2013

State of Arizona Hazard Mitigation Plan

Executive Summary

Across the United States, natural and human-caused disasters have led to increasing levels of death, injury, property damage, and interruption of business and government services. The toll on families and individuals can be immense and damaged businesses cannot contribute to the economy. The time, money and effort to respond to and recover from these disasters divert public resources and attention from other important programs and problems. Arizona has had over 188 federal or state declarations since 1966 and many more significant but undeclared disaster events. Arizona recognizes the consequences of disasters and the critical need to reduce the impacts of natural and human-caused hazards.

The elected and appointed officials of the State of Arizona also know that with careful selection, mitigation actions in the form of projects and programs can become long-term, cost effective means for reducing the impact of natural and human-caused hazards. Applying this knowledge, the State of Arizona Hazard Mitigation Planning Team (the Planning Team) has collaborated to prepare this *2013 State of Arizona Hazard Mitigation Plan* (the Plan). With the support of various officials, the State of Arizona, and the Federal Emergency Management Agency (FEMA), this Plan has resulted in a resource to guide the State toward greater disaster resistance in full harmony with the character and needs of the region.

People and property in Arizona are at risk from a variety of hazards that have the potential for causing widespread loss of life and damage to property, infrastructure, and the environment. The purpose of hazard mitigation is to implement actions that eliminate the risk from hazards, or reduce the severity of the effects of hazards on people and property. Mitigation is any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation encourages long-term reduction of hazard vulnerability. The goal of mitigation is to save lives and reduce property damage. Mitigation can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical community 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.

This Plan has been prepared in compliance with Section 322 of the *Robert T. Stafford Disaster Relief and Emergency Assistance Act* (*Stafford Act* or the *Act*), 42 U.S. C. 5165, enacted under Sec. 104 the *Disaster Mitigation Act of 2000*, (*DMA 2000*) Public Law 106-390 of October 30, 2000. This Plan identifies hazard mitigation measures intended to eliminate or reduce the effects of future disasters throughout the State.

The State of Arizona shall comply with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend its Plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d).

Purpose, Authority and Approval

The purpose of the 2013 State of Arizona Hazard Mitigation Plan (the Plan) is to provide guidance for hazard mitigation in the State of Arizona. The Plan identifies hazard mitigation actions and projects that have the potential to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural and human-caused disasters in Arizona. This Plan also meets requirements of a Standard State Mitigation Plan under 44 CFR 201, published by the Federal Emergency Management Agency (FEMA).

Meeting the requirements of the regulations mentioned above keeps the State of Arizona eligible to receive disaster assistance including hazard mitigation grants available through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended.

This plan was prepared by the Arizona Division of Emergency Management (ADEM), a division of the Department of Emergency and Military Affairs (DEMA). Arizona Revised Statutes (ARS) 26-305 establishes ADEM under DEMA via the following:

> *A. There is established in the Department of Emergency and Military Affairs the Division of Emergency Management which is administered by the department, under the authority of the Adjutant General, subject to powers vested in the Governor as provided by law.*

The section goes on to designate ADEM as the State of Arizona entity responsible for emergency preparedness, including mitigation, via the following:

> *B. The division shall prepare for and coordinate those emergency management activities which may be required to reduce the impact of disaster on persons or property.*
>
> *C. Through the powers vested in the Governor, the division shall coordinate the cooperative effort of all governmental agencies including the Federal government, this State and its political subdivisions to alleviate suffering and loss resulting from disaster.*

TABLE OF CONTENTS

Maps

Tables

Figures

Appendices

1. Introduction

What is Hazard Mitigation?

The first step to understanding the State Hazard Mitigation Plan is to understand what hazard mitigation is. Hazard Mitigation is defined as any action taken to reduce or eliminate the long term risk to human life and property from human-caused or natural hazards. A hazard is any event or condition with the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, environmental damage, business interruption, or other structural and financial loss. As communities continue to grow, hazard mitigation will play an even more important role in the government's primary objective of protecting its citizens' health, safety and welfare.

Hazard mitigation aims to make human development and the natural environment safer and more resilient. Hazard mitigation generally involves altering the built environment to significantly reduce risks and vulnerability to hazards so that life and property losses can be avoided or reduced. Mitigation can also include removing the built environment from disaster prone areas and maintaining natural mitigating features, such as wetlands or floodplains. Hazard mitigation makes it easier and less expensive to respond to and recover from disasters by breaking the damage and repair cycle.

Examples of hazard mitigation measures include, but are not limited to the following:

- Development of mitigation standards, regulations, policies, and programs
    - Land use/zoning policies
    - Strong statewide building code and floodplain management regulations
    - Dam safety program, seawalls, and levee systems
- Acquisition of flood prone and environmentally sensitive lands
- Retrofitting/hardening/elevating structures and critical facilities
- Relocation of structures, infrastructure, and facilities out of vulnerable areas
- Public awareness/education campaigns
- Improvement of warning and evacuation systems

Benefits of hazard mitigation include:

- Saving lives and protecting public health
- Preventing or minimizing property damage
- Minimizing social dislocation and stress
- Reducing economic losses
- Protecting and preserving infrastructure
- Less expenditures on response and recovery efforts

In 2005, a study by the National Institute of Building Sciences through its Multi-Hazard Mitigation Council, reported to Congress that money spent on reducing the risk of natural hazards is a sound investment. On average, a dollar spent on hazard mitigation saves the nation about $4 in future benefits. In addition, FEMA grants to mitigate the effects of floods, hurricanes, tornados, and earthquakes between 1993 and 2003 are expected to save more than 220 lives over approximately 50 years.

