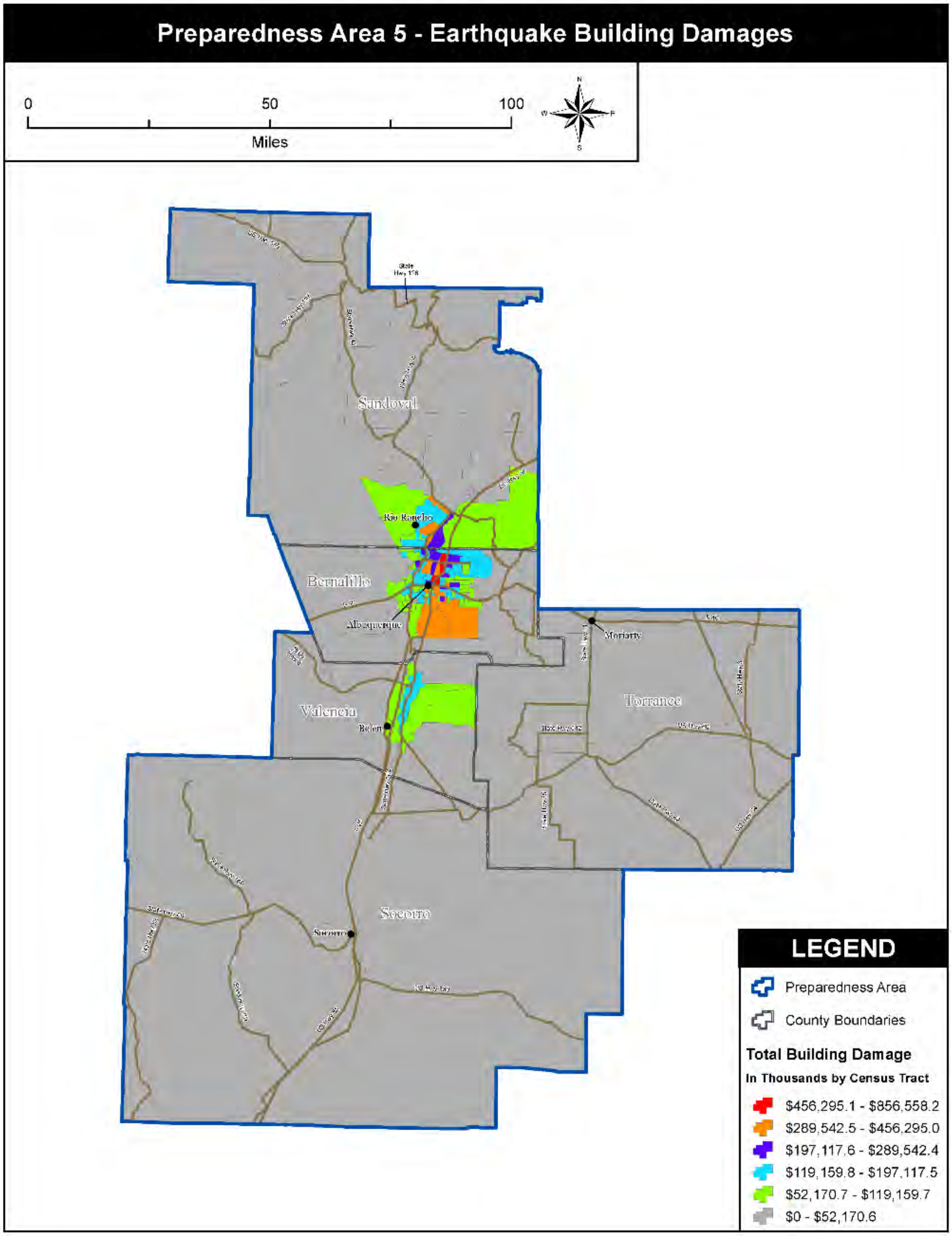
Earthquake – Preparedness Area 5

The following Figure 6-82 presents the expected building-related economic loss estimates for a probable maximum earthquake event modeled in Preparedness Area 5. Figure 6-83 shows building damage information by census tract on a map. The north-central region of the Preparedness Area would experience the most in building damages due to the modeled earthquake.

Figure 6-82 Hazus Earthquake Building-Related Loss Estimates (PA 5)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$113.66 M	$1,254.61 M	$36.86 M	$63.27 M	$1,468.41 M
Capital-Related	$0.00 M	$48.49 M	$1,174.82 M	$21.68 M	$16.16 M	$1,261.14 M
Rental	$572.70 M	$355.17 M	$510.16 M	$11.35 M	$37.34 M	$1,486.73 M
Relocation	$1,915.93 M	$283.97 M	$753.89 M	$54.19 M	$262.80 M	$3,270.77 M
Income Losses (subtotal)	***$2,488.63 M***	***$801.29 M***	***$3,693.48 M***	***$124.08 M***	***$379.57 M***	***$7,487.05 M***
Structural	$3,301.10 M	$710.98 M	$1,596.16 M	$240.25 M	$280.94 M	$6,129.43 M
Non-Structural	$10,644.01 M	$3,254.21 M	$5,403.24 M	$1,015.39 M	$1,006.26 M	$21,323.11 M
Content	$2,411.90 M	$678.87 M	$2,513.23 M	$640.29 M	$461.20 M	$6,705.49 M
Inventory	$0.00 M	$0.00 M	$64.59 M	$111.07 M	$3.11 M	$178.76 M
Capital Stock Losses (subtotal)	***$16,357.00 M***	***$4,644.06 M***	***$9,577.22 M***	***$2,007.00 M***	***$1,751.50 M***	***$34,336.78 M***
Total Estimated Losses	**$18,845.64 M**	**$5,445.35 M**	**$13,270.71 M**	**$2,131.07 M**	**$2,131.07 M**	**$41,823.83 M**

Figure 6-83 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA 5)



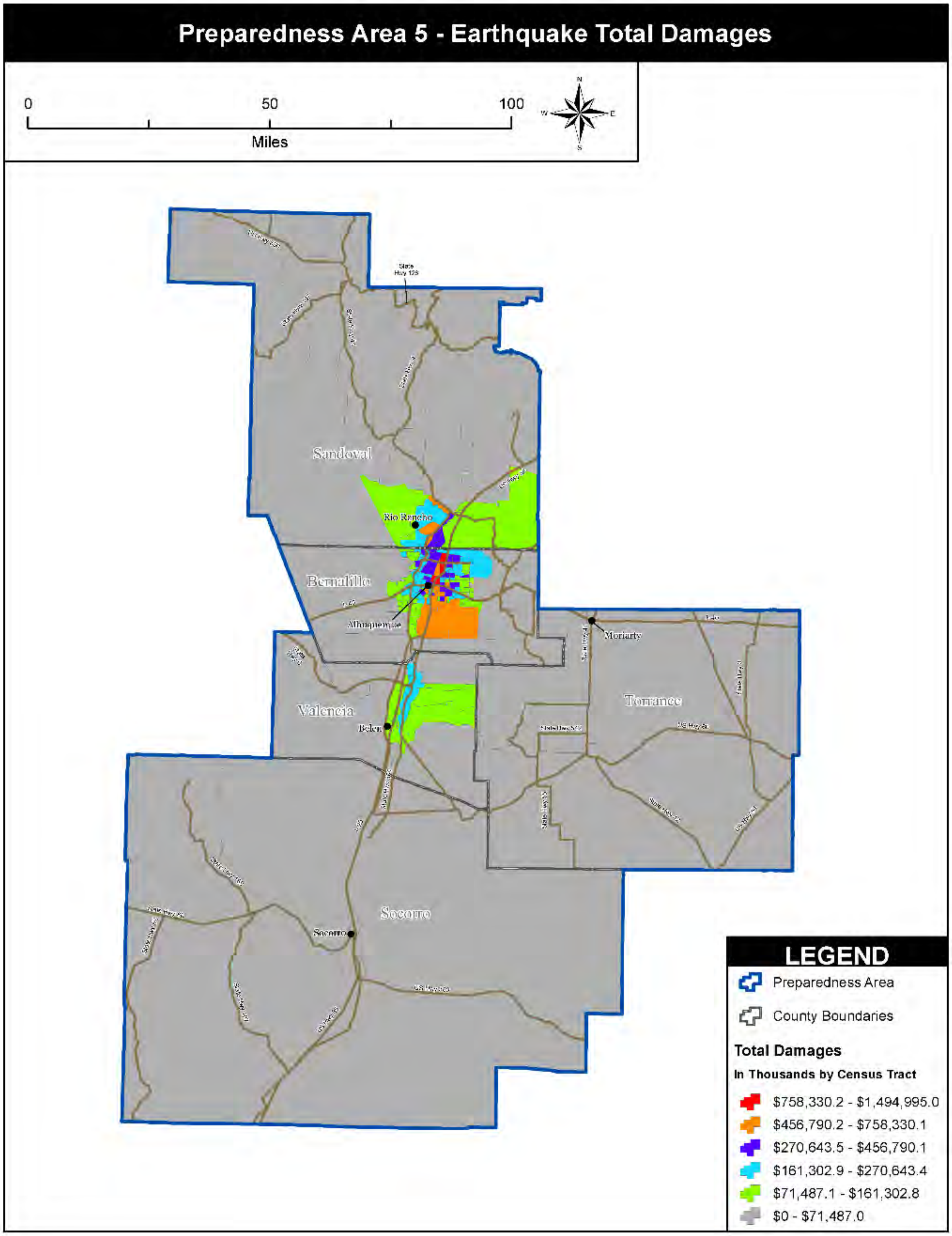
The following Figure 6-84 presents additional modeled impacts from this same event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-84 Hazus Earthquake Impacts and Loss Estimates (PA 5)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 70,823
	Moderate: 79,760
	Extensive: 52,368
	Complete: 68,581
Total Economic Losses (includes building and lifeline losses)	$41,977.57 million
Damage to Schools	122 with at least moderate damage
Damage to Medical Facilities	18 with at least moderate damage
Damage to Fire Stations	4 with at least moderate damage
Damage to Transportation Systems	143 highway bridges, at least moderate damage
	67 highway bridges, complete damage
	0 railroad bridges, moderate damage
	1 airport facilities, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	67,228
Shelter Requirements	44,206 people out of 904,943 total population
Debris Generation	14.41 million tons

Figure 6-85 shows total damages resulting from the modeled earthquake in Preparedness Area 5. Similar to building damages, the north-central region of the area would experience the most in total damages.

Figure 6-85 Total Earthquake Damages by Census Tract (PA 5)



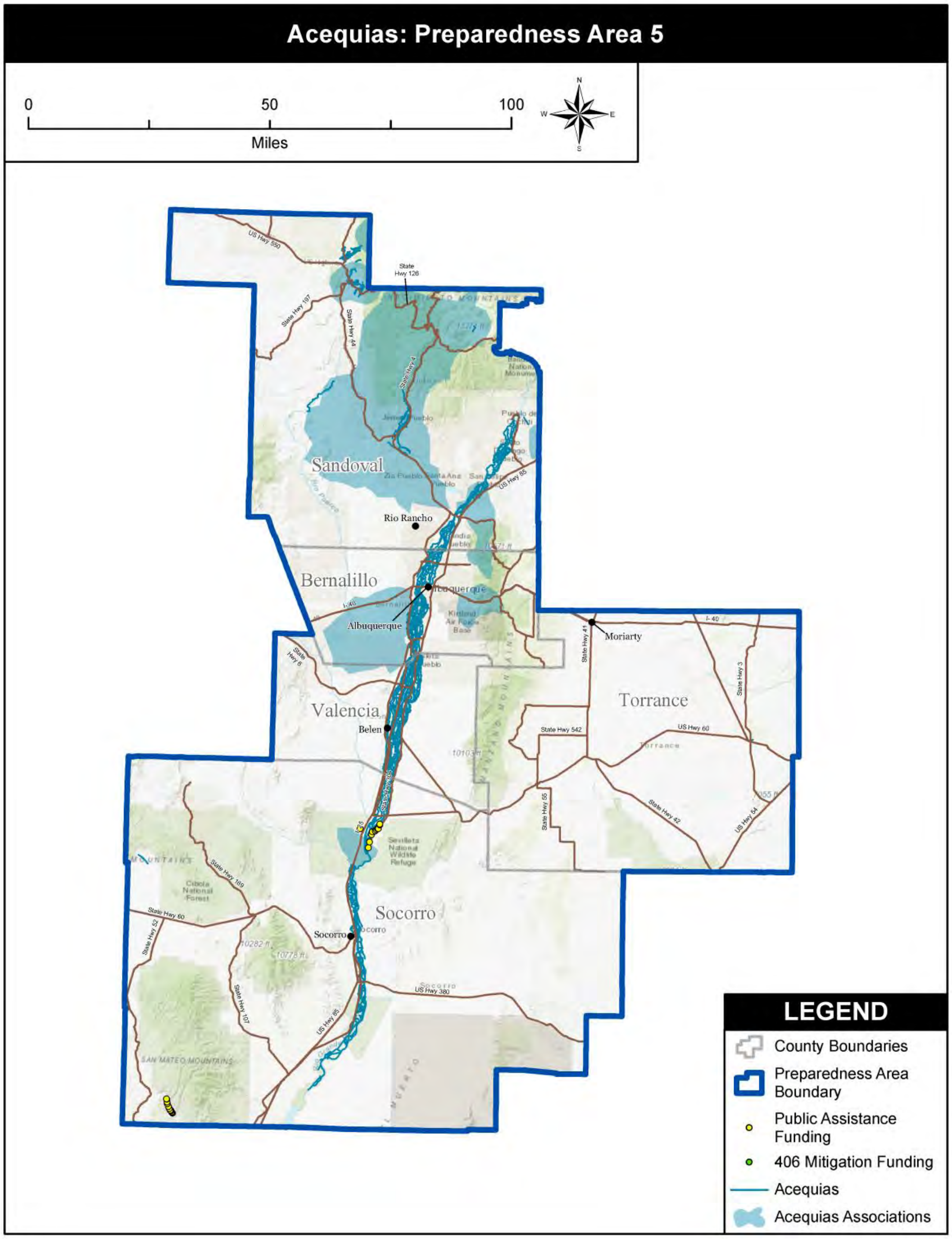
Flood/Flash Floods – Preparedness Area 5

Flash floods have been and will continue to be a significant threat to the economic and social well-being of communities in the region. Preparedness Area 5 is the most populated Preparedness Area in the State and faces elevated levels of social and physical vulnerability to flooding. However, in some local jurisdictions all political subdivisions participate in the National Flood Insurance Program (NFIP). Here, manufactured homes that will be residences within the county are required to be placed on a permanent foundation per zoning/land use regulations in each respective jurisdiction. There is one State critical facility currently mapped as being in the floodplain.

The map below shows locations of acequias in Preparedness Area 5. Preparedness Area 5 contains acequias heavily concentrated along the Rio Grande River, running north to southwest throughout the Preparedness Area (Figure 6-86). The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 5, there are an estimated 1,413 miles of acequia infrastructure identified from existing datasets. There are five known Acequia Associations in the region as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 1,098 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 30 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within the Preparedness Area (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

Figure 6-86 Acequias in Preparedness Area 5



Landslide and Rockfall – Preparedness Area 5

Within Preparedness Area 5, there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Areas of likely susceptibility in Preparedness Area 5 include both mountains and mesa flanks. In Preparedness Area 5, mountainous areas exhibiting large areas of likely susceptibility include the San Mateo, Oscura, Manzano, and Sandia Mountains. The southern flank of the Jemez Mountains also is mapped as having relatively higher susceptibility, as well as mesas along the Jemez and Rio Puerco Rivers. In contrast to the rest of the State, somewhat higher susceptibilities could be expected locally in Torrance County. Bernalillo, Sandoval, Socorro and Valencia Counties have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 5

Preparedness Area 5 has a similar distribution of mapped highly to extremely susceptible deposits as Preparedness Area 3. High to extreme susceptibilities are found along valley margins in alluvial fans being deposited along the edges of the north-south trending mountain chains, both bordering the Rio Grande valley and in the closed basins. This pattern holds for all of Bernalillo, Torrance, Valencia, south and eastern Sandoval, and Socorro counties. In western Sandoval County, high susceptibilities are found along valley margins draining from the Jemez and Nacimiento Mountains, and cover much of the regions.

Wildfire – Preparedness Area 5

Preparedness Area 5 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought, and high fuel loads due to pine beetle kill. The local plans created by jurisdictions within Preparedness Area 5 focus their mitigation efforts on education and outreach as well as on existing property protection and wildfire prevention strategies.

However, vegetation treatments have been ongoing and are planned to continue to mitigate the high fuel loads in Preparedness Area 5. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan Update. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-87 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 5. A total of 845,676 acres of vegetation have been treated and an additional 33,701 are planned for treatment, totaling 879,377 acres of treated vegetation. This equates to approximately 9% of Preparedness Area 5’s total land area. Figure 6-88 shows the breakdown of planned, completed, and historic treatments. Historically, most acres of treatment were completed by the BLM and tribal entities. The majority of acres completed treatments were performed by the USFS, followed by the BLM. The majority of acres of planned treatments will be completed by the USFS. Figure 6-89 shows the percent of total acres treated by land ownership. Overall, the USFS will treat the most acres of vegetation, followed closely by the BLM.

Figure 6-87 Preparedness Area 5 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	**Land Owner**	**Acres**	**Percent**
33,701 (0.3% of PA 5 land area)	BLM	13,830	41.04%
	MRGDC	374	1.11%
	MRGDC, Village of Corrales	10	0.03%
	Private, State, County	10	0.03%
	State	174	0.51%

	Tribal: Alamo Navajo	10	0.03%
	Tribal: Santa Ana Pueblo	10	0.03%
	USFS	19,262	57.16%
	USFS, BLM	10	0.03%
	Valles Caldera Trust	10	0.03%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
599,839 (5.9% of PA 5 land area)	BLM	221,184	36.87%
	BOR	24	0.00%
	DOD	280	0.05%
	FWS	14,755	2.46%
	Municipal	201	0.03%
	NM Game and Fish	71	0.01%
	NMDOT	50	0.01%
	Private	26,486	4.42%
	Private, State	99	0.02%
	State	11,863	1.98%
	State Park	77	0.01%
	Tribal	9,863	1.64%
	USFS	314,886	52.50%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
245,837 (2.4% of PA 5 land area)	BLM	77,115	31.37%
	Private	49,300	20.05%
	State	309	0.13%
	Tribal	74,870	30.46%
	USFS	44,242	18.00%

Figure 6-88 Preparedness Area 5 Total Acres of Vegetation Treatment

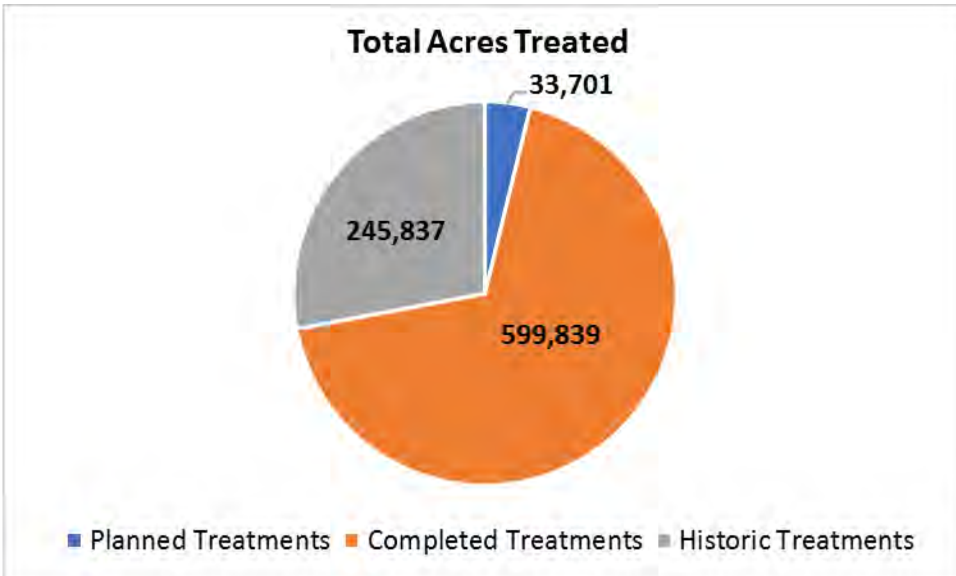
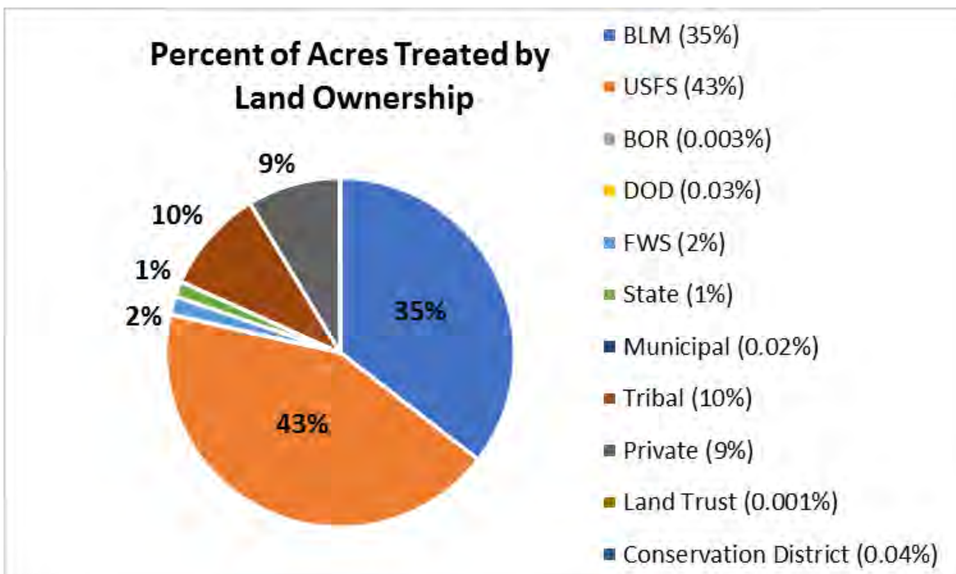


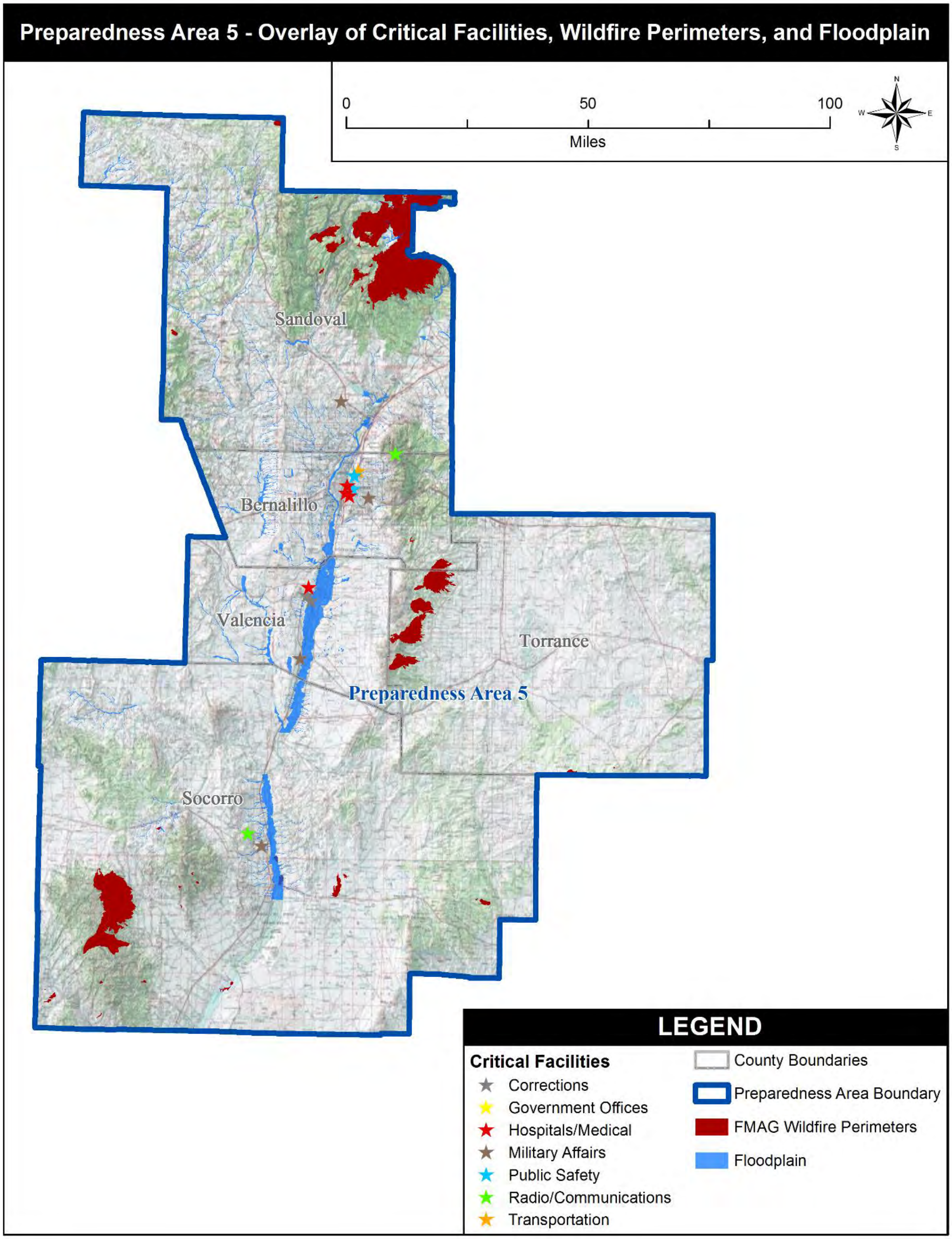
Figure 6-89 Preparedness Area 5 Percent of Total Acres Treated by Land Ownership



Summary – Preparedness Area 5

The following Figure 6-90 presents an overview of the best available mapping data for Preparedness Area 5. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 5 has experienced several past wildfires, and contains areas within the floodplain, particularly through the central portion of the Preparedness Area. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, with Preparedness Area 5 experiencing population growth, it is important to continue to reduce its vulnerabilities to natural hazards.

Figure 6-90 Preparedness Area 5 Risk and Vulnerability Summary



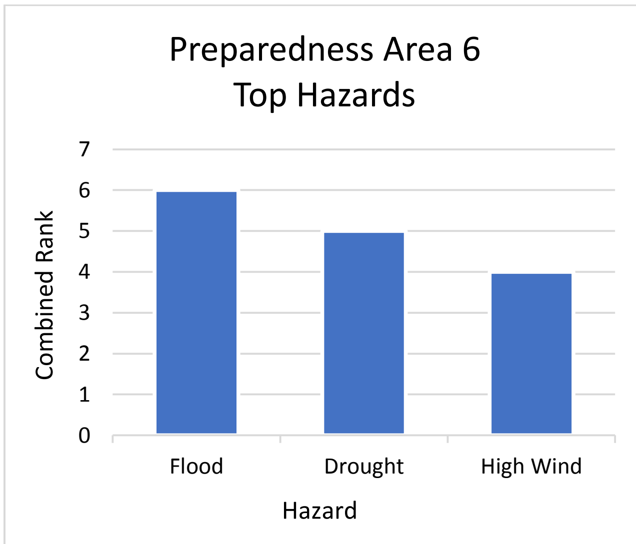
6.10 Vulnerability Assessment – Preparedness Area 6

The following vulnerability analysis is based on information collected from best available data and analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 6. Local jurisdictions within the Preparedness Area identified the following three hazards as being top priority planning concerns:

- Flood/Flash Floods
- Drought
- High Wind

Figure 6-91 provides a weighted summary of this local hazard mitigation plan analysis. Identified hazards were scored based on how the local plan ranked each hazard (high[3], medium[2], low[1]).

Figure 6-91 Preparedness Area 6 Top Hazards



Because they are identified in previous local planning efforts as priority hazards, the vulnerability assessment focuses on the hazards listed above. Although earthquakes, landslides, or land subsidence were not identified as a primary hazard concern for the region, vulnerability analysis is included for as that information is available and will allow for vulnerability comparisons relative to other Preparedness Areas.

Exposure – Preparedness Area 6

Preparedness Area 6 has a total population of 348,246 people and there are over 131,000 households in the Area. Additionally, there are an estimated 144,000 buildings in Preparedness Area 6. Approximately 94% of the buildings and 81% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 6, wood frame construction makes up 51% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

There are six State critical facilities located with Preparedness Area 6. This includes the following facility types: corrections (1), hospitals/medical (2), radio/communications (2), and transportation (1).

The transportation and utility lifeline inventory within Preparedness Area 6 includes over 2,000 miles of highways, 343 bridges, and 16,907 miles of pipes.

Changes in Development – Preparedness Area 6

The following Figure 6-92 presents population counts and projections for those counties included in Preparedness Area 6. Overall the area has seen gradual growth, but this is being entirely driven by only two of the area's seven counties. Mitigation efforts in Preparedness Area 6 should focus on these particular growth areas, as encouraging development outside of hazard areas is one of the most effective tools to help reduce risk and vulnerability.

Figure 6-92 Preparedness Area 6 County Population Changes

County	Census 2010 Population	2016 Population Estimate	Percent Change
Catron County	3,725	3,508	-5.83%
Doña Ana County	209,233	214,207	2.38%
Grant County	29,514	28,280	-4.18%
Hidalgo County	4,894	4,302	-12.10%
Luna County	25,095	24,450	-2.57%
Otero County	63,797	65,410	2.53%
Sierra County	11,988	11,191	-6.65%
Preparedness Area 6	**348,246**	**351,348**	**0.89%**

Steady population growth in the region amid persistent drought conditions will further exacerbate the impacts of drought on communities within Preparedness Area 6. In the future, the need to acquire additional sources of water may pit some cities against other users for a diminishing supply of water. Additionally, this is one of the most populated Preparedness Areas in the State and therefore faces elevated levels of social and physical vulnerability to flooding.

Critical Facilities – Preparedness Area 6

The State's critical facilities identified through this planning process are not anticipated to be impacted by drought or high wind events. Detailed earthquake loss estimations for critical facilities, as defined by Hazus, include the following counts expected to suffer at least moderate damage: hospitals (0), schools (9), EOCs (0), police stations (1), and fire stations (6). There are no State critical facilities currently mapped as being in the floodplain. All critical facilities in Preparedness Area 6 are located in areas with very low wildfire hazard potential, as described in Figure 6-93 and Figure 6-94. One hospital/medical facility is located in the WUI as described in Figure 6-95 and Figure 6-96.

Figure 6-93 Preparedness Area 6 Critical Facilities and Wildfire Hazard Potential, 2014

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
SOUTHERN NEW MEXICO CORRECTIONAL FACILITY	Corrections	Very Low

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	WILDFIRE POTENTIAL - 2014
New Mexico Department of Transportation - District 1	Transportation	Very Low
Fort Bayard Medical Center	Hospitals/Medical	Very Low
Caballo Mountain	Radio/Communications	Very Low
New Mexico Rehabilitation Center	Hospitals/Medical	Very Low
BELEN READINESS CENTER	Military Affairs	Very Low

Figure 6-94 Preparedness Area 6 Critical Facilities Wildfire Hazard Potential

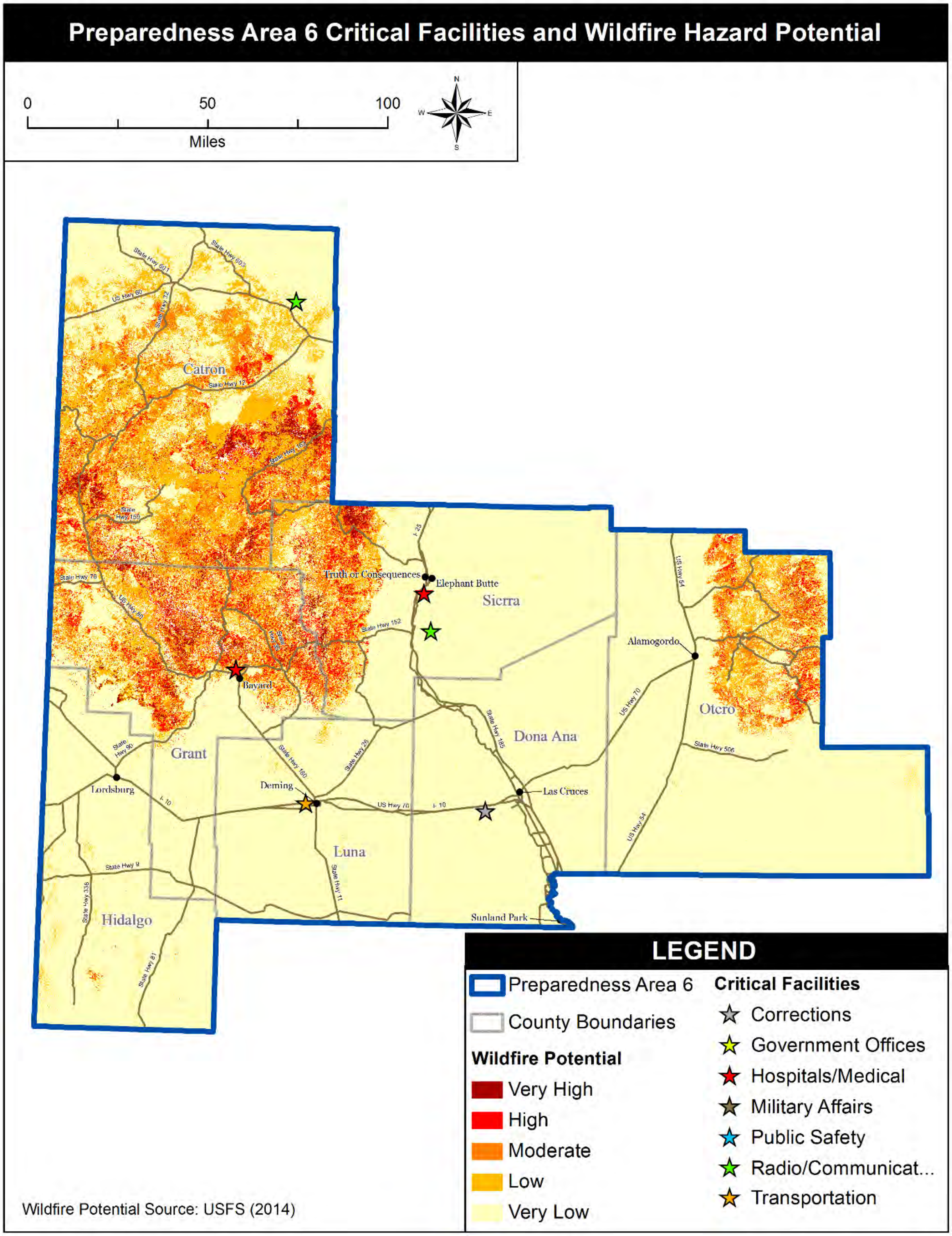
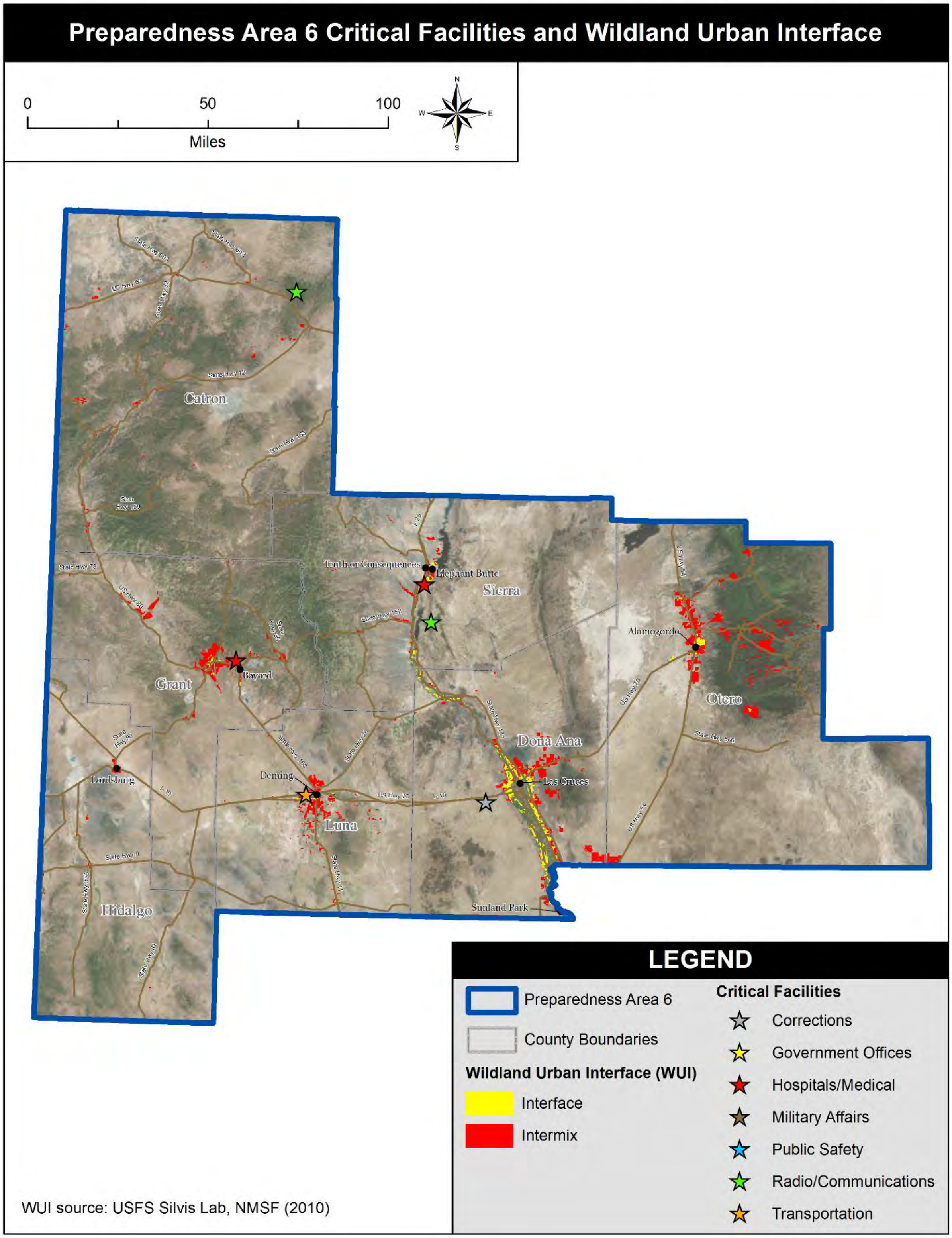


Figure 6-95 Preparedness Area 6 Critical Facilities Located in the WUI, 2010

CRITICAL FACILITY NAME	CRITICAL FACILITY TYPE	2010 Wildland Urban Interface
New Mexico State Veterans Home	Hospitals/Medical	Medium Density Interface

Figure 6-96 Preparedness Area 6 Critical Facilities and WUI



Drought – Preparedness Area 6

Drought was ranked as the second top priority hazard in Preparedness Area 6. A large portion of the land mass of Preparedness Area 6 is experiencing extended extreme drought conditions. The region is also vulnerable to extreme heat conditions. Together, these conditions elevate regional wildfire vulnerability and create a perfect storm for future wildfire disasters. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event. Additionally, reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s.

No standard methodology exists for estimating losses due to drought, which generally does not have a direct impact of the built environment. Losses should instead be measured by potential impacts to various systems, such as: agriculture, water supplies, recreation/tourism, and natural systems.