DMA 2000 Requirements and Official Adoption and Approval

Requirement: §201.4(c)(6) and §201.4(c)(7): The Plan must be formally adopted by the State prior to submittal to [FEMA] for final review and approval [and] include assurances that the State will comply with all applicable Federal statutes and regulation in effect with respect to the periods for which it received grant funding, in compliance with 44 CFR 13.11(c). The State will amend its Plan whenever necessary to reflect changes in the State or Federal laws and statutes as required in 44 CFR 13.11(d).

The 2013 State of Arizona Hazard Mitigation Plan meets the requirements Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. Additionally, this plan meets the minimum planning requirements under 44 Code of Federal Regulations, Part 78 (Flood Mitigation Assistance). It is intended that this plan also meet the requirements of the Disaster Mitigation Act of 2000 (DMA2K), Section 322. Section 322 of the Act requires that states, as a condition of receiving federal disaster mitigation funds, have a mitigation plan in place that describes the planning process for identifying hazards, risk and vulnerabilities, identifies and prioritizes mitigation actions, encourages the development of local mitigation and provides technical support for these efforts.

The Arizona Division of Emergency Management is authorized by ARS §26-305 to prepare for and coordinate those emergency management activities that may be required to reduce the impact of disaster on persons or property; and through the powers vested in the Governor, the division shall coordinate the cooperative effort of all governmental agencies including the federal government, this state and its political subdivisions to alleviate suffering and loss resulting from disaster.

2. Planning Process

Overview

Requirement: §201.4(c)(1): [The State plan must include a] description of the planning process used to develop the plan, including how it was prepared, who was involved in the process and how other agencies participated.

Requirement: §201.4(b): The [State] mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, interested groups and be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives.

The Mitigation Planning Program Manager (MPPM) of the Mitigation Group at the Arizona Division of Emergency Management (ADEM) led the planning effort to review and revise this Plan. As was done in the past, we solicited participation for the Planning Team. With much turnover at other agencies and after several attempts to enlist Planning Team members, it was determined for the sake of ease and efficiency to perform the update duties via email and phone. This method was further supported by the brief three year update cycle in effect and the rarity of catastrophic disasters such as the country's recent coastal storms.

The Planning Team participated, working independently reviewing and making revision recommendations for specific portions of the Plan. Subject matters and other agencies were also consulted with as needed to update data in the Risk Assessment and to assess progress in the Mitigation Strategy section.

Descriptions of how the Plan was reviewed and revised and any major changes are discussed at the beginning of each section.

Planning Team

The Planning Team members are (red text indicates newly participating members):

Name/Title	Agency	Role/Responsibilities
Darlene Trammell State Hazard Mitigation Officer	ADEM	Oversee planning effort.
Susan Wood Mitigation Planning Program Mgr.	ADEM	Coordinate planning effort.
Wendy Smith-Reeve Division Director	ADEM	Approve Plan. Provide direction related to recovery.
Anthony Cox Hazard Analysis	ADEM	Provide general hazard information/data.
Billy Ross Emergency Response Coordinator	ADEM	Provide Terrorism and general hazard information/data and Mitigation Strategy input.
Mike Malone Waste Program Division	ADEQ	Provide information/data on air quality sections and topics.
Alcira Angulo Emergency Coordinator	ADES	Provide information/data on Disease and health related hazards and topics.
Maureen Towne Map Modernization Coordinator	AZ Dept of Water Resources	Provide ADWR program information and Mitigation Strategy input.

Name/Title	Agency	Role/Responsibilities
Paul Culberson Program Specialist and Coordinator	AZSERC	Provide information/data on Hazardous Materials Incidents.
Michael Conway, Ph.D. Geologic Extension Service	Arizona Geological Survey	Provide information on geological hazards and Mitigation Strategy input.
Rebecca Trayler Recovery Projects Manager	ADEM	Provide disaster recovery information/data as required.
Bob Barger AZ State Fire Marshall	Dept of Fire, Bldg, Life Safety	Provide information on fire related hazards.
Rick Weigle Planner	Maricopa County Emergency Mgmt	Review plan and provide comment.
Nancy Selover State Climatologist	State Climatologist Office	Provide information/data on meteorological hazards.
Brannon Eagar County EM Director	Apache County	Provide information/data on county specific sections/topics.
Robert Rowley County EM Director	Coconino County	Provide information/data on county specific sections/topics.
Michael O'Driscoll County EM Director	Gila County	Provide information/data on county specific sections/topics.
Terry Cooper County EM Director	Graham County	Provide information/data on county specific sections/topics.
Steve Rutherford Alternate County EM Director	Greenlee County	Provide information/data on county specific sections/topics.
Steve Biro County EM Director	La Paz County	Provide information/data on county specific sections/topics.
Pete Weaver County EM Director	Maricopa County	Provide information/data on county specific sections/topics.
Byron Steward County EM Director	Mohave County	Provide information/data on county specific sections/topics.
Dan Hinz County EM Director	Navajo County	Provide information/data on county specific sections/topics.
Jeff Guthrie County EM Director	Pima County	Provide information/data on county specific sections/topics.
Lou Miranda County EM Director	Pinal County	Provide information/data on county specific sections/topics.
Raymond Sayre County EM Director	Santa Cruz County	Provide information/data on county specific sections/topics.
Denny Foulk County EM Director	Yavapai County	Provide information/data on county specific sections/topics.
Gretchen Robison County EM Director	Yuma County	Provide information/data on county specific sections/topics.

Resource List		
County GIS Specialists	Various Counties	Provide new mapping for their respective county descriptions in Section 3.