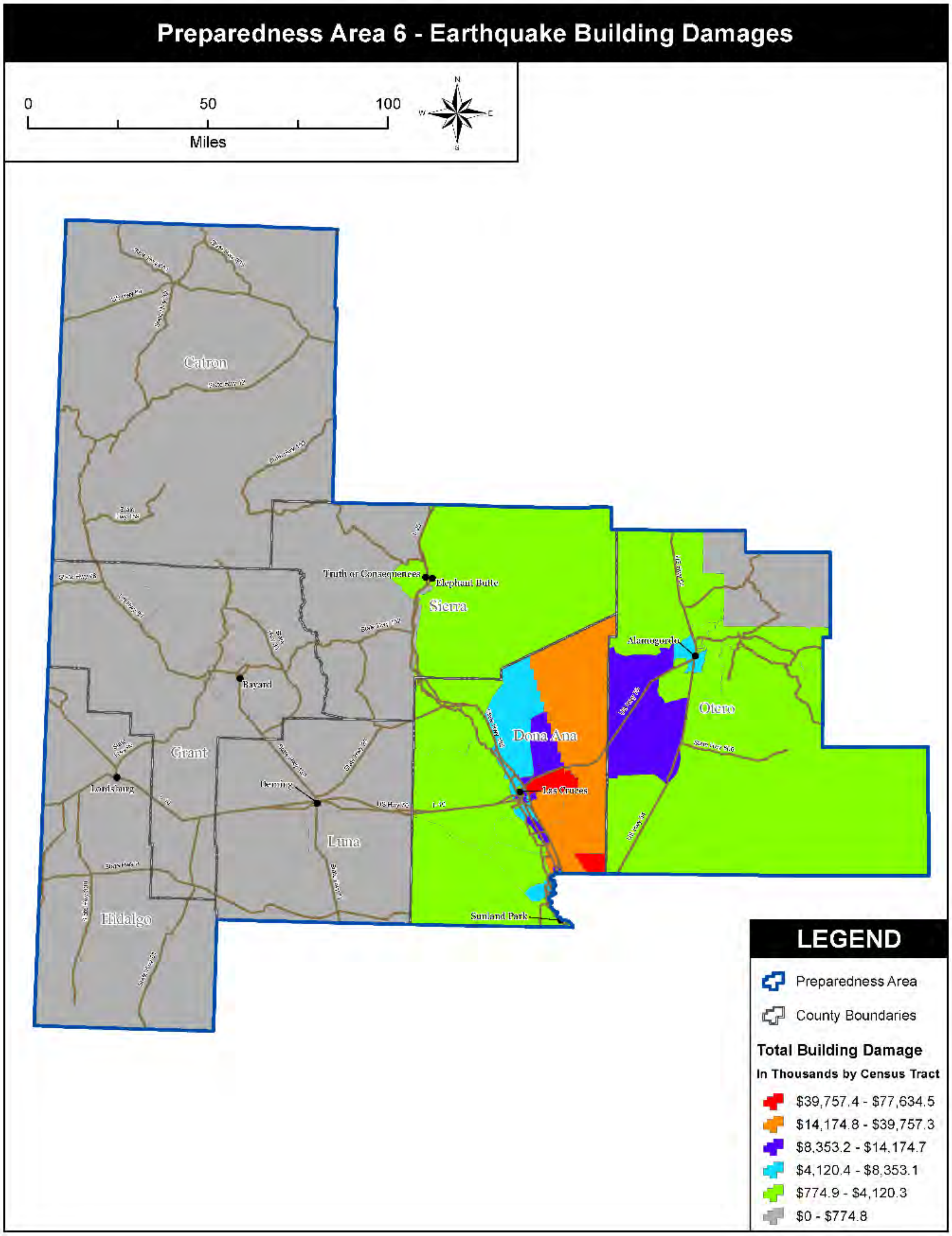
Earthquake – Preparedness Area 6

The following Figure 6-97 presents the expected building-related economic loss estimates for a probable maximum earthquake event modeled in Preparedness Area 6. Figure 6-98 shows building damage information by census tract on a map. The eastern region of the Preparedness Area would experience the most in building damages due to the modeled earthquake.

Figure 6-97 Hazus Earthquake Building-Related Loss Estimates (PA 6)

Loss Estimates	Single Family	Other Residential	Commercial	Industrial	Others	Total
Wage	$0.00 M	$2.83 M	$26.37 M	$0.74 M	$3.41 M	$33.35 M
Capital-Related	$0.00 M	$1.21 M	$22.78 M	$0.44 M	$0.56 M	$24.98 M
Rental	$10.76 M	$11.09 M	$11.62 M	$0.28 M	$2.03 M	$35.78 M
Relocation	$37.72 M	$26.42 M	$18.77 M	$1.70 M	$10.77 M	$95.39 M
Income Losses (subtotal)	***$48.48 M***	***$41.54 M***	***$79.54 M***	***$3.16 M***	***$16.78 M***	***$189.49 M***
Structural	$53.50 M	$45.91 M	$24.63 M	$4.24 M	$10.90 M	$139.18 M
Non-Structural	$164.90 M	$136.93 M	$54.30 M	$9.51 M	$25.68 M	$391.32 M
Content	$52.91 M	$25.87 M	$26.21 M	$5.91 M	$11.59 M	$122.50 M
Inventory	$0.00 M	$0.00 M	$0.72 M	$1.18 M	$0.16 M	$2.05 M
Capital Stock Losses (subtotal)	***$271.31 M***	***$208.71 M***	***$105.87 M***	***$20.83 M***	***$48.33 M***	***$655.04 M***
Total Estimated Losses	**$319.78 M**	**$250.24 M**	**$185.41 M**	**$23.99 M**	**$65.11 M**	**$844.53 M**

Figure 6-98 Hazus Earthquake Building-Related Loss Estimates by Census Tract (PA 6)



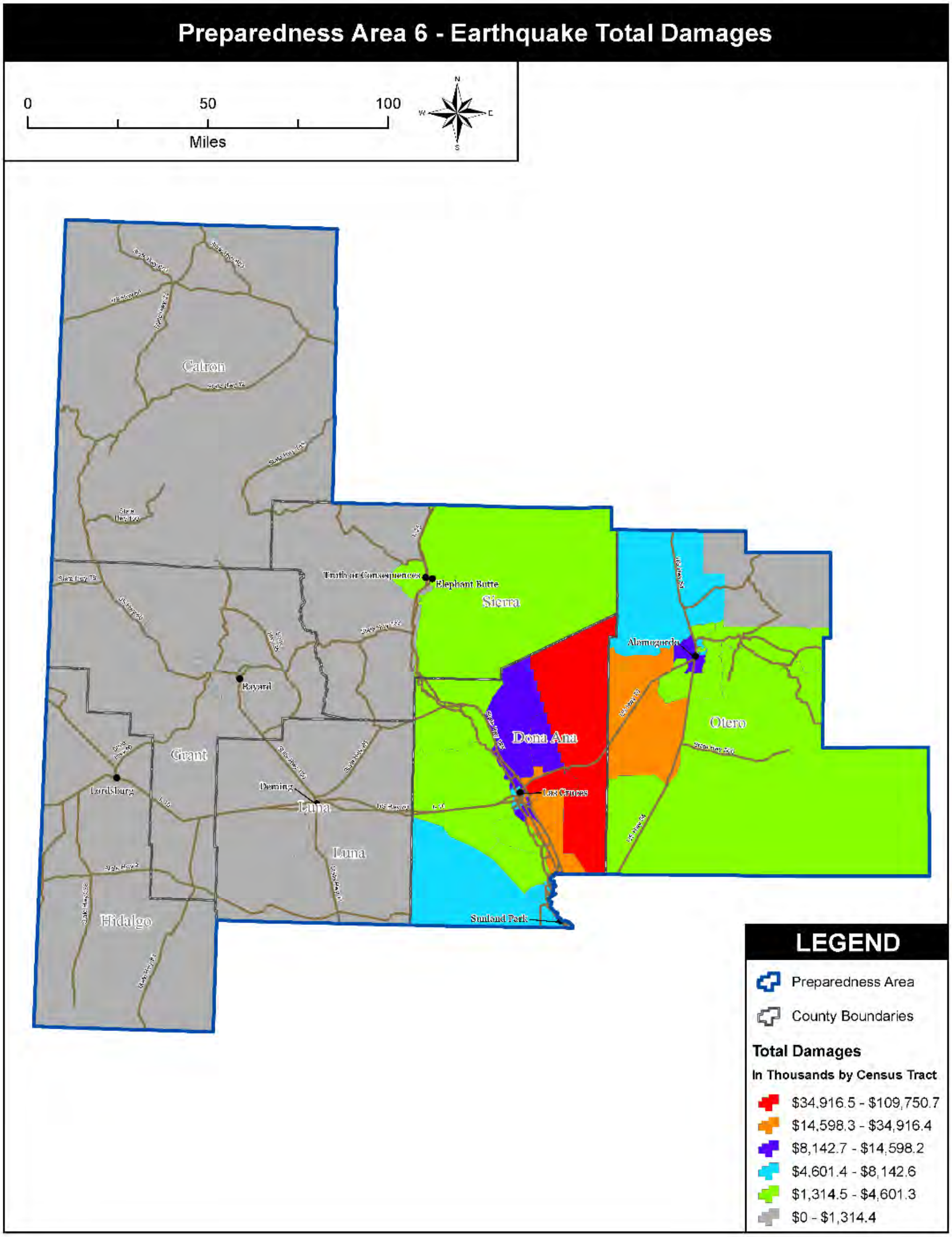
The following Figure 6-99 presents additional modeled impacts from this same event. Note that all definitions are taken from the Hazus Global Summary Report (GSR).

Figure 6-99 Hazus Earthquake Impacts and Loss Estimates (PA 6)

Impact	Summary of Modeled Impacts
Total Buildings Damaged	Slight: 16,607
	Moderate: 11,607
	Extensive: 4,182
	Complete: 1,364
Total Economic Losses (includes building and lifeline losses)	$852.50 million
Damage to Schools	9 with at least moderate damage
Damage to Medical Facilities	0 with at least moderate damage
Damage to Fire Stations	6 with at least moderate damage
Damage to Transportation Systems	2 highway bridges, at least moderate damage
	0 highway bridges, complete damage
	0 railroad bridges, moderate damage
	0 airport facilities, moderate damage
Households without Power/Water Service	Power loss, Day 1: 0
	Water loss, Day 1: 0
	Water loss, Day 3: 0
	Water loss, Day 7: 0
	Water loss, Day 30: 0
	Water loss, Day 90: 0
Displaced Households	870
Shelter Requirements	771 people out of 348,246 total population
Debris Generation	0.39 million tons

Figure 6-100 shows total damages resulting from the modeled earthquake in Preparedness Area 6. Similar to building damages, the eastern region of the area would experience the most in total damages.

Figure 6-100 Total Earthquake Damages, Preparedness Area 6



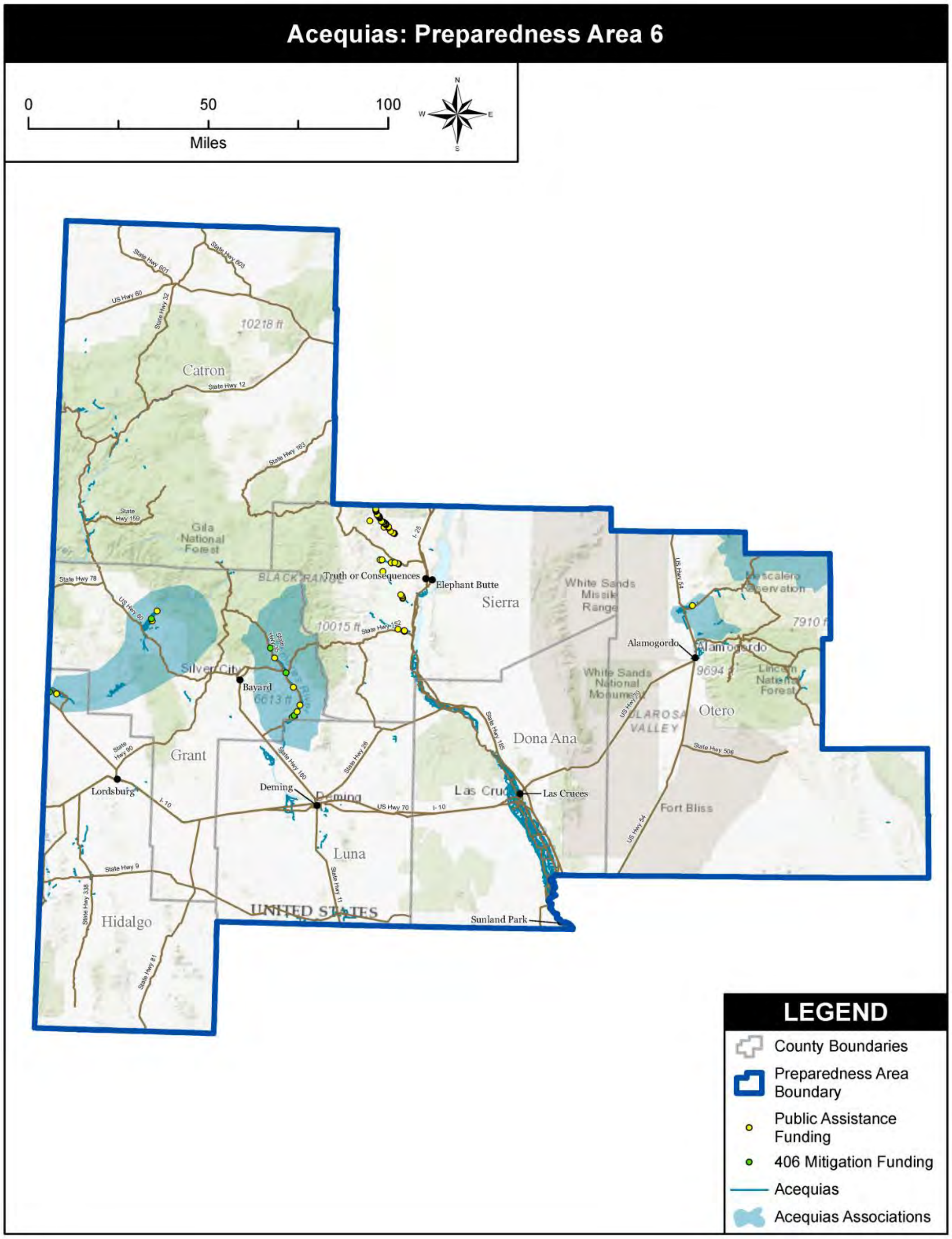
Floods/Flash Floods – Preparedness Area 6

Floods/flash floods were ranked as the number one top hazard priority for Preparedness Area 6. Under the right conditions, virtually every Preparedness Area in the State of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including mudslides. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September.

The map below shows locations of acequias in Preparedness Area 6. Preparedness Area 6 contains acequias heavily concentrated along the Rio Grande River in the southcentral region of the Preparedness Area (Figure 6-101). The acequias are vulnerable to flood damages and have the potential to flood surrounding property. For Preparedness Area 6, there are an estimated 1,224 miles of acequia infrastructure identified from existing datasets. There are four known Acequia Associations in the region, as identified by the New Mexico Acequia Association data. Based on known locations in the region, EDAC has identified 674 miles of at risk acequia infrastructure based on their proximity to the NFHL.

There are also 85 acequia recipients of public assistance to support disaster recovery on record with DHSEM which have been mapped within the Preparedness Area (identified with a yellow dot). Locations that received 406 mitigation funding as part of Public Assistance are also mapped (shown with a green dot).

Figure 6-101 Acequias in Preparedness Area 6



High Wind – Preparedness Area 6

High wind was ranked as the third top priority hazard in Preparedness Area 6. Severe wind storms are a typical occurrence in New Mexico, especially in the spring. Across the State, property damage and physical injury are the most frequently reported impacts of high wind events. Secondary hazards associated with high winds include downed power lines (additional wildfire hazard), structural instability and collapse, and injury dues to airborne dust and debris.

Large-scale dust storms occasionally occur in the White Sands region of New Mexico and in the Preparedness Area from Deming westward to the Arizona border. Major dust events can transport mineral aerosols (dust) for long distances, obscuring vision for motorists and causing breathing problems for people with respiratory difficulties. Since 2014 there have been 15 deaths attributed to dust storms caused by high wind. In addition, there was an accident caused by high wind dust storms that involved 18 trucks and seven cars.

Several severe wind storms have caused road closures within the Preparedness Area. A number of counties within Preparedness Area 6 are home to large numbers of mobile homes and commercial and public buildings. Structures of this type are highly vulnerable to high wind events. In many cases, however, these buildings have not been inventoried at the local scale.

Landslide and Rockfall – Preparedness Area 6

Within Preparedness Area 6, there are local areas mapped as likely susceptibility for deep-seated landslides and rockfall. Preparedness Area 6 generally lacks mesas. More likely susceptible areas consist of steep, mountainous areas that include most of the Sacramento, San Andres, Black Range, and Animas Mountains. The Mogollon Mountains have a slightly higher predicted susceptibility for rock fall than for deep-seated landslides. Somewhat higher susceptibilities could be expected locally in Luna County and Dona Ana County. Catron, Grant, Hidalgo, Otero, and Sierra counties have sizeable areas with relatively high potential (i.e., likely susceptibility) for deep-seated landslides or rockfall.

Land Subsidence (includes collapsible soils) - Preparedness Area 6

Much of the southern half of Preparedness Area 6 is mapped as highly to extremely susceptible to collapsible soils. The extremely susceptible areas are all alluvial fan deposits on the alluvial fan margins of mountains, primarily in the more arid southern half of the Area, including Otero, Dona Ana, Sierra, and Luna counties. Much of these counties, more distally in the fan deposits and at high elevations in these fan deposits, have high susceptibilities. Hidalgo and Grant counties have few extremely susceptible areas, but have extensive highly susceptible areas, once again associated with alluvial fan deposits on the margins of the closed basins and large river valleys of the regions. Catron County has relatively few highly or extremely susceptible soils. These are mostly on valley margins of the San Francisco River and other, smaller streams, and in alluvial fan on the northern flank of the western San Agustin Plains.

Wildfire – Preparedness Area 6

Preparedness Area 6 did not rank wildfire as one of their top priority hazards, however all preparedness areas in New Mexico are vulnerable to wildfire. Vegetation treatments have been ongoing and are planned to continue to mitigate high fuel loads in Preparedness Area 6. Vegetation Treatment Mapping was conducted by NM State Forestry as described in the Capability Section, **New Mexico Vegetation Treatments Geodatabase** subsection of this Plan Update. Vegetation treatments include actions such as prescribed burns and mechanical thinning to decrease the amount of fuel load and mimic frequent, low-intensity burns that are natural to the ecosystem. Figure 6-102 shows planned, completed (1996-present), and historic (pre-1996) vegetation treatments by total acres and land owner in Preparedness Area 6. A total of 2,753,401 acres of vegetation have been treated and an additional 559,724 are planned for treatment, totaling 3,313,125 acres of treated vegetation. This equates to approximately 16% of Preparedness Area 6's total land area. Figure 6-103 shows the breakdown of planned, completed, and historic treatments. Historically, most acres of treatment were completed by the USFS. The majority of acres of completed treatments were performed by the USFS, followed by the BLM, and the BLM will perform the most acres of planned treatment. Figure 6-104 shows the percent of total acres treated by land ownership. Overall, the USFS will treat the most acres of vegetation.

Figure 6-102 Preparedness Area 6 Planned, Completed, and Historic Vegetation Treatments

Planned Treatments			
Total Acres	**Land Owner**	**Acres**	**Percent**
559,724 (2.7% of PA 6 land area)	BLM	248,216	44.35%
	Municipal	1,147	0.21%
	Private	6,971	1.25%
	SLO, Private	6,886	1.23%
	State	660	0.12%
	State, Private	52,642	9.41%
	Tribal: Mescalero Apache	33,334	5.96%
	USFS	121,836	21.77%
	USFS, Private	82,705	14.78%
	USFS, State Wildlife Area	5,326	0.95%
Completed Treatments (1996-present)			
Total Acres	**Land Owner**	**Acres**	**Percent**
2,288,049 (11.2% of PA 6 land area)	BLM	670,567	29.31%
	BLM, Private	17,145	0.75%
	BLM, State	2,093	0.09%
	DOD	419	0.02%
	Municipal	131	0.01%
	Private	101,814	4.45%
	Private, BLM	12	0.00%
	State	150,271	6.57%
	Tribal	4,734	0.21%
	Tribal: Mescalero Apache	157,399	6.88%
	USFS	1,183,465	51.72%
Historic Treatments (pre-1996)			
Total Acres	**Land Owner**	**Acres**	**Percent**
465,352	BLM	18,866	4.05%

(2.3% of PA 6 land area)	Private	8,354	1.80%
	Tribal	25,076	5.39%
	USFS	413,056	88.76%

Figure 6-103 Preparedness Area 6 Total Acres of Vegetation Treatment

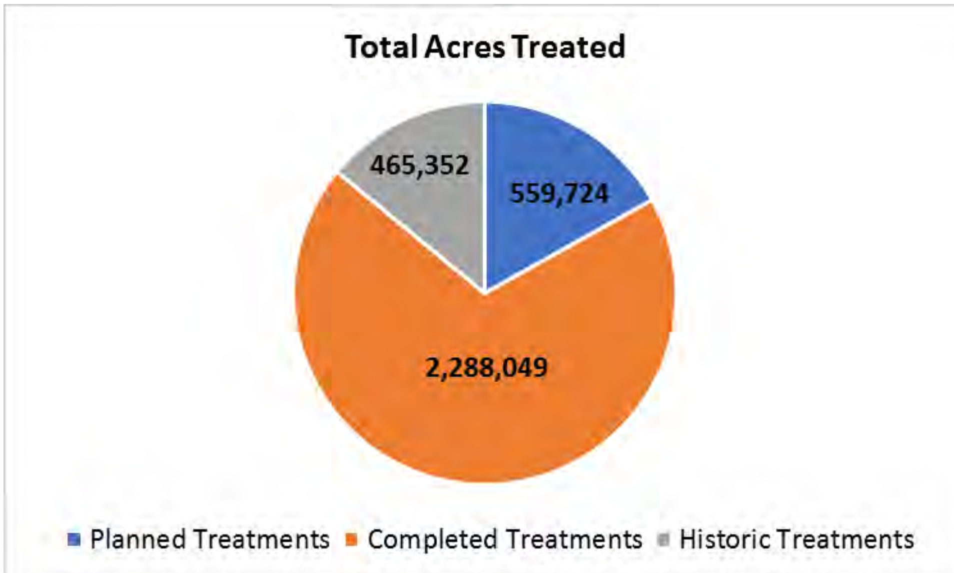
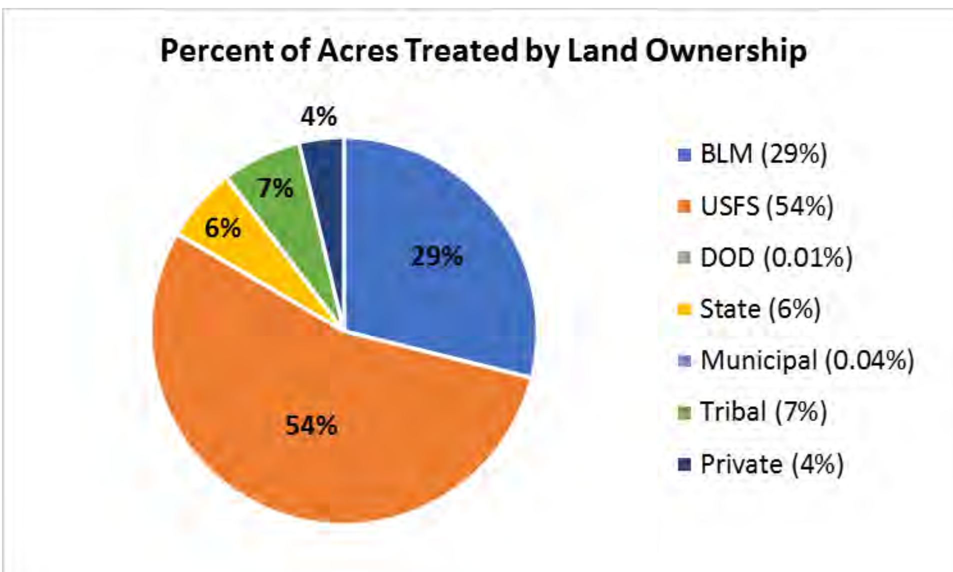


Figure 6-104 Preparedness Area 6 Percent of Total Acres Treated by Land Ownership

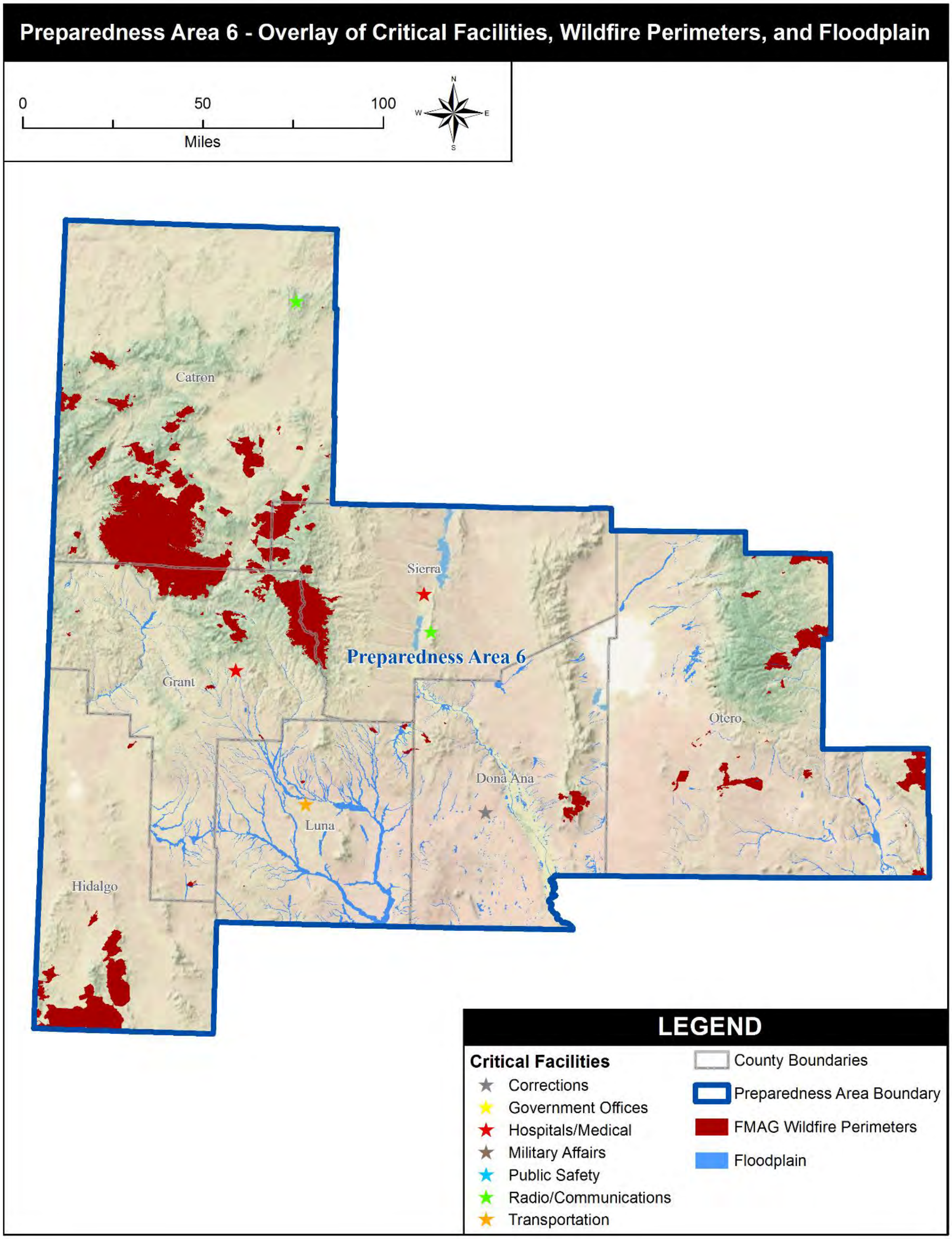


Summary – Preparedness Area 6

The following Figure 6-105 presents an overview of the best available mapping data for Preparedness Area 6. This includes critical facilities, historical wildfire perimeters, and the 100-year floodplain. Preparedness Area 6 has experienced several past wildfires, particularly in the eastern portion of the

Preparedness Area, and contains areas within the floodplain. Overall, the State has made a number of successful advances in analyzing and identifying potential vulnerabilities to a number of hazards profiled since 2013. However, with Preparedness Area 6 experiencing population growth, it is important to continue to reduce its vulnerabilities to natural hazards.

Figure 6-105 Preparedness Area 6 Risk and Vulnerability Summary



7 MITIGATION STRATEGY

7.1 Overview of the Mitigation Strategy Concept

The ultimate mission of all hazard mitigation is to reduce injury and property damage from the impact of natural hazards. State, Tribal, and Local governments can make progress toward this goal through an intense and coordinated planning effort and by the use of prudent fiscal management to achieve the objectives set forth in mitigation plans.

The Hazard Identification/Risk Assessment (HIRA) Section of this Plan Update focuses on the hazards that are most likely to impact the State of New Mexico. The hazards in alphabetical order are dam failure, drought, earthquake, extreme heat, expansive soils, flood/flash flood, high wind, landslide, land subsidence, severe winter storm, thunderstorm (including lightning and hail), tornado, volcanoes and wildfire.

Strategies reflect what the State government agencies would like to mitigate. For the purposes of this Plan Update, the State Hazard Mitigation Planning Team (SHMPT) does not consider the lack of funding as a limiting factor in the identification of mitigation strategies. Instead, solid mitigation actions are included in the Plan Update with the hopes that funding will become available at some point in time. Other factors, such as special considerations due to the National Environmental Policy Act (NEPA) and the National Historic Properties Act (NHPA), impose limitations on the spending of Federal funds, making some actions highly challenging to implement. For the purposes of this Plan Update, the SHMPT does not consider environmental and historic compliance as a limiting factor in the identification of mitigation strategies. When the time comes to decide on pursuing a specific project, these influences must be considered in addition to other requirements of the relevant funding source.

The SHMPT and Subject Matter Experts reviewed the mitigation goals and action items from the 2013 Plan. Edits and updates were integrated into the 2018 Plan Update based on the feedback provided.

7.1.1 Mitigation Goals

The goal of mitigation is to save lives and to reduce injuries, property damage and recovery times. Mitigation can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical facilities, reduce exposure to liability, and minimize community disruption. Preparedness, response, and recovery measures support the concept of mitigation and may directly support identified mitigation actions.

Goals for natural hazard mitigation in New Mexico are:

1. Reduce the number of injuries due to natural hazards;
2. Reduce the number of fatalities from natural hazards;
3. Reduce the amount of property damage, both public and private, from natural hazards;
4. Reduce the number of necessary evacuations;
5. Shorten recovery time for both community function and the natural environment after natural hazard events;
6. Improve communication, collaboration and integration among State, Tribal and Local emergency management agencies;

7. Increase awareness and understanding of risks and opportunities for mitigation among the citizens and elected officials of New Mexico; and
8. Mitigate repetitive loss and severe repetitive loss structures in the state to reduce impacts of flooding

7.1.2 Setting Priorities

The SHMPT and Subject Matter Experts worked together to prioritize a myriad of mitigation actions. The methodology used to determine mitigation action priorities was based upon the SHMPT's understanding of the STAPLE+E framework.

STAPLE+E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental and the framework provides a systematic approach to weighing the pros and cons of potential mitigation actions. FEMA recommends using the STAPLE+E framework because it comprehensively addresses the major factors important to weighing the costs and benefits of implementing one action over another.

Figure 7-1 below summarizes each of the seven STAPLE+E characteristics by highlighting the considerations taken when weighing one mitigation action against another. Additional textual explanations for each characteristic are provided below.

Figure 7-1 STAPLE+E Evaluation Summary

Evaluation Category	Consideration
Social	• Effects on a specific segment of the population • Disrupt communities • Impact on community values • Impact on cultural resources
Technical	• Realistic • Long-term solution • Secondary impacts
Administrative	• Capability (staffing levels and training) • Funding availability • Maintenance oversight
Political	• Political support • Public support • Local champion or proponent
Legal	• Legal authority • Liability • Action potentially subject to legal challenge
Economic	• Cost to implement and maintain mitigation action • Burden to local economy • Contribution to economic goals • Outside funding available
Environmental	• Affects land/water resources • Affects endangered species • Consistent with applicable environmental laws • Consistent with community's environmental goals

7.1.2.1 *Social*

The public must support the overall implementation strategy and specific mitigation action. Each proposed mitigation action was evaluated in terms of social impact and community acceptance by taking the following themes into consideration:

- The action does not adversely affect one segment of the population;
- The action will not disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people;
- The action is compatible with present and future community values; and
- The action will not adversely affect cultural values or resources.

7.1.2.2 *Technical*

Only those actions for which there are reasonable solutions, given the technological requirements of the project, have been considered in this Plan Update. No assumptions were made that new technologies will emerge to solve challenging problems. Each proposed mitigation action was evaluated in terms of technical feasibility by taking the following themes into consideration:

- The action can realistically be accomplished;
- The action is a long-term solution; and
- The action reduces/eliminates secondary impacts.

7.1.2.3 *Administrative*

This evaluation criteria examines the anticipated staffing, funding, and maintenance requirements for the mitigation action to determine if administrative capabilities necessary to implement the action are available to the state. Each proposed mitigation action was evaluated in terms of administrative capability by taking the following themes into consideration:

- Existing capability is available or can readily be obtained (staff, technical experts, reference information);
- Funding is available or can readily be obtained; and
- Resources for oversight and maintenance are available or can readily be obtained.

7.1.2.4 *Political*

Very often, the support of political stakeholders and decision-makers is critical to the timely implementation a mitigation action. Therefore, each proposed mitigation action was evaluated in terms of its political feasibility by taking the following themes into consideration:

- There is political support to implement and maintain the action;
- There is a department, agency or individual willing to help see the action to completion; and
- There is a department, agency or individual willing to take responsibility for long-term maintenance.

7.1.2.5 *Legal*

Each level of government operates under a specific source of delegated authority. Therefore, without the appropriate legal authority, many mitigation actions cannot be lawfully implemented. Each proposed mitigation action was evaluated in terms of its legal implications and parameters by taking the following themes into consideration:

- The State, Tribe, or community has the legal authority to implement the proposed action;
- There are no potential legal consequences such as liability;
- It is unlikely that the action will be challenged by stakeholders who may be negatively affected.

7.1.2.6 *Economic*

No quantitative Benefit Cost Analysis was completed for the proposed mitigation actions. Such an analysis would require detailed information only available at the time that the project completed a scoping phase. The SHMPT agreed that considering the economics of a proposed mitigation action should be based on the general understanding that the cost to implement and maintain the project would at least equal future damages avoided. Furthermore, economic considerations must include the present economic base and projected growth. Each proposed mitigation action was evaluated in terms of its economic impacts by taking the following themes into consideration:

- The cost appears to at least equal the future damages avoided;
- A long-term financial burden will not be placed on the tax base or local economy to implement this action;
- The action contributes to other community economic goals, such as capital; improvements or economic development; and
- Outside sources of funding are available.

7.1.2.7 *Environmental*

The careful consideration of environmental impacts is important to mitigation planning because of a strong public desire for sustainable and environmentally healthy communities. There are many statutory considerations, such as the National Environmental Policy Act (NEPA), to keep in mind when using Federal funds. Numerous mitigation actions may well have beneficial impacts on the environment. For instance, sediment/erosion control actions or arroyo/wetland restoration projects help restore the natural function of the floodplain. Such mitigation actions benefit the environment while creating sustainable communities that are more resilient to disasters. Each proposed mitigation action was evaluated in terms of its environmental impacts and secondary benefit by taking the following themes into consideration:

- The action will not have a negative effect on natural resources such as arroyos, wetlands, forests, etc.;
- The action will have beneficial impacts on natural resources such as improving floodplain natural functions;
- The action will have beneficial impact on cultural resources such as preserving historic properties or structures;
- The action will not have a negative effect on any endangered or threatened species;
- The action complies with Local, State, and Federal environmental laws or regulations; and
- The action is consistent with environmental goals.

The SHMPT and Subject Matter Experts applied the STAPLE+E framework and methodology for action ranking. For the purposes of this State Mitigation Plan Update, STAPLE+E scores are calculated for each mitigation action on a scale of low/poor (1 point), to medium/good (2 points) to high/excellent (3 points) priority based on an overall ranking of each of the seven characteristics. The scores are then averaged (based on the total number of voting project team members) and the actions are prioritized based on their average scores. The "Adapted STAPLE+E Averages" recorded under each mitigation action item (below) are based on the ranking activity conducted by the SHMPT and Subject Matter Experts during the 2018 Plan update.

7.2 Mitigation Action Items

The process for developing mitigation actions for the New Mexico Hazard Mitigation Plan consisted of a thorough review and evaluation of the actions in the 2013 plan. The SHMPT and Subject Matter Experts provided progress updates for each mitigation action and slight modifications to the narrative of the 2013 actions.

Below is a brief description of 42 mitigation actions. The actions are listed under each natural hazard type. The natural hazard types are in alphabetical order for ease of reference. Mitigation actions that address multiple hazard types are described in the first category and reference is made under each individual hazard type. At the end of the list of mitigation actions are two summary charts. The first (Figure 7-2) shows ranking by hazard type and the second (Figure 7-3) shows all actions ranked in priority order. Under each action there is a comment on "2018 Update" based on information provided by the SHMPT and Subject Matter Experts. Any updates to the action descriptions are included in the '2018 Update' paragraph for each action.

All mitigation actions listed here are actions that the SHMPT and Subject Matter Experts believe will most significantly and effectively reduce the impacts of natural hazards on New Mexico communities. The actions included in this "wish list" are meant to be implemented as staffing and funding become available. There is no implied or actual commitment to the implementation of these suggested actions. "Suggested Funding" in the descriptions below refer to cash, in-kind resources, staff time, technical assistance, or other resources.

7.2.1 Multi-Hazard

1. **Develop Comprehensive Public Education/Outreach Strategies**

   The campaign as envisioned includes a series of public service announcements, pamphlets, trainings, and demonstration activities on the hazards New Mexicans face. Special populations will be identified for targeted messages (mobile homes, low income, homebound, apartment dwellers). The effort would focus on one hazard each month and would involve collaborating with local subject matter experts. Additional special topics would also be covered, such as evacuation and sheltering in place.

   Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire

   How Contributes to Strategy: This program educates the public on the range of possible mitigation, prevention and preparedness actions that could be initiated within the State. It will show simple do-it-yourself initiatives through large scale federally funded projects. It will introduce topics and concepts that are familiar to emergency managers, but that are relatively new to the general population.

Suggested Responsible Party: NMEMA, NMFMA, THE NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY, EDAC, DHSEM, State Forestry, NM Environment Department, NM Department of Agriculture, Office of the State Engineer, Department of Energy Minerals and Natural Resources, local hardware and home improvement stores, local media outlets, websites, etc.
Estimated Expenses: Employee time, materials, estimated costs for first year $100,000
Funding Sources: FEMA grants, NMEMA, NMFMA, THE New Mexico Institute of Mining and Technology, EDAC, DHSEM, State Forestry, NM Environment Department, NM Department of Agriculture, Office of the State Engineer, Department of Energy Minerals and Natural Resources, private contributions, local emergency management personnel time, legislative allotments
Timeframe: Immediate and ongoing
Adapted STAPLE+E Average: 2.71
Ranking: 4

2018 UPDATE:

State Forestry has hosted a variety of public education and outreach strategies to reduce wildland fire risk. Through social media, Fire Adapted Communities, Living with Fire Guide One Less Spark, and Ready, Set, Go!, print, radio, and television medias. The most recent television ads aired on Telemundo TV and on MY50 TV May 9, 2017 through June 30, 2017 targeting landowners/homeowners using the One Less Spark initiative. Pandora internet radio ads with wildfire prevention messages have been used to reach out to the Spanish speaking public in rural areas. Billboards with wildfire prevention messages have been used to reach out to the public along highways and interstates in numerous locations around the state. Smokey Bear wildfire prevention materials have been purchased and issued at numerous events including the New Mexico State Fair. The State Forestry Division participates yearly in Wildfire Awareness Week. A press conference is typically held in the month of May with the Governor, State Forester and other state dignitaries in attendance at the Rio Grande Nature Center State Park in Albuquerque. The media, print, radio and television, is in attendance at these events. State Forestry produced and maintains the online resource "After Wildfire: A Guide for New Mexico Communities," as well as associated print resources. See http://afterwildfirenm.org/.

DHSEM has funded several public education and outreach projects utilizing FEMA HMGP funding and non-federal match. Funds were made available utilizing DHSEM sub-grants. For the SSCAFCA Arroyo Safety Project, arroyo safety curriculum was developed for school age children, including creation of cartoon animal characters to deliver the safety message. For the adult audience, the following products have been developed or are under development; brochures, newspaper ads, mobile phone application and community workshops. The Socorro County Wildfire Education Project focuses on presenting Ready, Set, Go! and Firewise messaging to the public. The Los Alamos County Wildfire Mitigation and Education Project focuses on disseminating public education materials to school age children and the community. The New Mexico Department of Agriculture prepared and disseminated a newspaper insert that provided both mitigation and preparedness messaging. The insert was initially distributed in 2013 and was then up-dated and distributed again in 2015. Another New Mexico Department of Agriculture Project focused on Watershed Health Education. The "Know Your Watershed" publication was prepared in coordination with various agencies such as State Forestry, New Mexico State University Extension Program and the Southwest Border Food Safety and Defense Center.

In addition, the following FEMA HMGP risk assessment/mapping projects include a public education component; NM Tech Landslide and Collapsible Soils Susceptibility Mapping; State Forestry Treatment Opportunity Mapping; and EDAC Acequia Mapping. Funds were made available utilizing DHSEM sub-grants.

Using National Earthquake Hazard Reduction Program funding, DHSEM developed a two-sided flyer to provide general information about earthquake risk in New Mexico and to encourage participation in the 'drop, cover and hold on' drill ShakeOut!. Using the same funding source, DHSEM also produced a ShakeOut! poster to encourage participation.

2. **Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies**

This action focuses on creating the statewide repository and providing access to local and tribal entities. GIS capabilities vary between local jurisdictions and tribes. Local jurisdictions and tribal entities do not always have the capability for in-house GIS personnel and resources. EDAC is working to compile all of the public GIS information into one location (as described above). Some hazard types below include a separate action item to create a hazard map (earthquake hazard, land slide, land subsidence, soil hazard). There is not a single State-wide map that shows the risk for these hazard types.

Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire

How Contributes to Strategy: Although funding for GIS personnel and resources varies with each entity, the State should make all publicly available data accessible for mitigation planning and recovery.