The following is an overview of the planning efforts for this update:

- ADEM received a PDM grant to cover the cost of hiring a contractor to update the Risk Assessment portion of this Plan. Michael Baker Corp was awarded the contract and assisted in updating various data and maps within that Plan portion.
- The Contractor reached out to members of the Planning Team based on hazard expertise and solicited review, input and updated data of the Risk Assessment.
- ADEM's Mitigation Planning Program Manager (MPPM) reached out to all county emergency managers to have them update their respective county descriptions (in Section 3), which were changed to include new discussion topics. After the descriptions were done or deadline had been reached, the section was distributed back to the county emergency managers for review and approval.
- The MPPM reached out to all county GIS Specialists for updated county maps as well as newly requested maps such as Population and Land Ownership. Most points of contact responded with maps. After maps were received or deadline had been reached, the section was distributed back to the county emergency managers for review and approval.
- The MPPM reached out to agencies that are named as 'Lead Agency' for mitigation measures from the previous version of this Plan, asking for current status of their respective measures. They were also asked for measure revisions and/or updates as appropriate.
- The MPPM reached out to the Planning Team including all county emergency managers for new information related to the Funding Sources within the Mitigation Strategy (Section 5). Some new funding sources were added based on the human-caused hazards added during this update.
- ADEM's Mitigation Group produced and update draft of the HMGP Administrative Plan for inclusion in the 'Plan Maintenance Procedures' section.

3. State and County Descriptions

Section Changes:

No notable changes to the State Overview.

State Overview

Population

Maricopa County, which includes Phoenix, Scottsdale, Mesa, and numerous other local jurisdictions, has by far the largest population in the State, both in terms of total population and households, as well as in terms of potentially vulnerable population groups. Pima County, which includes Tucson, is the next largest county.

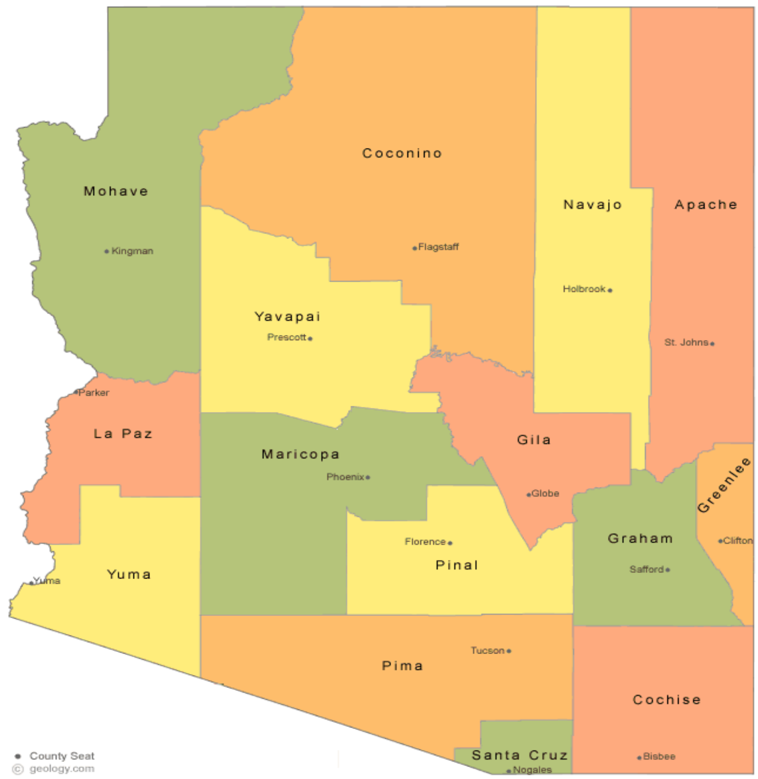


Table CD-1: Population in Arizona, July 2012

State/County	Population	% of Pop 65 Yrs + of Age	% of Pop Under 18 Yrs of Age	% of Pop Below Poverty Level
State of Arizona	6,553,255	14.8%	24.7%	16.2%
Apache	73,195	12.3%	30.9%	34.7%
Cochise	132,088	18.1%	22.4%	16.2%
Coconino	136,011	9.7%	22.5%	19.8%
Gila	53,144	24.9%	20.9%	20.9%
Graham	37,416	11.9%	27.8%	21.6%
Greenlee	8,802	12.1%	28.7%	17.2%
La Paz	20,281	34.9%	17.7%	19.4%
Maricopa	3,942,169	13.0%	25.7%	14.9%
Mohave	203,334	24.9%	19.8%	16.8%
Navajo	107,094	14.6%	28.7%	26.2%

State/County	Population	% of Pop 65 Yrs + of Age	% of Pop Under 18 Yrs of Age	% of Pop Below Poverty Level
Pima	992,394	16.6%	22.4%	17.4%
Pinal	387,365	15.9%	25.4%	14.3%
Santa Cruz	47,303	14.6%	29.4%	26.2%
Yavapai	212,637	26.3%	18.1%	14.9%
Yuma	200,022	16.4%	27.2%	20.8%

Source: U.S. Census Bureau: State and County QuickFacts, June, 2013.

Growth and Assessing Vulnerability

Overall, Arizona has experienced growth in the past three years. According to the U.S. Census Bureau, July 2010 – July 2012 carried a population increase of 2.5%. However, many counties such as Graham, Navajo, Gila and La Paz have experienced a population decline in the past three years. Population growth directly correlates to growth in the sectors of housing, retail, infrastructure, etc. Growth in these sectors can inform the goals of hazard mitigation, especially in hazard prone areas, and will drive the need for more or enhanced planning mechanisms at the local level to ensure smart growth. Growth will also increase the need for mitigation activities to protect the existing and new development. Over the past three years, ADEM has worked closely with growing Arizona counties and communities by aiding in the review and update of their hazard mitigation plans to ensure they reflect and address growth related challenges. Aid in the form of secured funding for the mitigation plan updates, provision of resources such as brochures and pamphlets, input to discussions during planning team meetings, and mitigation plan review, were provided by ADEM.

Table CD-2: County Population Growth from July 2010 to July 2012

County	Growth %
Pinal	10.7%
Maricopa	3.6%
Yuma	3.2%
Apache	3.0%
Greenlee	2.0%
Coconino	1.9%
Mohave	1.8%
Pima	1.7%
Cochise	1.5%
Yavapai	.7%
Santa Cruz	.6%
Graham	-0.3%
Navajo	-0.4%
Gila	-0.8%
La Paz	-1.1%

Source: US Census Bureau: State & County QuickFacts, June, 2013.

Table CD-3: Top 15 Growing Arizona Jurisdictions for July 2010 - July 2012

Jurisdiction	County	Growth
Duncan	Greenlee	7.87%
Guadalupe	Maricopa	7.37%
Buckeye	Maricopa	6.52%
Thatcher	Graham	6.13%
Goodyear	Maricopa	6.12%
Marana	Pima	5.90%
Gilbert	Maricopa	5.62%
Queen Creek	Maricopa	5.33%
Clifton	Greenlee	4.58%
Litchfield Park	Maricopa	4.36%
Chandler	Maricopa	3.81%
Peoria	Maricopa	3.51%
Prescott	Yavapai	3.33%
Somerton	Yuma	3.25%
Paradise Valley	Maricopa	3.03%

Source: Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2012;
U.S. Census Bureau, Population Division

Geography

Arizona is the sixth largest state in the United States, with 114,006 square miles[1]. Major features of the state are shown on the following map titled *Major Features of Arizona*.

Arizona is typically considered a desert state, but is actually comprised of six major terrestrial ecoregions with widely varying geography [2]. Each of the following six ecoregions cover varying land areas within the state:

- Arizona Mountain Forests ecoregion
- Chihuahuan Desert ecoregion
- Colorado Plateau Shrublands ecoregion
- Mojave Desert ecoregion
- Sierra Madre Occidental pine-oak forests ecoregion
- Sonoran Desert ecoregion

[1] Economic and Business Research Program, 2003
[2] National Geographic, 2003

The Arizona Mountain Forests ecoregion contains a mountainous landscape, much of which is known as the Mogollon Rim, located in approximately the center of the state and running diagonally from southeast to northwest, including portions of Apache, Coconino, Graham, Gila, Greenlee, Maricopa, Mohave, Navajo, Pinal, and Yavapai Counties. This ecoregion includes numerous small to medium-sized cities and towns, such as Eagar, Flagstaff, Globe, Pinetop-Lakeside, Payson, Prescott, and Sedona. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in this ecoregion is comprised largely of a mix of Scrub Grassland, Mogollon Chaparral Scrubland, Great Basin Conifer Woodland, Rocky Mountain Conifer Forest, and Plains Grassland

The Chihuahuan Desert ecoregion occupies much of the southeastern portion of Arizona, including portions of Cochise, Gila, Graham, Greenlee, Pima, Pinal, and Santa Cruz Counties. Located within this ecoregion are the small to medium-sized desert communities of Bisbee, Douglas, Safford, and Sierra Vista. The elevation varies in this zone from approximately 3,000 to 4,500 feet. Due to its generally higher elevations the Chihuahuan Desert is cooler than its Sonoran Desert counterpart, with dry summers and occasional winter rains.

The Colorado Plateau Shrublands ecoregion covers much of the northern one-third of the state, including portions or all of Apache, Coconino, Mohave, Navajo, and Yavapai Counties. This ecoregion includes numerous small cities and towns, including Holbrook, Page, and Winslow. Elevations in this zone average around 4,000 to 5,000 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub, as shown in the following map titled *Terrestrial Ecoregions of Arizona*. Temperatures can vary widely in this zone, with comparatively warm summers and cool winters.

The Mojave Desert ecoregion covers a relatively small portion of northwest Arizona, including portions of Coconino and Mojave Counties. This ecoregion includes the communities of Kingman and Bullhead City, as well as a portion of the lower Grand Canyon. The elevation varies in this ecoregion from 1,500 feet to nearly 4,000 feet on some mountains. Typically the climate in this ecoregion is very hot and dry during the summer and comparatively warm during the winter.

The Sierra Madre Occidental pine-oak forest ecoregion is scattered throughout southeast Arizona, including small portions of Cochise, Graham, Greenlee, Pima, Pinal, and Santa Cruz Counties. Located within this ecoregion is the Town of Nogales, several portions of the Coronado National Forest, as well as the Chiricahua and Galiuro Wilderness areas. As a whole, this ecoregion is considered to have mild winters and wet summers, with variation within these regions due to the fluctuation in elevation associated with the forests.

The Sonoran Desert ecoregion is an arid environment that covers most of the southwestern one-third of the state, including portions or all of Gila, Graham, La Paz, Maricopa, Mojave, Pima, Pinal, Yavapai, and Yuma Counties. Located within this ecoregion are the major metropolitan areas of Phoenix and Tucson as well as numerous smaller towns and cities such as Florence, Parker, and Yuma. The elevation varies in this zone from approximately sea level to 3,000 feet. Vegetation in this zone is comprised mainly of Sonoran Desert Scrub, as shown in the following map titled *Terrestrial Ecoregions of Arizona*. Typically the climate in this zone is hot and dry during the summer and comparatively warm during the winter.

The primary component of the Arizona Mountain Forests is the Mogollon Rim, a mountainous area that is the major landform defining the northern from the southern portions of the state. The White Mountains in the central eastern part of the state are another large mountainous area. There are also a series of “mountain islands” in the southeastern corner of the state, including the Graham Mountains. Each of these mountainous areas is associated with relatively dense vegetation, ranging from high grasslands to Ponderosa Pine forests.

Arizona also contains a number of rivers, the largest of which is the Colorado, which runs year round and defines most of the western border of the state. The Colorado River has also created the Grand Canyon, which acts as a major barrier to movement in the northwestern portion of the state. Other large rivers, most of which are controlled via dams and run only occasionally, include the Aqua Fria, Gila, Salt, and the Verde Rivers.