Suggested Responsible Party: DoIT, EDAC

Estimated Expenses: Computer equipment, software, GIS technicians/contractors

Funding Sources: FEMA, USACE, State budget

Timeframe: Ongoing

Adapted STAPLE+E Average: 2.62

Ranking: 8

2018 UPDATE:

The New Mexico CTP, the Earth Data Analysis Center, has created the New Mexico Multi-Hazard Risk Portfolio (MHRP) which consists of interactive maps, geospatial data, and a desk reference to present a geospatial hazard risk inventory for New Mexico. The multi-year program has focused on a different hazard each year in order to provide a comprehensive view of natural hazard risk for the State. The hazards to date are flood, wildfire and landslide. The information is available on the NMFlood website http://nmflood.org/ a portal provided as part of the CTP's participation in FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program. The MHRP follows FEMA's watershed approach to flood hazard analysis. The GIS data from the MHRP is available for download from the Resource Geographic Information System and Clearinghouse (RGIS).

In addition, GIS data will be made available for download from the Resource Geographic Information System and Clearinghouse (RGIS) for following FEMA HMGP risk assessment/mapping projects; Collapsible Soils Susceptibility Mapping; State Forestry Treatment Opportunity Mapping; and EDAC Acequia Mapping. Funds were made available utilizing DHSEM sub-grants. It is anticipated that the data will be made available by the end of 2018.

3. **Establish and Enhance GIS Capabilities within DHSEM**

GIS capability allows DHSEM to identify specific hazard areas, critical facilities/key resources and to analyze the overlap of numerous hazard impacts. This information would provide data to prioritize mitigation and recovery efforts.

Hazards: Dam Failure, Drought, Earthquake, Flood, Heat (Extreme), Landslide, Land Subsidence, Soil (Expansive), Thunderstorms, Tornadoes, Volcano, Wildfire, Wind (High), and Winter Storms (Severe)

How Contributes to Strategy: By providing comprehensive multi-hazard data, DHSEM can pass-on site-specific information to local emergency managers to assist in prioritization of both long-term mitigation actions and recovery efforts.

Suggested Responsible Party: NMEMA, NMFMA, NMT, EDAC, DHSEM DHSEM State Floodplain Coordinator

Estimated Expenses: contract services, employee time, software, materials

Funding Sources: DHSEM Budget, FEMA grants (CAPSSSE)

Timeframe: Ongoing

Adapted STAPLE+E Average: 2.38

Ranking: 11

2018 Update

DHSEM had a contract with EDAC to provide GIS services for several years. The contract ended in 2017. DHSEM is in the process of getting the State Floodplain Coordinator access to GIS for flood related analysis.

4. **Map State Facilities and Assets in Relation to Identified Hazard Areas**

Including State owned and managed facilities in a GIS database will aid with the process of identifying critical facilities and assets that are within State-agency control. Having this critical facility information in a database that can be spatially queried allows for greater understanding of asset value and the impact that natural disasters would have on them. This would allow the re-examination of mitigation priorities.

Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire

How Contributes to Strategy: By integrating State owned or managed facilities into the comprehensive multi-hazard data, DHSEM can provide site-specific information to other State agencies to assist in prioritization of both long-term mitigation actions and recovery efforts.

Suggested Responsible Party: DHSEM, GSD, DoIT, State Forestry, National Guard, local emergency management agencies, UNM EDAC, NMT, SIPI

Estimated Expenses: Contract services, employee time, software, materials

Funding Sources: DHSEM Budget, FEMA grants (PDM, HMGP), UNM, NMT
Timeframe: Ongoing
Adapted STAPLE+E Average: 1.92
Ranking: 22

2018 UPDATE:

The Community Anchor Site Assessment (CASA) Database was built as part of the New Mexico Department of Information Technology (NMDOIT) State's Broadband Mapping Program. This geospatial database currently contains information on institutions such as: hospitals, police stations, fire stations, National Guard Emergency Readiness Centers, state government buildings, schools, and libraries, Emergency operations Centers, and community and senior centers. The CASA database includes information for each facility such as name, address, telephone number, latitude, longitude, and broadband network connectivity. NMDOIT continues to update and keep the CASA database current. This data base is what was used for the critical facility mapping included in the 2018 up-date of the State Mitigation Plan.

Specific sub-tasks under this action could include:

- Once the available data is identified, determine which facilities are critical. For example, not all State government owned or managed facilities are critical. The structures that house the communications system or the archival information may be labeled as critical, while the office building may not be identified as critical. An office building that houses staff during business hours could be evacuated and continue operations in a different location.
- For those facilities identified as critical, provide all data as explained in the Critical Facilities Section of this Plan. In particular, detail must be provided for critical radio and communication towers.

5. **Update Hazus and Train Emergency Management Personnel in Use**

FEMA, DHSEM and EDAC utilize the damage estimation software (Hazus) for preparedness and response planning. Hazus is a good tool for estimating damages to structures, utilities and roadways. It also provides estimates of injuries. However, there is limited applicability for realistic impacts of flash floods (here in New Mexico) vs. slow river rise flooding (riverine model used for Hazus).
Hazards: Earthquake, Flood, High Wind
How Contributes to Strategy: Hazus is a tool that can forecast potential damages from hazard events. It can help local emergency managers to fully understand the vulnerability within the state, counties and individual jurisdictions. This action includes creating a training workshop to explain why Hazus is important, how it can be useful, and how to update and use the program.
Suggested Responsible Party: DHSEM, EDAC, NMT, SIPI (Southwest Indian Polytechnic Institute)
Estimated Expenses: Employee time, training materials for workshop; software and hardware costs
Funding Sources: EMPG grant, FEMA grants, local emergency management, UNM EDAC, NMT, SIPI
Timeframe: 60+ months
Adapted STAPLE+E Average 2013: 1.83

Ranking: 25

2018 UPDATE:

This Plan includes new Hazus information for earthquake and flood damage estimates (as described in the Hazard Identification and Risk Assessment Section). The runs utilize 2010 census data. When the Hazus software integrates 2020 census data, the runs will need to be repeated. Outreach to local emergency managers and floodplain managers on the earthquake and flood Hazus run results has been provided by DHSEM staff at NMEMA Quarterly Meetings and NMFMA Workshops. Earthquake Hazus run data can be supplied to local emergency managers if requested and is available on a county-by-county basis.

6. **Implement Actions to Improve Forest and Watershed Health**

This action was identified in the Drought Task Force Impact Assessment Committee Status Report from January 2013. Implement actions as identified in the New Mexico Forest and Watershed Health Plan in addition to the New Mexico Forest Action Plan (formerly "New Mexico Statewide Natural Resources Assessment and Strategy and Response Plans."

Hazard: Drought, Flood, Wildfire

How Contributes to Strategy: Drought can affect forest health directly by causing drought stress in trees, and indirectly by increasing susceptibility to insects and disease. Large stands dead or dying trees greatly increase the risk of negative impacts on New Mexico's watersheds including higher fire danger.

Suggested Responsible Party: State Forestry, OSE, Environment Department, NM Energy Minerals and Natural Resources, NM Department of Agriculture

Estimated Expenses: $10 million per year for the New Mexico Watershed Restoration Initiative. Other actions may be identified by State Forestry and the State Forest and Watershed Management Coordinating Group

Funding Sources: Agency budgets, federal, state, and foundation grants

Timeframe: Continuous

Adapted STAPLE+E Average: 2.64

Ranking: 5

2018 UPDATE:

Since the 2014 session, the NM Legislature has appropriated $12.2 million to restore high priority watersheds and protect communities at risk. That investment has leveraged $6.6 million in Pittman-Robertson dollars, plus additional federal, state and private match. To date, State Forestry's Watershed Restoration Initiative includes 51 projects targeting 27,410 acres of forests and woodlands in 19 different watersheds across the state.

DHSEM has funded five HMGP mitigation projects that will improve forest and watershed health. These projects Those projects include; Claunch Pinto Wildfire Mitigation (in Torrance County); Los Alamos Wildfire Mitigation; Santa Clara Pueblo Flood Mitigation, Socorro County Bosque Wildfire Mitigation (North and South). All five projects are approved for Phase 1 only. It is anticipated that after all eligibility requirements are met, Phase 2 funding (for hazardous fuels reduction or defensible space) will be awarded.

7.2.2 Dam Failure

7. Hire a Dam Safety Engineer.

The Office of the State Engineer (OSE) has oversight over non-federally owned dams in New Mexico. However, there is no one specifically assigned to assist dam owners with preparedness activities such as development of their Emergency Action Plans (EAPs). An additional Dam Safety Engineer could focus on the large number of existing dams that do not hold an EAP. Potential areas for mitigation activities include resources to evaluate and reduce uncertainties with dam data, preparation of EAPs for all high hazard dams, comprehensive facility evaluations to quantify risk, and rehabilitation of existing dams. These actions will contribute to dam failure risk reduction through emergency planning and increased warning for affected communities.

Hazard: Dam Failure

How Contributes to Strategy: Emergency planning can reduce response time which can mitigate the hazards presented by a dam incident. The Dam Safety Engineer will be responsible for assisting the local dam owners and emergency management officials create or update their EAPs. The Dam Safety Engineer will create or coordinate creation of inundation zone maps and other EAP elements with input from dam owners and operators. Rehabilitation reduces the hazard associated with a dam failure and the proposed engineer position can assist owners to meet this need.

Suggested Responsible Party: DHSEM, OSE

Estimated Expenses: Salary and benefits for this position could be shared between DHSEM and the OSE

Funding Sources: EMPG, existing or future OSE budget

Timeframe: When funding is available

Adapted STAPLE+E Score 2013: 2.17

Ranking: 16

2018 UPDATE:

Due to extraordinary circumstances in the national economy, the State of New Mexico will not be hiring a Dam Safety Engineer anytime soon. It is possible that the New Mexico Silver Jackets could enable more participation and better communication. The OSE has an unfunded engineer position and it will analyze the budgetary obstacles for filling this position.

8. Rehabilitate or Remove Unsafe Dams Starting with "High Hazard" Classification

The OSE identified nearly 100 dams across the state as needing repair or rehabilitation to correct safety concerns. There are numerous public and private dam owners that do not have the financial capability to make the necessary repairs.

Hazard: Dam Failure

How Contributes to Strategy: Poorly maintained dams pose significant risks to the communities and infrastructure below them. Removal of these dams will reduce or eliminate the potential for catastrophic failure and will preserve life and property.

Suggested Responsible Party: OSE, Silver Jackets, dam owner groups, and NM OSE Dam Safety Bureau

Estimated Expenses: Funding for engineering analysis and demolition when appropriate.

Funding Sources: EMPG, special legislative funding, federal funding through NRCS programs and proposed National Dam Safety Program funds, owner cost share
Timeframe: 60 months+
Adapted STAPLE+E Score 2013: 1.77
Ranking: 27

2018 Update
The term 'rehabilitate' was added to this action as analysis proved that some unsafe dams did not need to be removed if rehabilitation could be accomplished effectively. Three High Hazard Potential dams were rehabilitated in Colfax, Grant, and Los Alamos counties after the 2013 plan. These projects were completed with local funds and state appropriations. Other local and tribal implementation may have also occurred over the five-year period. Rehabilitation projects are in the planning stages at multiple dams but the need is largely unmet.

9. **Create Emergency Action Plans for "High" and "Significant Hazard" Class Dams**
Dam owners are required to have Emergency Action Plans (EAPs) but assistance for dam owners is needed to accomplish this goal. The OSE has created an EAP template for dams within New Mexico. The EAP provides steps for the owner to follow in a potential emergency that help to recognize problems and to make decisions in order to provide the best response to avert a dam failure if possible. Each EAP has an inundation map based on modeling of the potential dam failure under various operation conditions. An evacuation map is then prepared in consultation with local emergency management officials from the inundation map. Many owners report that the costs associated with preparation of the inundation maps are prohibitive and interaction with emergency professionals is needed for proper planning.
Hazard: Dam Failure
How Contributes to Strategy: The new EAPs will specifically lay out the emergency procedures, notification lists, and inundation zones of each dam. Emergency action planning can help to eliminate unnecessary evacuations and has been shown to increase warning which can save lives. The future Dam Safety Engineer or other entities could be responsible for assisting in the preparation of these EAPS and can work with local emergency officials and owners to maintain them.
Suggested Responsible Party: Dam owners, local emergency managers, DHSEM, OSE, Dam Safety Engineer, Silver Jackets
Estimated Expenses: Engineering analysis and mapping and staff time
Funding Sources: EMPG existing or future budgets, FEMA National Dam Safety Program Grant, future state funding
Timeframe: 60 months
Adapted STAPLE+E Score 2013: 2.26
Ranking: 12

2018 Update

The terms "high" and "significant hazard" were added to this action as the terminology and definitions have changed since the 2013 Plan update.

Twenty-two EAPs have been prepared and put into use by New Mexico dam owners since the 2013 Plan. These EAPs were prepared with owner effort and funding and through application of

State appropriations and a FEMA National Dam Safety Program grant provided to OSE. Efforts made by the New Mexico Department of Agriculture with State and Federal funding and staff time contributed greatly to this increase. The EAP compliance rate for State-regulated high hazard potential dams is about 40% at this time. The compliance rate for all Federal, Tribal and State dams is about 38% based on the National Inventory of Dams. Other Federal and Tribal implementation may have also occurred over the five-year period.

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.3 Drought

10. **Mandate Xeriscaping with Drought Resistant Species at State Facilities and encourage Xeriscaping State-wide**

Xeriscaping refers to landscaping in ways that requires little to no supplemental irrigation. The end result is a reduction in water use at State owned facilities. Once implementation occurs, the State facilities could serve as field examples of xeriscaping methods and techniques.

Hazard: Drought

How Contributes to Strategy: The use of xeriscaping requires less water to maintain therefore more water is available for other uses (such as human consumption, agriculture, livestock, ecological enhancement, etc.). Xeriscaping can enhance habitat for native bees, butterflies, and other fauna.

Suggested Responsible Party: New Mexico State Legislature, State agencies

Estimated Expenses: Installation of plants and hardscape

Funding Sources: Existing budgets

Timeframe: 60 months

Adapted STAPLE+E Average: 2

Ranking: 19

2018 Update

The text "and encourage xeriscaping State-wide" was added to this action as the SHMPT agreed that State agencies could provide technical assistance and incentives to further xeriscaping activities beyond State owned facilities.

The New Mexico Department of Agriculture removed grass growing lawns at their main office in Las Cruces and replaced them with Xeriscaping and antique farm machinery. Additional State, Local, and Tribal implementation may have occurred over the five-year period.

11. Require Grey Water Systems at State Owned Facilities and encourage Grey Water Use State-wide

This action requires installation of grey water systems for new State construction and retrofits of existing structures. Reusing water to irrigate landscaping would conserve potable water for uses such as human consumption, agriculture, and livestock.
Hazard: Drought
How Contributes to Strategy: The use of greywater requires less fresh water to maintain landscaping making more water available for other uses and other people. This action would also lessen strain on failing septic tanks and treatment plants. This action could also result in enhanced groundwater recharge, improved forest health and improved watershed health.
Suggested Responsible Party: New Mexico State Legislature, State agencies
Estimated Expenses: Up to $50,000 depending on the facility
Funding Sources: Unknown at this time
Timeframe: 60 months
Adapted STAPLE+E Average: 1.62
Ranking: 31

2018 Update

The text "and encourage grey water use State-wide" was added to this action as the SHMPT agreed that State agencies could provide technical assistance and incentives to further grey water use beyond State owned buildings. No activities were reported to DHSEM for inclusion. However, State implementation may have occurred over the five-year period.

12. Establish a Rebate Program

Establish new rebate programs where they do not exist, for homeowners who convert to low flow toilets or purchase EnergyStar certified clothes and dish washers.
Hazard: Drought
How Contributes to Strategy: These fixtures and appliances use less energy and less water than conventional fixtures/appliances. The reduction of the amount of water used would allow water to be directed toward other uses. This action could also result in enhanced groundwater recharge, improved forest health and improved watershed health.
Suggested Responsible Party: DHSEM, OSE, local emergency managers, water conservation and watershed health interest groups
Estimated Expenses: $50,000-$1,000,000
Funding Sources: US EPA grants
Timeframe: 36 months
Adapted STAPLE+E Average: 1.46
Ranking: 36

2018 UPDATE

There has been no work towards accomplishing this action. Additional research needs to be conducted to 1) clarify how the State's anti-donation clause would affect implementation and 2) identify successful rebate programs that have been implemented in the State and elsewhere.

13. **Incorporate Drought Mitigation Activities into Range Management Plans**

This was a new mitigation action for the 2013 State Plan. It was identified in the Drought Task Force Impact Assessment Committee Status Report from January 2013. NMDA provides technical assistance in the form of consultation in developing range management plans and sound agricultural practices. Cooperation between State, Federal and industry organizations must be part of developing and monitoring mitigation strategy implementation.

Hazard: Drought

How Contributes to Strategy: Including drought mitigation activities in range management plans and sound agricultural practices will provide appropriate techniques that can be implemented at a site-specific scale to reduce the impact of drought.

Suggested Responsible Party: NMDA, industry organizations, ranch owners and managers

Estimated Expenses: More detail is needed for specific action items

Funding Sources: State budget

Timeframe: Continuous

Adapted STAPLE+E Average: 2.57

Ranking: 9

2018 Update

NMDA and NMSU provided the Extension Disaster Education Network tool kit to Socorro County to set up a drought task force. This task force has been successful in identifying vulnerabilities and implementing mitigation strategies. Additional State, Local, and Tribal implementation may have occurred over the five-year period.

14. **Develop New Useable Water Sources**

Additional water sources are a constant concern in New Mexico. Advances in technology have allowed continued extraction of water from sources previously thought to have been unusable. Identifying the location of new sources and determining the impact of new techniques is an ongoing process.

Hazard: Drought

How Contributes to Strategy: un-clear

Suggested Responsible Party: local water providers

Estimated Expenses: water extraction and purification equipment

Funding Sources: State budget

Timeframe: Continuous

Adapted STAPLE+E Average: 1.77

Ranking: 26

2018 Update

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

15. **Public Water Supply and Drought Vulnerability Assessments**

Better understanding of the vulnerability of public water supply will assist emergency, utility and land use managers to mitigate the impacts of reduced resource availability. Municipal water supply assessments are currently being conducted by NMED. Additional assessments could be done at a county, watershed (regional) and/or State-wide basis. The assessments would identify specific vulnerabilities and also recommend mitigation measures such as water supply monitoring, water conservation measures, utilization of multiple points of diversion, identification of additional sources of water, and/or developing Standard Operating Procedures specific to drinking water supply.

Hazard: Drought

How Contributes to Strategy: As part of the assessment mitigation actions would be identified. A strategy for implementation of the mitigation actions would be the next step in making the community more resilient to drought. As an example, a mitigation action recommended in an assessment may be "install and utilize monitoring equipment to track the water supply level". When the community implements this measure and determines that the water supply is too low, they could switch to alternative water source or implement water conservation measures. The end result is a reduction of the impact of drought on the community.

Suggested Responsible Party: NMED, OSE, DHSEM

Estimated Expenses: More detail needed for specific action items

Funding Sources: State budget

Timeframe: 36 months

Adapted STAPLE+E Average: 2.77

Ranking: 3

<u>2018 Update</u>

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

Multi-Hazard Actions:

<u>Develop Comprehensive Public Education/Outreach Strategies</u>

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

<u>Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies</u>

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

<u>Establish and Enhance GIS Capabilities within DHSEM</u>

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

<u>Map State Facilities and Assets in Relation to Identified Hazard Areas</u>

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

<u>Implement Actions to Improve Forest and Watershed Health</u>

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: Drought, Flood, Wildfire

7.2.4 Earthquake

16. **Develop the New Mexico Seismic Map or Series of Maps to Effectively Predict the Probability of Seismic Damage State-wide.**

    Although there are numerous studies and mapping projects that have been conducted State-wide, there is not one compilation map or series of maps that conveys earthquake hazard in an easily understandable format. The series of probability maps generated by the USGS and Al Sanford at NM Tech could be analyzed and represented in easier to understand graphics so that the lay person can understand the information.

    Hazard: Earthquake

    How Contributes to Strategy: Combining existing risk maps into one map or series of maps would provide a visual snapshot of State-wide earthquake hazard. A series of maps may need to be produced in order to reflect the hazard at an appropriate scale.

    Suggested Responsible Party: DHSEM, New Mexico Institute of Mining and Technology, DoIT

    Estimated Expenses: Cost for engineering studies, GIS mapping and production

    Funding Sources: State budget, DoIT, New Mexico Institute of Mining and Technology, FEMA Earthquake Hazards Reduction State Assistance Program, EMPG

    Timeframe: 60 months

    Adapted STAPLE+E Average: 2.31

    Ranking: 13

    2018 UPDATE:

    No action has been taken to develop State-wide seismic maps for probability.

17. **Complete Basic Vulnerability Assessments for State Owned Critical Facilities**

    Most State owned facilities have not been engineered to withstand Earthquakes. Complete a seismic assessment of all critical facilities State-wide with the Belen to Taos corridor as a priority due to the seismic risk. A systematic study of these facilities would establish a susceptible structure prioritization. The loss of any of these facilities could lead to loss of life, injury, structural damage and delayed response time. The result of the seismic assessment would be a comprehensive attribute table (or database) linked directly to geospatial references. Mapping would visually communicate seismic risk to the public.

    Hazard: Earthquake

    How Contributes to Strategy: Understanding which structures are at risk and prioritizing critical facilities for earthquake retrofit would provide an ordered listing for an implementation schedule.

    Suggested Responsible Party: DHSEM, OSE, GSD, New Mexico Institute of Mining and Technology

    Estimated Expenses: Cost for engineering study at the identified critical facilities

    Timeframe: 60 months

    Funding Sources: State budget, EMPG

    Adapted STAPLE+E Average: 2.00

    Ranking: 20

2018 UPDATE:

This mitigation action has been modified with more detail as provided by the New Mexico Institute of Mining and Technology professor involved in the Rapid Visual Assessment projects. DHSEM has provided a grant to New Mexico Institute of Mining and Technology to begin a Rapid Visual Assessment of critical facilities in the eight counties along the Rio Grande Rift. However, students were only able to access the outside of the structures and therefore not able to input all of the relevant data that needed to be included in the assessment. Reports for many structures and the summary reports will be available in the near future. Although the Rapid Visual Screening (RVS) method allows emergency managers to determine whether buildings are potentially seismically hazardous and should be further analyzed by a professional engineer, the number of structures requiring further analysis is often high and the cost prohibitive. Because this method does not provide a ranking of the structures needing further analysis, emergency managers are left with no guidance as to how to prioritize them. For this reason, Dr. Claudia Wilson and three former students at NM Tech: Jesus Flores, Ivan Perez-Gonzalez, and Elliot Esquivel, developed a fuzzy-logic based method for prioritizing structures considered potentially hazardous by RVS. This method considers the number and type of plan and vertical irregularities, the number and type of falling hazards, the structure's risk category, and if applicable, its historical significance.

18. **Develop Region-Specific Earthquake Building Codes and Zone Map that Reflects Actual Risk**

This action was identified during 2013 SHMPT and Subject Matter Expert discussions. There are wind and snow load region-specific building codes for New Mexico, but no similar system exists for earthquake. The range of earthquake risk varies greatly State-wide and building codes should reflect the actual risk.

Hazard: Earthquake

How Contributes to Strategy: New buildings can be built stronger, according to the most recent seismic design specifications that are regionally specific. This will lessen vulnerability to earthquake damage.

Suggested Responsible Party: CID, GSD, DCA, local jurisdictions and tribal entities that implement building codes

Estimated Expenses: Uncertain at this time

Funding Sources: Existing budgets, FEMA Hazard Mitigation Grant Program, EMPG

Timeframe: 60 months

Adapted STAPLE+E Average: 1.77

Ranking: 28

2018 Update

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

19. **Retrofit Most Hazard-Prone Critical and Public Facilities**

The result would be critical facilities that are retrofit to withstand earthquake risk that is regionally specific. Retrofitting these facilities will assure their operation during an earthquake event. It will allow for continuity of operations during and after an earthquake and will lead to fewer injuries.

Hazard: Earthquake

How Contributes to Strategy: The previous mitigation action relates to both new and existing buildings. If existing buildings were retrofit to the region-specific earthquake building code, damage would be lessened and there would be less injury.
Suggested Responsible Party: Local jurisdictions, GSD, DCA
Estimated Expenses: Design, engineering, construction material purchase and installation
Timeframe: 60 months
Funding Sources: State legislature, FEMA Mitigation grant programs, EMPG
Adapted STAPLE+E Average: 1.46
Ranking: 37

2018 Update

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

20. Participate in ShakeOut! and Encourage Participation Statewide

Shake-Out is the largest ever earthquake drill which encourages participants to 'drop, cover and hold on'. It is implemented internationally with 2013 being the first coordinated Western States Shake-Out. By participating in the exercise, individuals will be better prepared to survive and recover quickly from an actual earthquake event.
Hazard: Earthquake
How Contributes to strategy: This is an education and outreach strategy that engages citizens, jurisdictions, organizations and agencies. It is an active participatory method that will lead to reduced structural damage and less injury during an actual earthquake event.
Suggested Responsible Party: local jurisdictions, State agencies, schools
Estimated Expenses: Public Service Announcements, free registration on-line, DHSEM lead agency
Timeframe: Annual October event
Funding Sources: DHSEM staff, New Mexico Bureau of Geology and Mineral Resources staff, individual communities and agencies as interest increases.
Adapted STAPLE+E Average: 2.31
Ranking: 14

2018 Update:

The text "and encourage participation State-wide" was added to this action as the SHMPT agreed that state agencies could provide technical assistance and outreach to increase participation beyond State agencies.

The first New Mexico ShakeOut! was held in October 2014. DHSEM staff worked with the Southern California Earthquake Center to post a New Mexico ShakeOut! website. Potential participants were encouraged to register on the New Mexico ShakeOut! website so that participation could be tallied for DHSEM Preparedness Areas and individual sectors (schools, government, business, citizens, etc). In 2014, there were more than 102,000 participants in the New Mexico ShakeOut!; the majority were Albuquerque Public Schools participants. The New Mexico ShakeOut has also been implemented in 2015, 2016, and 2017. DHSEM conducted a formal drill for ShakeOut! in 2015. In 2016 and 2017, DHSEM conducted informal presentations and run-through of the 'drop, cover and hold-on' drill in the State Emergency Operations Center each year. State-wide, participation in 2017 was more than 6,000. Individual communities throughout the State have implemented ShakeOut! drills as part of their annual emergency exercise requirement. DHSEM Earthquake Program Manager provides outreach to local emergency managers on ShakeOut! through Preparedness Area Coordinators, NMEMA membership email list serve and NMEMA Quarterly Meetings.

Using National Earthquake Hazard Reduction Program funding, DHSEM developed a two-sided flyer to provide general information about earthquake risk in New Mexico and to encourage participation in ShakeOut!. Using the same funding source, DHSEM also produced a ShakeOut! poster to encourage participation. There is a tremendous amount of public education and outreach materials available on the New Mexico ShakeOut! website. For more information go to https://www.shakeout.org/newmexico/

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

Update Hazus and Train Emergency Management Personnel in Use

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.

Hazards: Earthquake, Flood and High Wind

7.2.5 Expansive Soils

21. Map Location of the Various Types of Hazardous Soils

This was a new mitigation action for the 2013 Plan and was suggested by the SHMPT and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Expansive soil occurrence and damage data collection is needed. Research of existing soil data for corrosive and hydrocompactive soils should also be included. Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.

Note: Based on the results of research and data collection, it may be effective to have all hazard soils discussed as one subject in future updates of the Plan.

Hazard: Expansive Soil, Land Subsidence

How Contributes to Strategy: Mapping hazardous soils would provide emergency managers, land managers, land developers, building code officials and agriculture officials with better understanding of the potential impact of hazardous soils. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.
Suggested Responsible Party: DoIT, DHSEM, DOT, New Mexico Institute of Mining and Technology
Estimated Expenses: Current staff and resources
Funding Sources: State budget, DOT, HMGP, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 2.00
Ranking: 21

2018 Update:
A series of maps depicting the estimated hazards posed by collapsible soils has been completed and delivered to the NM DHSEM (Dec. 15, 2017). These show State-wide susceptibility of the hazard in addition to data quality. Expansive and corrosive soil data are not included in this product. The product is released as New Mexico Bureau of Geology and Mineral Resources Open-file Report 593 and can be downloaded from the website of the New Mexico Bureau of Geology and Mineral Resources: http://geoinfo.nmt.edu/publications/openfile/ . The data will also be made available on the RGIS platform.

NMDOT has data for areas impacting New Mexico roadways. NMDOT does not have the expertise on impacts related to vertical construction.

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

7.2.6 Extreme Heat

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Update Hazus and Train Emergency Management Personnel in Use
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

7.2.7 Flood

22. Acquire or Relocate and Educate regarding Repetitive Loss and Severe Repetitive Loss Properties

For the 2013 Plan, there were 39 repetitive loss properties in the State, 22 of which were NFIP insured at the time of losses. Creating and implementing an outreach strategy for encouraging acquisition or relocation are tasks that could assist with implementing this action item.
Hazard: Flood
How Contributes to Strategy: The acquisition or relocation of these properties will reduce the damages to the structures as well as the costs to repair them. Outreach to encourage removing the structures from harm's way will reduce the amount of damage and avoid injury.
Suggested Responsible Party: DHSEM, State Floodplain Coordinator, Local Floodplain managers, local jurisdictions, property owners
Estimated Expenses: Cost of structure acquisition or cost of retrofits and relocation
Funding Sources: HMGP, FMA, SRL, PDM, local/homeowner matching funds.
Timeframe: Unknown as based on voluntary participation of property owners
Adapted STAPLE+E Average: 2.15
Ranking: 17

2018 UPDATE:
The text "and educate regarding repetitive loss and severe repetitive loss" was added to this action as the SHMPT agreed that subject matter experts could provide technical assistance and outreach to increase understanding of options to mitigate losses.

There are currently 36 Repetitive Loss Structures and two Severe Repetitive Loss structures. No repetitive loss structures have been purchased or relocated through State or FEMA funded efforts. However, local government or private efforts may result in removal of at risk structures. The State Floodplain Coordinator will develop and implement an outreach strategy to encourage local communities to inform business and private property owners about the advantages of removing repetitive loss and severe repetitive loss structures from flood hazard areas.

23. Add or Improve Flood Control Structures at Known Flood Impact Points
Depending on the nature of the flooding, ponding (detention, retention or sediment), arroyo/river crossing (low water, culvert, bridge), energy dissipation, bank stabilization, erosion

control elements or other structural mitigation measures may be appropriate to lessen the impact of flooding. Allow installation/improvement of flood control structures (proactively or on an emergency basis) to protect downstream resources and assets from post-fire flood or debris flow.

Hazard: Flood

How Contributes to Strategy: Existing infrastructure has not been upgraded to include additional flow rates due to modification of watershed condition (added infrastructure that impacts flow direction/amount, increased impervious surface, increased erosion/sedimentation, denuded vegetation, burn scar, etc.). Updating drainage and other infrastructure to respond to current watershed conditions will decrease flood impacts on structures and the landscape in addition to reducing injury or death.

Suggested Responsible Party: DOT, land management agencies, local jurisdictions

Estimated Expenses: Staff time, construction costs

Funding Sources: DOT, HMGP, PDM,

Timeframe: 60 months

Adapted STAPLE+E Average: 2.21

Ranking: 15

2018 UPDATE:

Numerous State agencies (DOT, State Forestry, Energy Minerals and Natural Resources), local jurisdiction and Tribal entities implement flood mitigation projects every year. However, each project is not reported to DHSEM for tracking purposes. DHSEM has provided HMGP or PDM funding for eight structural flood mitigation projects (Corrales Salce Basin, Los Alamos Reservoir Canyon Road, Nambe Pueblo Debris Flow Barriers, Rio Rancho SportsPlex, Santa Clara Pueblo Flood Mitigation, SSCAFCA Alberta Road, SSCAFCA Cactus Ponds, SSCAFCA Bosque del Bernalillo). Of the eight, four are approved for Phase 1 only. It is anticipated that after all eligibility requirements are met, Phase 2 funding (for construction) will be awarded.

NMDOT studies flood impacts post fire. Budget constraints make it very difficult to mitigate. NMDOT relies on land management agencies for data. Budget constraints and lack of data make it difficult to add to or improve existing flood control structures.

24. **Study the Probability, Extent, Vulnerability and Impact of Post-Fire Flooding**

This is a new mitigation action for the 2013 Plan. USACE and USGS have generated flood frequency predictions and debris flow hazard assessments for areas impacted by recent wildfires. These studies have helped emergency and land managers plan for and mitigate some of the effects of post-fire flooding and debris flows. Public education and outreach, including targeted outreach to planners and decision-makers, should be part of the dissemination of the resulting maps and reports.

Hazard: Flood

How Contributes to Strategy: Understanding site-specific impacts of post-fire flooding and debris flows have helped emergency and land managers plan for and mitigate some of the effects of post-fire flooding and debris flows. In addition, the maps and reports have scientific data that can inform decisions by public officials regarding land use and infrastructure development and pre-emptive mitigation measures. The maps and reports can also be

incorporated into Community Wildfire Protection Plans (CWPPs) and shared with public and private land owners so that they can make decisions that will reduce future impact of flooding.
Suggested Responsible Party: USACE, USGS, DHSEM, land management agencies, local jurisdictions, tribal entities
Estimated Expenses: staff time, production of reports and maps
Funding Sources: USACE, USGS, State legislature, land management agencies
Timeframe: Ongoing
Adapted STAPLE+E Average: 2.79
Ranking: 2

2018 UPDATE

Some collaborative groups have used USGS debris flow hazard assessments for different purposes: (1) help guide post-fire recovery efforts; (2) incorporate results from predictive assessment into wildfire risk assessment; (3) use predictive assessment to inform pre-fire planning for post-fire conditions.

USGS produced several debris flow models for individual wildfire burned areas (Track and Las Conchas reports issued in 2011, Whitewater-Baldy report issued in 2012, Little Bear report issued 2013, pre-wildfire evaluation for the Sandia and Manzano Mountains and surrounding areas report issued in 2014, pre-wildfire evaluation for the Jemez Mountains report issued in 2016). Reference links to post-wildfire debris flow models are listed in the Capability Appendix (Appendix B, Agency Plans and Programs Summary, Wildfire).

25. **Study the Probability, Extent, Vulnerability and Impact of Alluvial Fans.**

This is a new mitigation action for the 2013 Plan although it was discussed in the Hazard Identification and Risk Assessment Section of the 2010 Plan. The study could include: 1) identification and mapping of alluvial fan flood hazards, 2) definition of active and inactive areas of erosion and deposition, and 3) definition and characterization of the base flood within defined areas.
Hazard: Flood
How Contributes to Strategy: Understanding the patterns of alluvial flooding will allow emergency managers, floodplain managers and land management agencies to identify and implement effective mitigation measures to reduce the impacts of future damage.
Suggested Responsible Party: USACE, USGS, DHSEM, NMFMA, land management agencies, local jurisdictions, tribal entities
Estimated Expenses: Staff time, production of reports and maps
Timeframe: Ongoing
Funding Sources: USACE, USGS, State legislature, land management agencies
Adapted STAPLE+E Average: 1.46
Ranking: 35

2018 UPDATE:
The New Mexico CTP as part of the RiskMap program created a database of available digital alluvial data. The data were compiled from the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) published detailed geologic surveys as well as the State-wide surficial

geologic map at a scale of 1:500,000. The data are available for download from the Resource Geographic Information System and Clearinghouse (RGIS). As new geologic maps are published the data will need to be added to the database. Older, paper geologic maps need to be digitized to produce a more comprehensive alluvial fan database.

26. **Increase the Number of Communities Participating in the Community Rating System**

The Community Rating System (CRS) is a component of the National Flood Insurance Program. CRS reduces flood insurance rates in exchange for a community conducting certain flood hazard reduction activities that are beyond the minimum national standard for floodplain management.

Hazard: Flood

How Contributes to Strategy: The benefits of a community completing CRS actions is two- fold. It not only reduces insurance rates, thereby enticing additional homeowners to get flood insurance so that they can pay for flood damage repairs, but it also strengthens a community's reliance. Examples of CRS activities include floodplain mapping available on a public web site or a local floodplain ordinance that requires No Adverse Impact approach to development that impacts floodplains.

Suggested Responsible Party: DHSEM, State Floodplain Coordinator, local floodplain managers, local jurisdictions

Estimated Expenses: Staff time, legal review, community outreach, raising political support

Funding Sources: Existing budgets, US EPA watershed and water quality grant programs

Timeframe: 60 months

Adapted STAPLE+E Average: 1.50

Ranking: 34

2018 UPDATE:

There are currently 11 CRS communities in the State (more detail in the Flood/Flash Flood HIRA profile, National Flood Insurance Program subsection). Since the 2013 State Plan was written, three communities moved from Class 9 to Class 8 (Albuquerque, Bernalillo County, Farmington).

27. **Provide Technical Assistance for the Development or Modification of Codes and Ordinances**

Local jurisdictions (especially those that have recently joined the NFIP or that have new floodplain administrators) may have difficulty in the creation of jurisdiction specific language that addresses floodplain management. If the communities are interested in implementing higher standards than the minimum Federal requirement, the model codes may not be easily understandable. The State Floodplain Coordinator and NMFMA could provide training or workshops on this topic.

Hazard: Flood

How Contributes to Strategy: In order to have an effective program, local jurisdictions must have appropriately written ordinances. In order to implement an effective floodplain management program at the local level, the floodplain management ordinance must integrate with other existing local codes and standards in addition to accomplish the specific local community goals.

Suggested Responsible Party: DHSEM State Floodplain Coordinator, NMFMA

Estimated Expenses: Staff time

Funding Sources: CAPSEEE

Timeframe: Ongoing
Adapted STAPLE+E Average: 1.67
Ranking: 29

2018 UPDATE:
The State Floodplain Coordinator provides model ordinance examples to local communities and tribal entities upon request.

28. Provide FEMA Introductory Floodplain Management Training in State Every Year
Bring the following courses to New Mexico as demand increases; 1) G273 Managing Floodplain Development through the National Flood Insurance Program and 2) G278 National Flood Insurance Program/Community Rating System
Hazard: Flood
How Contributes to Strategy: Having trained floodplain administrators will allow each community to have better oversight and management of their development to assure it is compliant with NFIP guidance and regulation. This will reduce property losses and injuries in the long run.
Suggested Responsible Party: DHSEM, NMFMA
Estimated Expenses: Instructor time, training manuals, attendees time, travel expenses
Funding Sources: Existing budgets
Timeframe: Two year cycle
Adapted STAPLE+E Average: 1.42
Ranking: 38

2018 Update
The New Mexico Floodplain Managers Association continues to organize and host the four-day Managing Floodplain Development Through the National Flood Insurance Program (FEMA G273) course once each year. In October 2016, the ASFPM provided the instructors and training material through a contract with FEMA. In other years, FEMA provided the instructors and training materials. The next offering of the course is scheduled for February 2018 and is full with 27 registrants. There has not been sufficient interest in the CRS course (minimum is 20 to 25 registrants for FEMA to provide instructors). The State Floodplain Coordinator will work with NMFMA to determine 1) if there is sufficient interest to support offering G273 a second time each year and 2) if the CRS course can be field deployed with less than the minimum registrants.

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Update Hazus and Train Emergency Management Personnel in Use
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

Implement Actions to Improve Forest and Watershed Health
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: Drought, Flood, Wildfire

7.2.8 High Wind

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Update Hazus and Train Emergency Management Personnel in Use
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

7.2.9 Landslide

29. **Map Landslide and Rock Fall Susceptibility Areas**
This was a new mitigation action for the 2013 Plan and was suggested by the SHMPT and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. The USGS produced landslide maps approximately 30 years ago based on aerial photographs of steep regions throughout the State. There are archive paper copies at 1:100,000 and mylars of a compilation at 1:500,000 scale. It would be helpful to produce State-wide landslide maps in digital format based on this mapping done 30 years ago. The Department of Transportation also has landslide information that is used for design and maintenance priorities. This information should also be included in a State-wide digital map to enhance the

accuracy of the product. Recent landslides related to road building and irrigation ditch failures should also be included.

Hazard: Landslide

How Contributes to Strategy: Mapping landslide and rock fall susceptibility will provide emergency managers, road designers, traffic engineers and public works entities to better understand the potential impact of landslides. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.

Suggested Responsible Party: DoIT, DHSEM, DOT, New Mexico Institute of Mining and Technology

Estimated Expenses: Current staff and resources

Funding Sources: State budget, DOT, HMGP, PDM

Timeframe: 60 months

Adapted STAPLE+E Average: 1.92

Ranking: 23

2018 Update:

This action was edited from the 2013 Plan to reflect the project with the greater usefulness, landslide and rock fall susceptibility. The SHMPT agreed that debris flow run out zones were being analyzed and mapped by the USGS in significant burn scar areas.