Climate

Arizona's geography results in an extreme climate in comparison with other states and also between locations within the state itself. The state's extreme climate is a major contributor to a number of natural hazards in Arizona, including floods, drought and wildfires.

Average annual temperatures are in the mid-seventies in the Sonoran Desert ecoregion located in the lower half of the state, including cities such as Phoenix, Tucson, and Yuma. By contrast, annual average temperatures are much lower at higher elevations in the Arizona Mountain Forests, Chihuahuan Desert, and Sierra Madre Occidental pine-oak forests ecoregions. Average annual temperatures for communities that exist in the Colorado Plateau Shrublands ecoregion fall between these two extremes.

Summer temperatures may exceed 120˚ in the Sonoran Desert ecoregion. Even relatively high elevations in the Arizona Mountain Forests ecoregion may reach high temperatures, such as in Flagstaff, which has been known to approach 100˚ during the summer. Remarkably, these same locations can reach well below freezing (32˚) in winter. For example, Flagstaff has dropped to –23˚, while even Phoenix winter temperatures have been known to fall into the teens.

These temperature extremes are at least partly the result of Arizona's relatively dry climate. This arid environment is itself a function of a number of factors, including Arizona's separation from nearby major water bodies (i.e., Pacific Ocean, Gulf of California, and Gulf of Mexico), intervening mountainous regions (i.e., Sierra Nevada Mountains), and relatively low elevations across two-thirds of the state.

Table CD-4: Arizona Average Temperatures

Average Temperatures In Arizona (Degrees Fahrenheit)												
City	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Flagstaff	29.7	32.2	36.6	42.9	50.8	60.1	66.1	64.4	57.8	47.1	36.5	30.2
Parker	54.1	58.7	63.8	70.7	79	87.7	93.2	92.3	86.2	74.6	61.6	53.9
Phoenix	54.2	58.2	62.7	70.2	79.1	88.6	92.8	91.4	86	74.6	61.6	54.3
St Johns	34.1	39.1	45.2	51.8	60.5	69.6	73.8	71.7	65.6	54.5	42.3	34
Tucson	54	57.4	61.7	68.4	76.9	86.1	88.5	87	83.07	72.6	60.9	54.2

Table CD-5: Arizona Average Monthly Precipitation

Average Monthly Precipitation in Arizona (Inches)												
City	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Flagstaff	2.18	2.56	2.62	1.29	.8	.43	2.4	2.89	2.12	1.93	1.86	1.83
Parker	.87	.70	.65	.17	.09	.02	.27	.61	.57	.32	.33	.57
Phoenix	.83	.77	1.07	.25	.16	.09	.99	.94	.75	.79	.73	.92
St Johns	.75	.56	.76	.45	.46	.49	1.72	2.33	1.42	1.17	.66	.70
Tucson	1.04	.96	.88	.33	.20	.28	1.93	2.23	1.24	1.21	.68	1.02

Economy

Between 2008-2010, the unemployment rates increased significantly due to the recession felt across the nation. Arizona's unemployment rate increased from 9.2% in May 2009 to 9.6 in May 2010[3]. As of June 3013, Arizona's unemployment rate was 8.5% slightly higher than the country's rate of 7.6% (Wall Street Journal). Unemployment rates in June 2013 were as high as 31.9% in Yuma and as low as 7.2% in the Phoenix area.

Top Industries by Number Employed
Education & Health Services
Goods Producing
Leisure & Hospitality
Financial
Manufacturing

The Arizona housing market has also improved in the recent past. Single family homes prices continue an upward trend, foreclosures are less than half of last year's number and homes purchased by investors is lower than it has been in several years. As of March 2013, the average home sales price was $305,397, up 24.6% from March of 2012. Lower priced homes are unbalanced with far more buyers than sellers, which might indicate sellers either locked in by negative equity and/or waiting for prices to rise further. Building land, materials and construction labor costs are all rising as subcontractors struggle as well, likely putting a further strain on the housing supply. (Center for Real Estate Theory & Practice, WP Carey School of Business, ASU March 2013 Monthly Report).

[3] AZ Dept of Commerce, June 2010.

Agriculture

Arizona ranks second in the US in head, leaf, and romaine lettuce, cauliflower and broccoli production. In 2010, there were more than 15,000 farms and ranches in Arizona, with dairy as our leading agricultural product. Arizona also ranks second in the nation in production of lemons and third in tangerine production[4].

Manufacturing

Manufacturing is a relative newcomer to the economy of Arizona, but since 1950 it has become one of the State's major sources of income, rivaling the five C's – cattle, copper, cotton, citrus and climate – on which the State's economy previously depended. Because of military needs and the shift of the nation's defense from coastal to inland areas during World War II, many new manufacturing plants, especially aluminum, were established. The greatest industrial growth is in the electronics and aviation fields, centered chiefly in the Phoenix and Tucson areas. In the late 1990's, the leading manufacturers were firms engaged in the production of electronics and electric equipment, particularly semiconductors, radios and televisions and printed circuit boards, manufacturers of transportation equipment, primarily aircraft and aircraft parts, guided missiles and vehicles used in space and the makers of instruments and related equipment. Other leading manufacturers included food processors, firms making metal products and printers and publishers.