EDAC completed digitizing the aforementioned USGS mapping of New Mexico landslides and rockfalls (originally released as USGS Open-file report 90-293) in December of 2016. A State-wide map depicting susceptibility of deep-seated landslides (constructed using the logistic regression method) and a susceptibility map for rockfall has been constructed by NM Tech. This analysis was completed utilizing FEMA HMGP funding through a DHSEM Sub-grants. The product is released as New Mexico Bureau of Geology and Mineral Resources Open-file Reports 594 and 595 (abbreviated here as NMBGMR OFR-594 and NMBGMR OFR-595) and can be downloaded from the website of the New Mexico Bureau of Geology and Mineral Resources: http://geoinfo.nmt.edu/publications/openfile/. The data will also be made available on the RGIS platform. One additional stakeholder outreach workshop will be implemented in 2018. On-going outreach will continue. It is un-clear how communities that do not have GIS will access the data. Depending on the level of interest, the geospatial data may be made available on a more accessible format.

This action was modified from the 2013 Plan because the debris flow topic is covered under Flood Mitigation (Action #24: Study Impact of Post-Fire Flooding/Debris Flow)

30. **Install Rock Nets or Other Protective Measures Along Roads**

Most of the landslide events in the state have been along roadways.

Hazard: Landslide

How Contributes to Strategy: Installation of rock nets protects vehicles and passengers, as well as reduces cleanup costs.

Suggested Responsible Party: DOT

Estimated Expenses: Cost for study along roadways.

Funding Sources: State budget, HMGP, PDM

Timeframe: 60 months

Adapted STAPLE+E Average: 2.08
Ranking: 18

2018 Update
No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period. NMDOT reports that this activity is developed during the project development process, introduced by the Districts as safety projects.

31. **Adopt Zoning which Restricts Development in Landslide Prone Areas**
Many areas in the State have no zoning restrictions at all, much less any specifically addressing landslide. Investigate if the New Mexico Building Code addresses this specific hazard. Research model ordinances that address this specific hazard. Adopt State-wide standard and encourage local communities and tribal entities to adopt codes that address their specific hazard.
Hazard: Landslide
How Contributes to Strategy: Restricting development in landslide prone areas reduces the risk of damage to structures and infrastructure while reducing the potential for injury or death.
Suggested Responsible Party: CID, DOT, DHSEM, New Mexico Institute of Mining and Technology
Estimated Expenses: staff time, legal review, community outreach, raising political support
Funding Sources: State budget
Timeframe: 60 months
Adapted STAPLE+E Average: 1.67
Ranking: 30

2018 Update
No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

7.2.10 Land Subsidence

32. Map Known Land Subsidence Areas

This is a new mitigation action for the 2013 Plan and was suggested by the SHMPT and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Data needs to be collected and compiled on past occurrence of the various types of land subsidence. For example, most of the land subsidence occurrences in the country have been due to sinkholes that are a sub-hazard of land subsidence. Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.

Hazard: Land Subsidence

How Contributes to Strategy: Mapping land subsidence area would provide emergency managers, land managers, land developers, building code officials and agriculture officials with better understanding of the potential impact of land subsidence. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.

Suggested Responsible Party: DoIT, DHSEM, DOT, New Mexico Institute of Mining and Technology

Estimated Expenses: Current staff and resources

Funding Sources: State budget, DOT, HMGP, PDM

Timeframe: 60 months

Adapted STAPLE+E Average: 1.92

Ranking: 24

2018 Update:

A series of maps depicting the estimated hazards posed by collapsible soils has been completed utilizing FEMA HMGP funding through a DHSEM Sub-grant. The maps show State-wide susceptibility of the hazard in addition to data quality. Expansive and corrosive soil data are not included in this product. The product is released as New Mexico Bureau of Geology and Mineral Resources Open-file Report 593 and can be downloaded from the website of the New Mexico Bureau of Geology and Mineral Resources: http://geoinfo.nmt.edu/publications/openfile/ . The data will also be made available on the RGIS platform.

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.11 Severe Winter Storm

33. Install Snow Fences

Blowing snow can pile up and create hazardous driving conditions.

Hazard: Severe Winter Storm

How Contributes to Strategy: Installing snow fences reduces the pile-up of snow along roadways, and will reduce dangerous driving conditions.

Suggested Responsible Party: NMDOT

Estimated Expenses: Purchase and installation of equipment

Timeframe: 30 months

Funding Sources: WIPP budgets, highway maintenance budgets

Adapted STAPLE+E Average: 1.62

Ranking: 32

2018 UPDATE

NMDOT continues to install and maintain snow fence at known wind drift areas. No additional activities were reported to DHSEM for inclusion. However, implementation may have occurred over the five-year period.

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.12 Thunderstorms (including lightning)

34. Require Use of Hail Resistant Materials in New State Funded Construction

Hail causes damages to roofing, windows and siding materials

Hazard: Thunderstorm

How Contributes to Strategy: This action would require that any new state facility erected contain hail/impact resistant materials. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation. Hail resistant materials can increase the cost by as much as 35-40%, but reduced insurance premiums can offset this.

Suggested Responsible Party: GSD, OSE, Legislature

Estimated Expenses: Dependent on the specific structure

Funding Sources: State Budget

Timeframe: 60 months

Adapted STAPLE+E Average: 1.31

Ranking: 41

2018 Update

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.13 Tornado

35. Encourage the Use and Installation of Storm Shelters in Tornado Prone Areas

There are very few storm shelters in some areas of the State that are particularly vulnerable to tornado impacts. Certain communities are especially vulnerable. Identification of local vulnerability in local and tribal mitigation plans will help to identify those communities that would benefit from a storm shelter program. Enforcing existing building codes provides the greatest benefit for new construction to mitigate damages due to tornado events.

Hazards: Tornado

How Contributes to Strategy: Storm shelters have been shown to greatly reduce the impact from tornadoes. Individuals must be trained on how to prepare for and utilize the shelters prior to required need for use.

Suggested Responsible Party: State agencies, local jurisdictions, tribal entities

Estimated Expenses: Dependent on the construction, size and specifications of each shelter location
Funding Sources: HMGP, HUD, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 1.08
Ranking: 32

2018 Update
No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

36. **Create Additional Shelters Using Public Buildings and Retrofit Existing Public Shelters with Safe Rooms**
Few public shelters are rated to serve as safe rooms. Moreover, additional shelter locations are needed on the eastern side of the state to protect building occupants.
Hazard: tornadoes
How Contributes to Strategy: Retrofitting of public buildings to include storm shelters is an effective way to protect community members. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.
Suggested Responsible Party: local jurisdictions, GSD, State agencies
Estimated Expenses: Cost dependent on the construction, size and specifications of each shelter location
Funding Sources: Existing budgets, HMGP, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 1.33
Ranking: 40

2018 Update
No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.14 Volcano

37. **Conduct Mapping and Delineation of Areas Vulnerable to Volcano Eruption**

This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Data needs to be collected and compiled on past occurrence of different types of volcanic activity. Currently the data base for volcanism in the State includes information on age and rock type (two factors useful in assessing risk). Improvement needs to be made for additional characteristics such as styles of eruption, longevity and scope of influence. Physical characteristics including structure and morphological development will contribute to making a mapping effort more useful for risk analysis. It may be beneficial to include volcanic activity outside the State that has the potential to impact New Mexico (ash clouds for example). Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.

Hazard: Volcano

How Contributes to Strategy: Mapping the various volcanic activity types would provide emergency managers, land managers, transportation industry and building code officials with information to better understand the potential impact of this hazard. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.

Suggested Responsible Party: DoIT, DHSEM, DOT, New Mexico Institute of Mining and Technology, USGS

Estimated Expenses: Unknown at this time

Funding Sources: Unknown at this time

Timeframe: 60 months

Adapted STAPLE+E Average: 138

Ranking: 39

2018 Update:

Nearly 200 new, high-precision ages have been generated for approximately 80 late Quaternary (< 500,000 years-old) volcanic vents throughout New Mexico. These data provide new insights into the time-space patterns of volcanism during this period. Data is currently being compiled for publication in various national journals. As part of this project, some small areas have new reconnaissance-style mapping and notable hazard-related features have been documented throughout the region. No work has been completed to understand the hazards related to eruptions from outside the State (which may produce ash fall in New Mexico). Future work will focus on filling data gaps in the age compilation and refining vent migration patterns. An additional dataset that would be useful would be high-resolution (< 10 cm) digital elevation models for areas of recent volcanism, which may show likely paths for lava flows should activity begin again.

38. **Provide Education About the Volcano Alert System and the Aviation Color Code Warning System**

This is a new mitigation action for the 2013 Plan and was suggested by the SHMPT and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Because this is a hazard that is not experienced often, many citizens don't understand the severity of the potential impact of volcanic activity.

Hazard: Volcano

How Contributes to Strategy: Educating citizens, emergency managers and first responders about the volcano alert system could likely reduce damage and potential injury in the future.

Suggested Responsible Party: DoIT, DHSEM, New Mexico Institute of Mining and Technology, USGS

Estimated Expenses: Unknown at this time

Funding Sources: Unknown at this time

Timeframe: 60 months

Adapted STAPLE+E Average: 1.58

Ranking: 33

<u>2018 Update</u>

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

Multi-Hazard Actions:

Develop Comprehensive Public Education/Outreach Strategies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and Enhance GIS Capabilities within DHSEM

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

7.2.15 Wildfire

39. Increase the Number of Fire Adapted Communities

The Firewise program emphasizes community responsibility for maintaining a safe community. Fire Adapted Communities acknowledge their wildfire risk and take actions to protect residents, homes, neighborhoods, businesses, infrastructure, forests and open spaces. Mitigation options for wildland fire need to address not only the management of fuels, but also the potential for growing population in wildfire threat areas. The State Forestry Division has conducted a State-wide assessment on forest health and outlined mitigation efforts and priorities to reduce fuel loads and create more defensible space. More specific mitigation goals and actions are detailed in the New Mexico Forest Action Plan (formerly "Statewide Assessment, Strategy and Response Plans.")

Hazard: Wildfire

How Contributes to Strategy: Fire Adapted Communities is a program designed to involve homeowners, local leaders, developers, agriculture producers and others in the effort to protect people property and natural resources from wildfires, by building and maintaining communities that are compatible to local environments. The New Mexico Fire Adapted Communities Learning Network connects and supports people and communities who strive to live more safely with wildland fire. The goal is to continue to increase the number of Fire Adapted communities and ramp up actions communities take to become Fire Adapted.

Suggested Responsible Party: NM Forestry, local fire departments, local emergency managers, FAC Learning Network

Estimated Expenses: Volunteer and community efforts

Funding Sources: Unknown at this time

Timeframe: 60 months

Adapted STAPLE+E Average: 2.79

Ranking: 1

<u>2018 Update</u>

As the threat from wildfires expands across New Mexico and the rest of the western United States, the importance of educating residents and visitors also continues to grow. Forestry helps facilitate "Ready, Set, Go!" "Fire Adapted Communities," and "Firewise Communities USA," the flagship of these educational endeavors. In 2017 the State-wide total of Firewise communities in New Mexico reached 28. Several additional communities are in the process of satisfying the requirements for Firewise recognition.

40. **Implement Defensible Space Around State Owned Facilities**

Defensible space around the structure will lessen the risk of structure damage.

Hazard: Wildfire

How Contributes to Strategy: Establishing defensible perimeter around state owned facilities will reduce the likelihood of these resources to being destroyed by wildfire.

Suggested Responsible Party: DHSEM, NM Forestry

Estimated Expenses: Brush/tree removal and maintenance of perimeter

Timeframe: 60 months

Funding Sources: Existing budgets, SFA-WUI

Adapted STAPLE+E Average: 2.64

Ranking: 6

2018 Update

No activities were reported to DHSEM for inclusion. However, State, Local, and Tribal implementation may have occurred over the five-year period.

41. **Increase Participation in Community Wildfire Protection Plans (CWPP)**

CWPP are community or county plans that address wildfire risk and mitigation for specific communities in New Mexico. The plan must have collaboration between land management

agencies and the community and it must prioritize fuel reduction areas and address the treatment of structural ignitability within the plan boundaries. Communities to target for participation are those with the highest risk.
Hazard: Wildfire
How Contributes to Strategy: Suggested Responsible Party: NM Forestry, local jurisdictions
Estimated Expenses: Creation and updates of plan
Timeframe: 60 months
Funding Sources: existing budgets, RFA, SFA-WUI, NM Assoc. of Counties Grants
Adapted STAPLE+E Average: 2.43
Ranking:10

2018 UPDATE
As of December 2017, there are 58 CWPPs in New Mexico. These 58 CWPPs identify 746 communities at risk from wildland fire.

42. Reduce Combustible Fuels Around Critical Facilities in WUI Areas
This action reduces the susceptibility to wildfires at critical facilities such as power stations, power lines, transformer sites, major transportation routes and critical watersheds. Critical facilities must be protected from wildfire on a priority basis. Transportation routes are critical for emergency traffic, residential ingress and egress. Some watershed areas can be vulnerable to other hazards (such increased sediment or pollutants) after wildfires.
Hazard: Wildfire
How Contributes to Strategy: By reducing fuel around critical facilities, wildfire risk is reduced. Therefore, less damage to structures or infrastructure will result. In addition, there will be less potential for injury and the possibility of loss of life.
Suggested Responsible Party: Local jurisdictions, utilities providers, DOT, State Forestry, facility owners
Estimated Expenses: Equipment and manpower
Funding Sources: Existing budgets, PDM, HMGP, RFA, SFA-WUI, RCA EAP,
Timeframe: 60 months
Adapted STAPLE+E Average: 2.64
Ranking: 7

2018 UPDATE

NMDOT continues to work with land managers to reduce fuel risk areas. No additional activities were reported to DHSEM for inclusion. However, implementation may have occurred over the five-year period.

Multi-Hazard Actions:
Develop Comprehensive Public Education/Outreach Strategies
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a Centralized Repository of Hazard Mapping Accessible for Local Jurisdictions, Tribal Entities, and State Agencies

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and Enhance GIS Capabilities within DHSEM
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State Facilities and Assets in Relation to Identified Hazard Areas
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Implement Actions to Improve Forest and Watershed Health
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: Drought, Flood, Wildfire

7.2.16 Ranking Results

The prioritization of mitigation actions in this Plan Update should not be construed as absolute. It is not necessary for the first priority to be met before subsequent priorities are addressed. Governmental agencies and institutions often make determinations about what project to implement based on available resources such as funding and staffing. Often grant funding is available for a specific project type; potential grant recipients must use what is available to them, even if the action item is not listed as the top priority. The priorities identified in this Plan Update are to be viewed as guidelines for State agencies, not as requirements. Tribal governments, local governments and institutions must make their own prioritization for mitigation actions based on appropriateness for each individual community or entity. Figure 7-2 shows mitigation actions ranked by hazard type, and Figure 7-3 shows mitigation actions by priority order.

The following approach was used in numbering the actions in ranked order.

1. If more than one action had the same two decimal place average score, the actions are in order based on the four decimal place average score.
2. If more than one action has the same four decimal place average score, the actions are in order based on the hazard ranking results (described in the HIRA section of the plan, Hazard Ranking subsection)
3. If more than one action relating to the same hazard has the same four decimal place average score, the actions are in order based on how they are numbered in the Mitigation Action section. Multi-hazard actions are first and then hazard types are ordered in alphabetical order.

Figure 7-2 Mitigation Action Rank by Hazard Type

Draft #	Mitigation Action	Adapted STAPLE+E Average	Prioritization Rank
	Multi-Hazard		
1	Public Education/Outreach	2.71	4
2	Centralized Hazard Mapping	2.62	8
3	Establish/Enhance GIS in DHSEM	2.38	11
4	Map State Facilities	1.92	22

Draft #	Mitigation Action	Adapted STAPLE+E Average	Prioritization Rank
5	Update/Train Hazus (Damage Estimator Software)	1.83	25
6	Improve Forest/Watershed Health	2.64	5
	Dam Failure		
7	Hire Dam Safety Engineer	2.17	16
8	Rehabilitate/Remove Unsafe Dams	1.77	27
9	Create EAPs for "High" and "Significant Hazard" Dams	2.36	12
	Drought		
10	Mandate Xeriscaping at State Facilities/Encourage Statewide	2.00	19
11	Require Grey Water System at State Facilities/Encourage State-wide	1.62	31
12	Establish Rebate Program	1.46	36
13	Drought Mitigation in Range Plans	2.57	9
14	New Water Sources	1.77	26
15	Water Supply/Drought Vulnerability Assessment	2.77	3
	Earthquake		
16	Map Seismic Risk State-wide	2.31	13
17	Vulnerability Assessment for State Critical Facilities	2.00	20
18	Develop Regional Earthquake Codes	1.77	28
19	Retrofit Public Facilities	1.46	37
20	Participate in ShakeOut! and Encourage Participation State-wide	2.31	14
	Expansive Soil		
21	Map Hazardous Soils	2.00	21
	Flood		
22	Acquire/Relocate Repetitive/Severe Loss Structures and Outreach	2.15	17
23	Add/Improve Flood Control Structures	2.21	15
24	Study Impact of Post-Fire Flooding/Debris Flow	2.79	2
25	Study Impact of Alluvial Fans	1.46	35
26	Increase Number of CRS Communities	1.50	34
27	Technical Assistance for Ordinance Development	1.67	29
28	One Week-Long Floodplain Management Class in State per Year	1.42	38
	Landslide		
29	Map Landslide and Rockfall Susceptibility Areas	1.92	23
30	Install Rock Nets or Similar	2.08	18
31	Adopt Zoning	1.67	30
	Land Subsidence		
32	Map Land Subsidence	1.92	24
	Severe Winter Storms		
33	Install Snow Fences	1.62	32
	Thunderstorm		
34	Hail Resistant Material in State Facilities	1.31	41
	Tornado		
35	Storm Shelters	1.08	42
36	Public Sheltering	1.33	40

Draft #	Mitigation Action	Adapted STAPLE+E Average	Prioritization Rank
	Volcano		
37	Mapping of Volcanic Hazards	1.38	39
38	Education on Warning System and Alert Codes	1.58	33
	Wildfires		
39	Increase Number of Firewise/Fire Adapted Communities	2.79	1
40	Defensible Space Around State Facilities	2.64	6
41	Increase Number of CWPPs	2.43	10
42	Reduce Combustible Fuel Around Critical Facilities	2.64	7

Figure 7-3 Mitigation Action Ranking in Priority Order

Prioritization Rank	Mitigation Action	Adapted STAPLE+E Average	Draft #
1	Increase Number of Firewise/Fire Adapted Communities	2.79	39
2	Study Impact of Post-Fire Flooding/Debris Flow	2.79	24
3	Water Supply/Drought Vulnerability Assessment	2.77	15
4	Public Education/Outreach	2.71	1
5	Improve Forest/Watershed Health	2.64	6
6	Defensible Space Around State Facilities	2.64	40
7	Reduce Combustible Fuel Around Critical Facilities	2.64	42
8	Centralized Hazard Mapping	2.62	2
9	Drought Mitigation in Range Plans	2.57	13
10	Increase Number of CWPPs	2.43	41
11	Establish/Enhance GIS in DHSEM	2.38	3
12	Create EAPs for “High” and “Significant Hazard” Dams	2.36	9
13	Map Seismic Risk State-wide	2.31	16
14	Participate in ShakeOut! and Encourage Participation State-wide	2.31	20
15	Add/Improve Flood Control Structures	2.21	23
16	Hire Dam Safety Engineer	2.17	7
17	Acquire/Relocate Repetitive/Severe Loss Structures and Outreach	2.15	22
18	Install Rock Nets or Similar	2.08	30
19	Mandate Xeriscaping at State Facilities/Encourage Statewide	2.00	10
20	Vulnerability Assessment for State Critical Facilities	2.00	17
21	Map Hazardous Soils	2.00	21
22	Map State Facilities	1.92	4
23	Map Landslide and Rockfall Susceptibility Areas	1.92	29
24	Map Land Subsidence	1.92	32

Prioritization Rank	Mitigation Action	Adapted STAPLE+E Average	Draft #
25	Update/Train Hazus (Damage Estimator Software)	1.83	5
26	New Water Sources	1.77	14
27	Rehabilitate/Remove Unsafe Dams	1.77	8
28	Develop Regional Earthquake Codes	1.77	18
29	Technical Assistance for Ordinance Development	1.67	27
30	Adopt Zoning	1.67	31
31	Require Grey Water Systems at State Facilities/Encourage State-wide	1.62	11
32	Install Snow Fences	1.62	33
33	Education on Warning System and Alert Codes	1.58	38
34	Increase Number of CRS Communities	1.50	26
35	Study Impact of Alluvial Fans	1.46	25
36	Establish Rebate Program	1.46	12
37	Retrofit Public Facilities	1.46	19
38	One Week-Long Floodplain Management Class in State per Year	1.42	28
39	Mapping of Volcanic Hazards	1.38	37
40	Public Sheltering	1.33	36
41	Hail Resistant Material in State Facilities	1.31	34
42	Storm Shelters	1.08	35

Increasing the number of Fire Adapted Communities remained the number one priority mitigation action. Studying the probability, extent, vulnerability and impact of post-fire flooding moved up to the second highest priority (it was the fourth in the 2013 Plan). Public Water Supply and Drought Vulnerability Assessments moved to the third highest priority (it was the seventh in the 2013 Plan).

It is interesting to note that nine of the top ten mitigation actions involve watershed treatment, wildfire risk reduction or enhanced water supply. The intensified drought-wildfire-flood cycle that we have witnessed in New Mexico has influenced this ranking outcome.

In general, earthquake, landslide, and expansive soils mitigation actions had higher priority than in the 2013 Plan. This may be due to the State-wide Vigilant Guard exercise that used a large earthquake in Albuquerque as the scenario. It may also be due to the landslide, rockfall, and collapsible soils susceptibility mapping and outreach that has recently been completed.

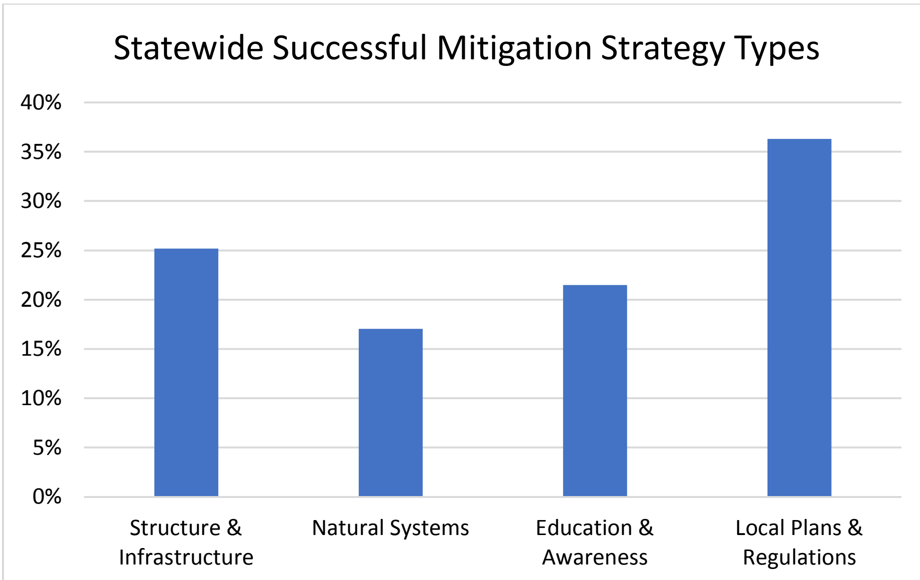
7.3 Local Mitigation Strategies Roll Up Results

As part of the 2018 SHMP process, local HMPs that were approved by FEMA since December 2012 (a total of 28) were reviewed and certain elements have been compiled at a State and Preparedness Area level for inclusion in the SHMP. The following narrative highlights some of this information as it relates to local mitigation strategies.

This exercise resulted in the review and classification of implemented and planned mitigation actions and projects. These actions and projects are classified into the four major categories of mitigation efforts: Structure & Infrastructure, Natural Systems, Education & Awareness, and Local Plans &

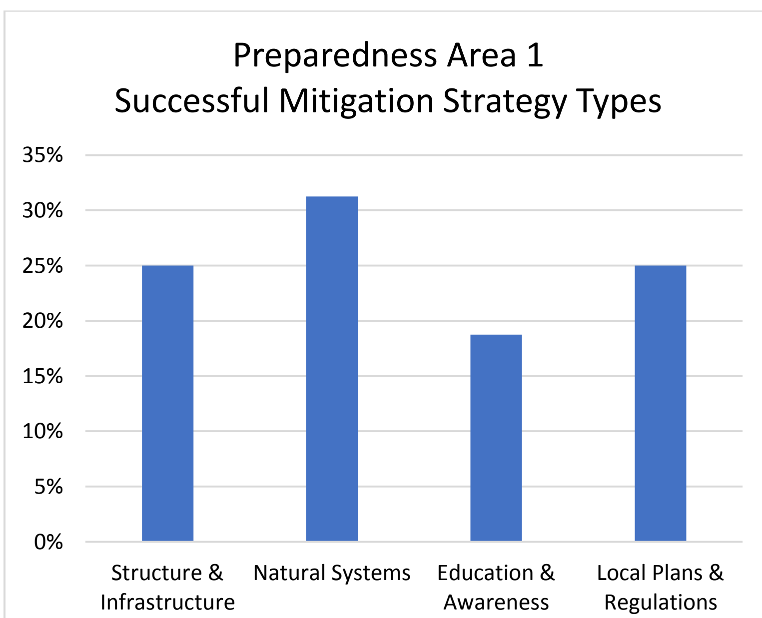
Regulation. The following Figure 7-4 shows the breakdown at a State level. Analyzing mitigation types at the State-wide level shows that Local Plans & Regulations are the most supported mitigation strategy types. Following the chart below are the results presented by Preparedness Area.

Figure 7-4 Statewide Successful Mitigation Strategy Types



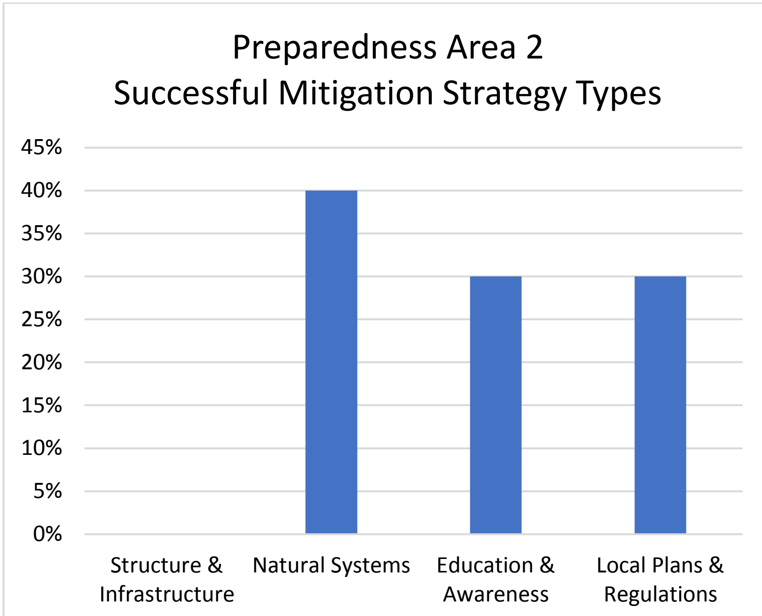
Preparedness Area 1 communities have successfully implemented a number of mitigation strategies identified in local hazard mitigation plans (Figure 7-5). These projects generally fall under the four mitigation project types somewhat consistently. Although, Natural Systems Protection project types were most often identified in local plans.

Figure 7-5 Preparedness Area 1 Successful Mitigation Strategy Types



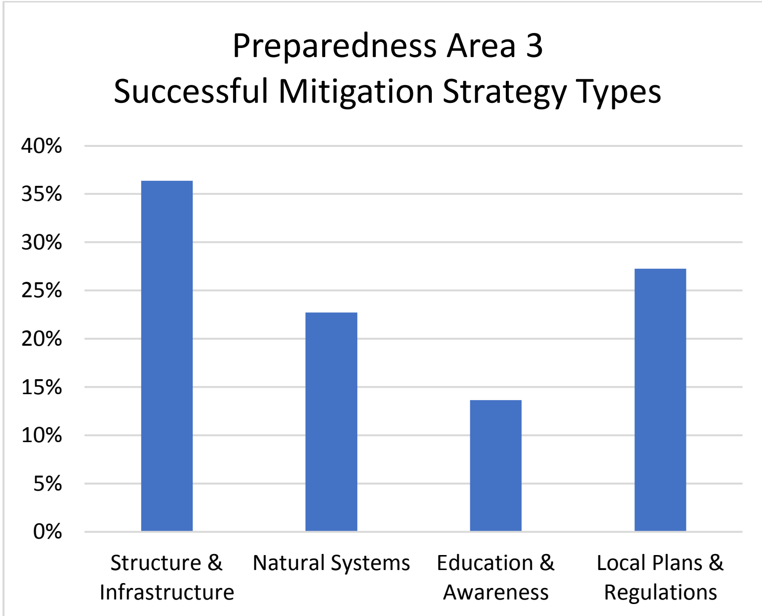
Preparedness Area 2 communities have successfully implemented a number of mitigation strategies identified in local hazard mitigation plans (Figure 7-6). Of the four project types, Natural Systems Protection project types were most often identified in local plans whereas Structure & Infrastructure Projects were not identified as successfully implemented projects.

Figure 7-6 Preparedness Area 2 Successful Mitigation Strategy Types



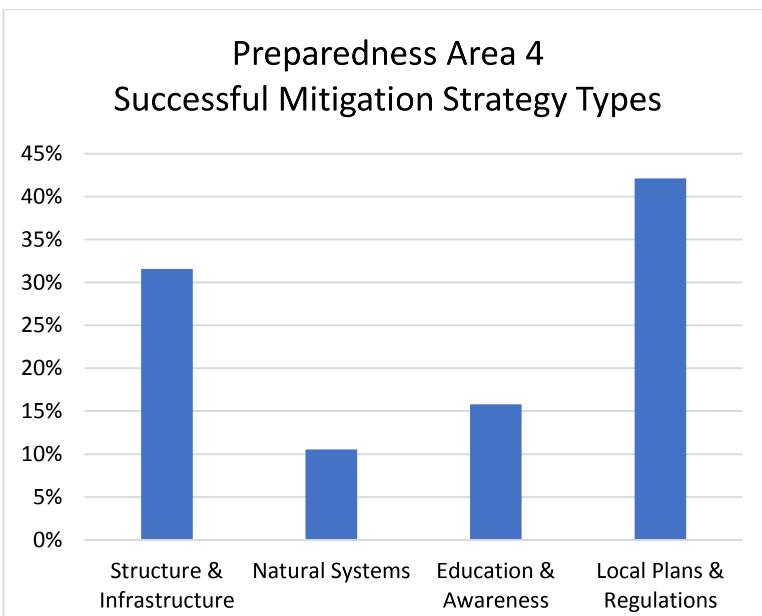
Preparedness Area 3 communities have successfully implemented a number of mitigation strategies identified in local hazard mitigation plans (Figure 7-7). Of the four project types, Structure & Infrastructure project types were most often identified in local plans whereas Education & Awareness Projects were least often identified.

Figure 7-7 Preparedness Area 3 Successful Mitigation Strategy Types



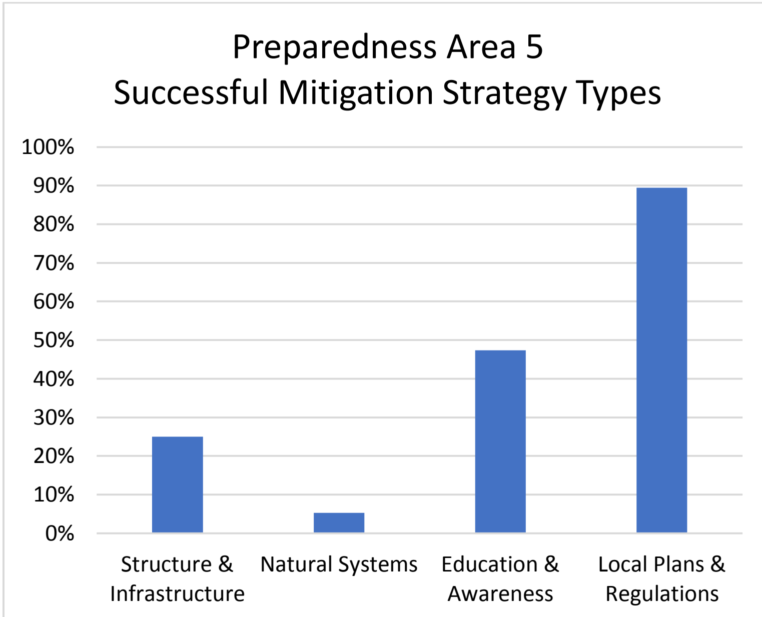
Preparedness Area 4 communities have successfully implemented number of mitigation strategies identified in local hazard mitigation plans (Figure 7-8). Of the four project types, Local Plan & Regulation project types were most often identified in local plans whereas Natural Systems and Education & Awareness projects were not often identified as successfully implemented project types.

Figure 7-8 Preparedness Area 4 Successful Mitigation Strategy Types



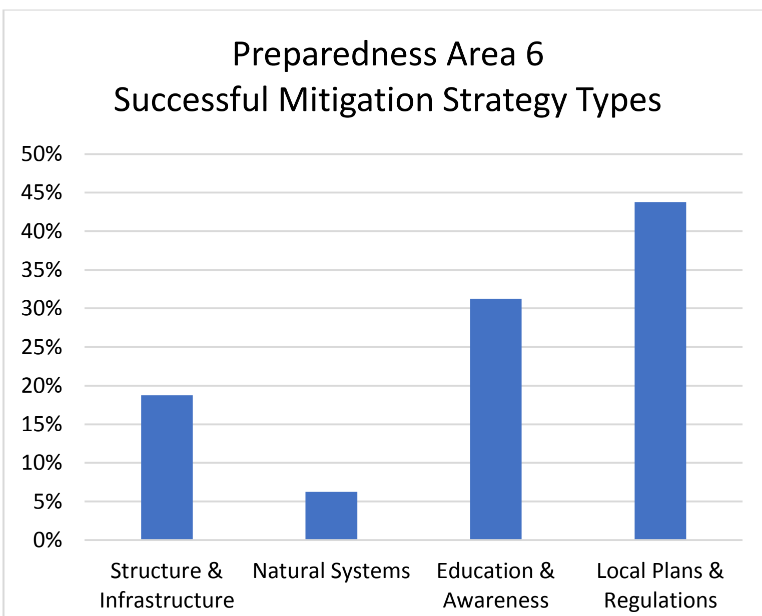
Preparedness Area 5 communities have successfully implemented a number of mitigation strategies identified in local hazard mitigation plans (Figure 7-9). Of the four project types, Local Plan & Regulation project types were most often identified in local plans whereas Natural Systems projects were not often identified as successfully implemented project types.

Figure 7-9 Preparedness Area 5 Successful Mitigation Strategy Types



Preparedness Area 6 communities have successfully implemented a number of mitigation strategies identified in local hazard mitigation plans (Figure 7-10). Of the four project types, Local Plan & Regulation project types were most often identified in local plans whereas Natural Systems projects were not often identified as successfully implemented project types.

Figure 7-10 Preparedness Area 6 Successful Mitigation Strategy Types



8 IMPLEMENTATION STRATEGY

Once the 2018 New Mexico Natural Hazard Mitigation Plan is approved by FEMA, it will be available on the DHSEM webpage for reference. An email notification will be sent to all SHMPT members, Subject Matter Experts, State agencies, Tribal entities and organizations with an interest in natural hazard mitigation. Neighboring State SHMOs and national organizations with an interest in natural hazard mitigation will also receive a notification.

Effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. Agencies and organizations involved with the preparation of the 2018 Plan Update will implement mitigation actions as resources become available. In many instances mitigation actions were identified that are already in the planning or implementation stages.

Monitoring, evaluating, and up-dating the State Natural Hazard Mitigation Plan are critical to maintaining its relevance. The SHMPT and Subject Matter Experts will continue to be asked for input into the Plan throughout the five year up-date cycle.

8.1 Monitoring and Evaluation

The Plan will be updated by the FEMA approved five year anniversary date, as required by the Disaster Mitigation Act of 2000 and subsequent FEMA Guidance. Future plan updates will account for any new hazard vulnerabilities, special circumstances or new information that becomes available. During the ongoing Plan evaluation process, the State will consider the following criteria for assessing the effectiveness of the current Plan:

- Has the nature or magnitude of hazards affecting the State changed?
- Are there new hazards that have the potential to impact the State?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the Plan?
- Should additional local resources be committed to address identified hazards?

In order to address these questions, an annual survey will be conducted in the fall of each year to encourage SHMPT and Subject Matter Expert feedback and to facilitate the review of the progress of mitigation activities. It is anticipated that the survey will be sent October 1 with comments due back by November 1. Questions and information to be collected on the annual survey will include:

- Describe any public outreach activities regarding the State Natural Hazard Mitigation Plan.
- If additional maps or hazard data is available, what information is relevant to the State Plan?
- If a natural disaster has occurred in this reporting period, provide data on the event and its impacts.
- Do any new critical facilities need to be added to the list?
- If there has been change in development patterns, provide information about how that could influence the effects of hazards or create additional risks.

- Are there different financial, technical or human resources now available for mitigation planning and project implementation?
- Describe any progress on mitigation action implementation.
- Should new mitigation actions be added? If so, describe the activity.

Results of the survey will then be compared to the goals and objectives established in the Plan and decisions will be made regarding whether actions should be discontinued or modified in any way in light of new developments in the region. Moving forward, systematic evaluation of data collected from the annual surveys will be the primary method for tracking initiation, status and completion of proposed mitigation activities.

In January of each year DHSEM will distribute a brief listing of the updates suggested for the Plan. The listing will be sent to all SHMPT and Subject Matter Experts. In addition, it will be posted on the DHSEM website along with the FEMA approved version of the Plan Update.

The SHMO will also monitor and evaluate the progress of DHSEM HMP projects via quarterly financial and performance reporting, site visits, and telephone, email and postal correspondence throughout the course of a project. For construction projects, the SHMO, or other designated person, will visit the project side at the request of sub-grantees to provide direct advice and to resolve challenges. The SHMO may visit a project site to perform an interim inspection at any time. State HMP projects will be evaluated in terms of their project phase (ongoing, deferred or complete), avoided losses and alignment with local land use and development plans. Other agencies and organizations represented by SHMPT members and Subject Matter Experts will monitor projects/actions identified in the HMP and will report status through the annual survey.

8.2 Plan Update

In year four of the five-year cycle, the SHMO will initiate the update process. If appropriate, a planning grant will be pursued. The SHMPT and SMEs will be invited to a Kick-off Meeting 20 months prior to the expiration of the Plan. Updates to each section of the Plan will occur during that time. The draft Plan will be submitted to FEMA for review in the spring of 2023. The chart below (Figure 8-1) summarizes the activities to take place during the next five years.

Figure 8-1 Plan Update Timeline

Approximate Timeline	Action	Responsible Party
2019		
October	Distribute Annual Survey	DHSEM Mitigation Program
November	Fill out and return Annual Survey	Planning Team and SMEs
2020		
January	Generate Update Report	DHSEM Mitigation Program
October	Distribute Annual Survey	DHSEM Mitigation Program
November	Fill out and return Annual Survey	Planning Team and SMEs
2021		
January	Generate Update Report	DHSEM Mitigation Program
July	Apply for grant funding for plan update	DHSEM Mitigation Program

Approximate Timeline	Action	Responsible Party
October	Distribute Annual Survey	DHSEM Mitigation Program
November	Fill out and return Annual Survey	Planning Team and SMEs
2022		
January	Generate Update Report	DHSEM Mitigation Program
February	Planning Team Kick-off Meeting	DHSEM Mitigation Program to facilitate Planning Team and SMEs participate
May	HIRA Planning Team Meeting	DHSEM Mitigation Program to facilitate Planning Team and SMEs participate
August	Capabilities Planning Team Meeting	DHSEM Mitigation Program to facilitate Planning Team and SMEs participate
November	Vulnerabilities Planning Team Meeting	DHSEM Mitigation Program to facilitate Planning Team and SMEs participate
2023		
February	Mitigation Actions Planning Team Meeting	DHSEM Mitigation Program to facilitate Planning Team and SMEs participate
April	Plan submittal to FEMA for review	DHSEM Mitigation Program
July-August	Edits plan based on FEMA comments	DHSEM Mitigation Program
September	Plan update approved	FEMA

It is anticipated that the Kick-off Meeting for the 2023 update will occur in February 2022. Specific items that will be reviewed and modified for the 2023 update will be based on based on Annual Survey results and SHMPT and Subject Matter input. At a minimum, the update will address the following:

- Should the same planning process be followed as in the 2018 update?
- Does the SHMPT and Subject Matter Expert list reflect the full range of interests State-wide?
- Are the State-wide mitigation goals still appropriate?
- Has the pattern or type of natural disasters changed sufficiently that the Plan should have a different focus?
- What policies or regulations have been modified at the State or Federal level that may impact the Plan update?

As the 2018 update was proceeding, it became obvious that certain topics could not be covered in enough depth due to the lack of availability of data and resources. If resources are available, it is anticipated that the following topics will be addressed in the 2023 update:

- Impacts of natural hazards that occur across State boundaries that impact New Mexico communities and wildlife populations
- Inventory and analysis of stream restoration projects and effectiveness at reducing flood impacts