Mining[5]

Copper mining has been contributing to Arizona's economy since the arrival of Europeans in the 16th Century. The production of copper and byproduct metals, especially molybdenum, silver and gold remains an important part of that economy even today. The total impact of the copper industry on Arizona's economy rose in 2006 as its direct impact increased. That total impact included combined direct and indirect contributions of:

- $4.719 billion direct and indirect impact on Arizona's economy
- $1.404 billion in personal income for Arizona's residents
- $2.990 billion in sales revenue for other Arizona businesses
- $325 million in revenue for Arizona state and local governments (Direct payments exceeded $141 million. The biggest share was paid to Arizona's public schools - $45 million) Arizona copper producers

Arizona copper producers, in 2006, had mining and processing operations at various locations in Cochise, Gila, Greenlee, Mohave, Pima, Pinal and Yavapai Counties that also produced substantial amounts of molybdenum, gold, silver and other metals as byproducts in the production of copper. Arizona copper producers exported about 8% of the metals they produced to other countries, particularly in the Far East. Those exports brought in $437 million.

Arizona's three large copper producing firms (ASARCO, BHP and Freeport-McMoRan) and several smaller firms mined in 2006:

- 787,236 tons of copper and other minerals with of total value of
- $5.628 billion (59% more than in 2005)
- 60% of the copper mined in the United States in 2006

4 AZ Farm Bureau, August 2013.

5 "Copper: An Economic Profile – Economic Engine for Arizona" AZ Mining Association, June 2010.

Tourism

The multi-billion dollar travel industry in Arizona is an important part of the state and local economies. The industry is represented primarily by businesses in the leisure and hospitality sector, transportation and retail. The money that visitors spend on various goods and services while in Arizona produces business receipts at these firms, which in turn generate earnings and employment for Arizona residents. In addition, state and local governments collect taxes that are generated from visitor spending. Most of these taxes are imposed on the sale of goods and services to visitors, thus avoiding a tax burden on local residents.

Total direct travel spending in Arizona in 2012 was $19.3 billion. There were approximately 38.1 million overnight visitors statewide, representing a 1.4% increase over 2011. Employment, earnings and tax receipts also declined. Nationally, there has also been a sharp decline in travel due to the recession. Travel activity to Arizona began to weaken earlier (4th quarter of 2007) than in the larger U.S. The collapse of the housing market and the economic recession in Arizona and Southern California were contributing factors.

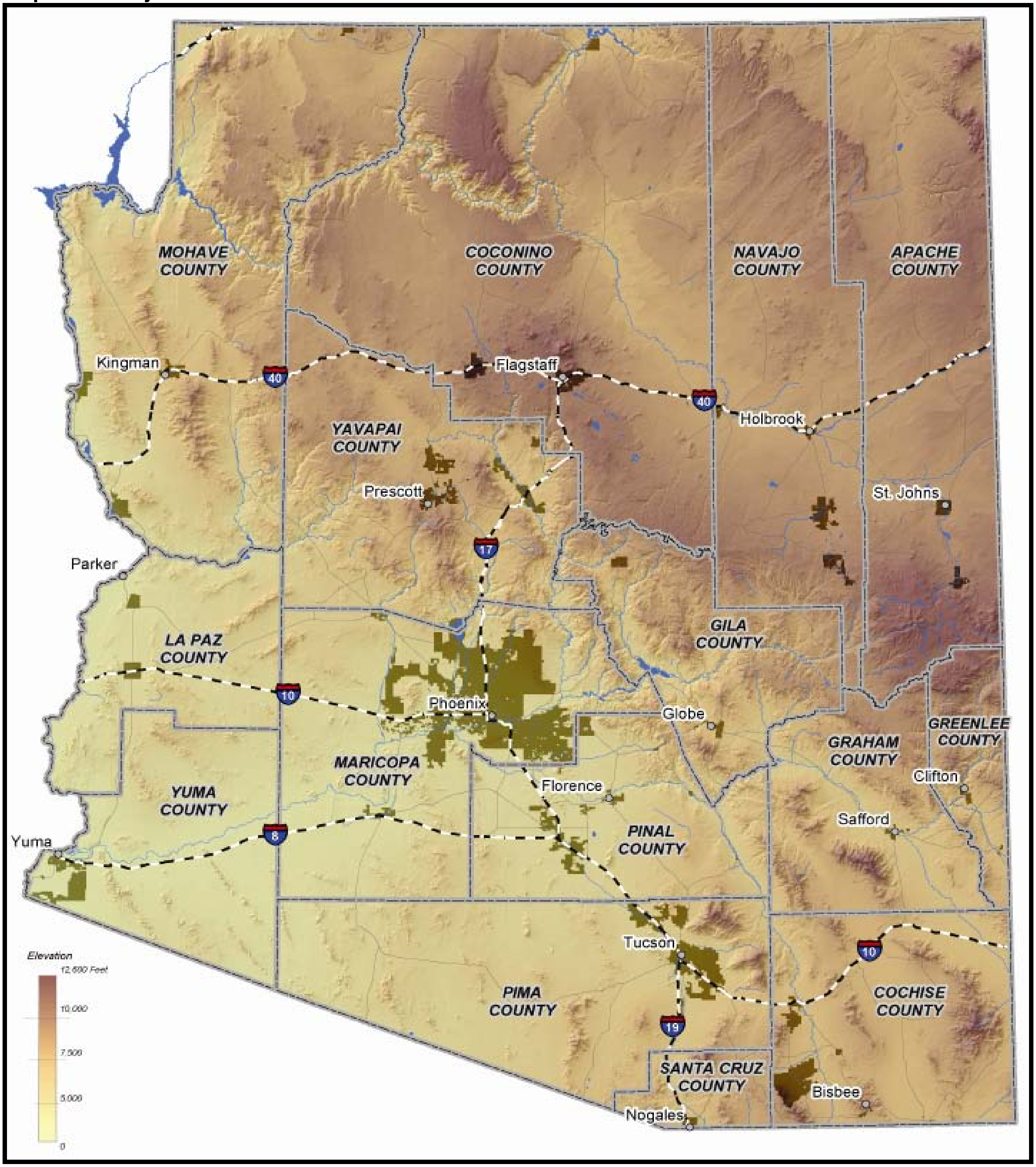
Direct travel spending in Arizona generated 166,900 jobs with earnings $50 billion in 2008. Three-fourths of these jobs were in the accommodations, food service and arts, entertainment and recreation industries. Additionally, $1.4 billion in state and local tax revenues were earned.

Tourism Economic Impact by Region in 2012							
		Overnight Visitors		Generated as a Result of Visitation			
Region	Counties	Total (Millions)	% of Statewide	Direct Spending (Billions)	Direct Jobs	Direct Earnings	State & Local Tax Revenue (Millions)
Phoenix & Central	Maricopa, Pinal	16.7	50	$ 2.2	91,600	$ 3.7B	$ 772
Tucson & Southern	Cochise, Pima, Santa Cruz	7.0	21	$ 3.3	28,000	$ 700M	$ 190
Northern	Apache, Coconino, Navajo	5.8	17.7	$ 1.5	15,900	$ 394M	$ 103
North Central	Gila, Graham, Greenlee, Yavapai	4.5	13.7	$1.06	12,100	$ 257M	$ 66
West Coast	La Paz, Mohave, Yuma	4.2	12.7	$ 1.3	13,800	$ 313M	$ 81

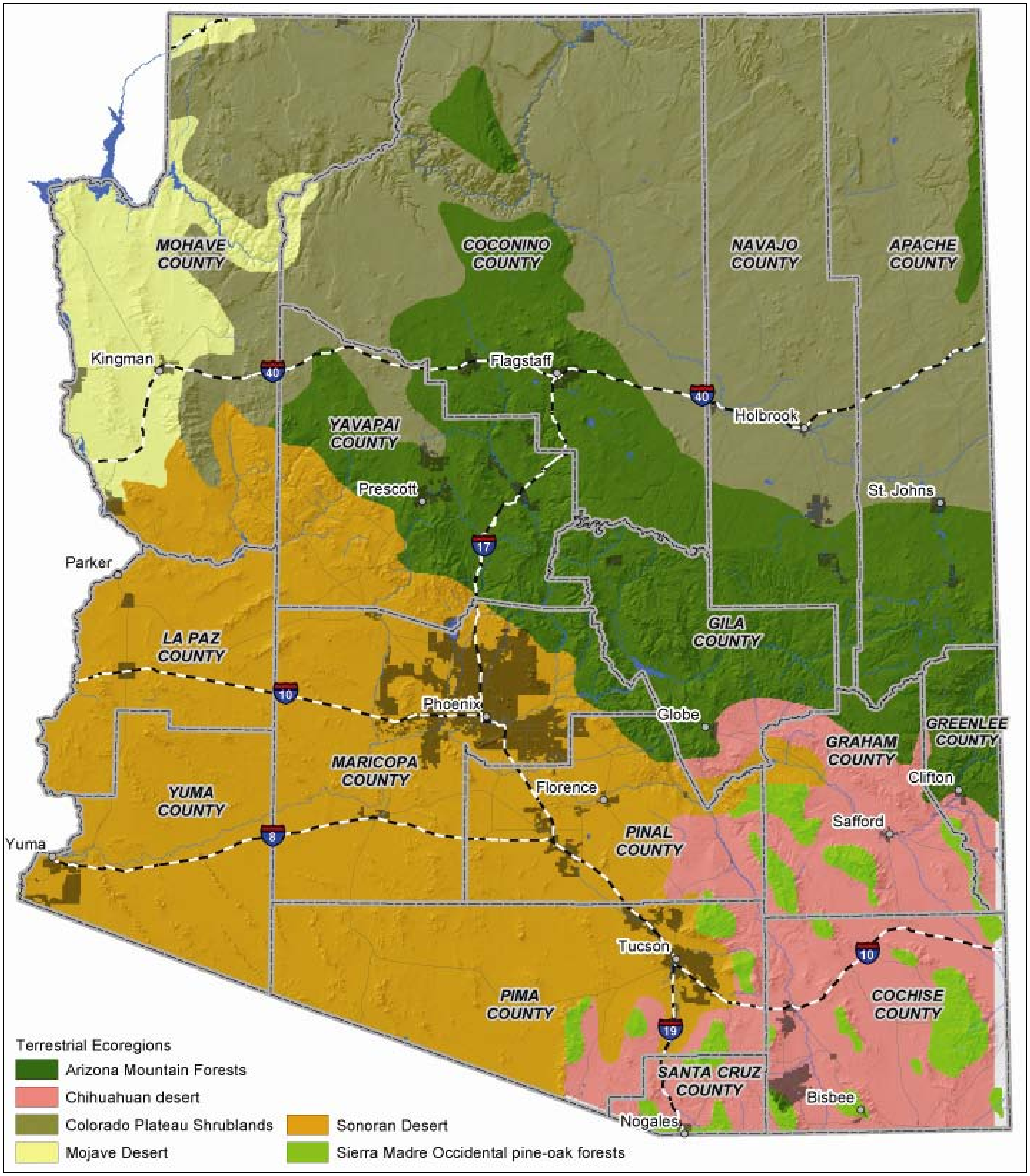
Source: “2013 Research Roundup: Arizona Tourism in 2012 and Beyond”, AZ Office of Tourism, August 2013.

Top Arizona Attractions by Visitation - 2009			
Natural Attractions		Private Attractions	
Grand Canyon Nat'l Park	4,348,065	Tempe Town Lake	2,615,000
South Mountain Park	2,000,000	London Bridge	2,500,000
Glen Canyon Nat'l	1,621,726	Chase Field (Phoenix)	2,128,799
Lake Mead Nat'l Recreation	1,568,972	Phoenix Zoo	1,446,362
Canyon de Chelly (Navajo Nation)	826,419	Jobing.com Arena	1,200,000
Source: Arizona Office of Tourism website, August 2013			

Map CD-1: Major Features of Arizona



Map CD-2: Ecoregions of Arizona



County Overviews

Section Changes

For this Plan, the following topics were added to the County Overviews:

- Land Use/Ownership
- Emergency Management
- Government
- Transportation
- Utilities

and the following maps were requested:

- Basic county map with major hwys/interstates
- Population (including 65+)
- Land Ownership

To collect this data, the staff of each county emergency management department was asked to provide information on the updated topics and maps of their county.

It is believed that the most accurate information would likely come from the county itself. The intention is to then build upon and use these county descriptions and maps in their respective future mitigation plan updates.

The following county descriptions' quality is as good as what was received from the counties themselves. Where maps were not provided, the maps from this Plan's last update were used. Where discussion was not provided, the topics were removed from their profile. We intend to continue to refine these descriptions for future use as appropriate.

Apache County

History / Geography

According to the Arizona Department of Commerce, Apache County was carved from Yavapai County – one of Arizona's original four counties – on February 24, 1879, by the 10th Territorial Legislative Assembly. Leaders of St. Johns and Globe had petitioned for their towns to be the county seat, but the honor went temporarily to Snowflake, with the provision that an election would determine the permanent county seat. In November, 1879, on the strength of votes from the mining town of Clifton (now in Greenlee County), St. Johns was designated the county seat. Apache County is located in the northeastern portion of the State of Arizona.

Apache County is divided into two distinct parts by the Mogollon Rim. The high country in the northern part of the county is considered Colorado Plateau Shrublands and is characterized by arid, desert-like conditions with mesas and plateaus. The southern part is considered Arizona Mountain Forests and is characterized by rugged mountain area, heavily wooded with pinon juniper and ponderosa pine.

The geographical characteristics of Apache County have been mapped into two terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 6,000 to 9,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely heavily wooded with pinon juniper and ponderosa pine forests, high altitude grasses, shrubs, and brush. A smaller section of Arizona Mountain Forests also exists to a smaller degree in the northeast corner of the county.
- **Colorado Plateau Shrublands** – this ecoregion covers the northern portion of the county and makes up the majority of the county with elevations that average around 6,000 to 6,500 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cold winters. The high country in the northern part of the county is arid and desert like with mesa and plateaus.

Geology / Climate

The majority of Apache County can be classified as Colorado Plateau Shrubland and Arizona Mountain Forest. The elevation range for these two ecoregions in the County is from approximately 5,000 to 9,000 feet. Such a range in elevation results in differences in climate. Climatic statistics for weather stations within the County are produced by the Western Region Climate Center and span records dating back to the early 1900's.

Average temperatures within Apache County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County.

Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

According to Census 2010 data, Apache County is home to 71,518 residents, with the majority of the population living on the reservations and incorporated communities of the County. The largest community is the Town of Eagar. All three incorporated cities are geographically located in the southern portion of the County. The other communities located throughout the county, with most situated along major highways are mostly comprised of only a few structures or landmark.

Population Estimates for Apache County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Apache County (total)	61,600	67,725	71,518	82,496	86,533
Eagar	4,030	4,965	4,885	5,241	5,614
St. Johns	3,295	3,560	3,480	5,059	5,612
Springerville	1,805	2,105	1,961	1,717	1,797
Unincorporated & Indian Reservations	N/A	N/A	61,192	5,628	5,567
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html, http://www.workforce.az.gov/census-data.aspx & http://www.workforce.az.gov/?PAGEID=67&SUBID=257					

Economy

Excellent fishing, hunting, and skiing make the White Mountains a year-round recreation area. Numerous archaeological sites are open to the public.

Fort Defiance, Arizona's first military post, the Town of Ganado, and Hubbell's famous trading post (now a National Historic Site) are located in northern Apache County on the Navajo Reservation. Chinle, another Indian trade center, is the gateway to the spectacular Canyon de Chelly National Monument. Also in Apache County are the stunning Petrified Forest National Park and the Painted Desert, Window Rock, the Navajo tribal capital, and Casa Malpais Archaeological site. The Apache Indian Reservation, located in the White Mountains around the settlement of Fort Apache, includes 25 excellent fishing lakes and the Sunrise Park Ski Resort for outdoor recreation, as well as a highly successful lumber mill and a casino.

The Apache County average labor force in 2008 was 21,383 with an unemployment rate of 10.1%. The major industries of the County include Retail Trade, Services, Utilities, and Public Administration.

Land Use / Ownership

Within Apache County, the US Forest Service, US Bureau of Land Management, and State Land constitute nearly 21% of combined land ownership. About 65% of the County is comprised of Indian Reservation land. The remaining portions of the County are either individually or corporately owned.

Emergency Management

OEM: The Apache County Emergency Management program is a division of the Apache County Sheriff's Office. It is staffed by one full-time administrative position and four part-time personnel.

EAS: We utilize the national EAS through local media outlets as well as our webpage, 311info.org which can also be accessed by telephone or cellular phone to receive the information by recording, Facebook, (Apache County Emergency Management) and Twitter accounts to deliver public information and warning.

Law Enforcement: Apache County has three incorporated cities and towns which each provide law enforcement service to their respective communities:

- Eagar Police Department
- Springerville Police Department
- St Johns Police Department

The Apache County Sheriff's Office provides law enforcement services to all 11,216 square miles, and the residents therein, of Apache County, including the Navajo Nation and the White Mountain Apache Tribe. Sheriff's Deputies are cross commissioned as tribal police officers on the Navajo Nation. Both the Navajo Nation and the White Mountain Apache Tribe provide law enforcement services to their respective populations.

Several state and federal law enforcement agencies serve Apache County as well:

- Arizona Department of Agriculture provides livestock investigation and enforcement
- Arizona Department of Public Safety provides traffic enforcement on federal and state highways
- US Forest Service Law Enforcement provides law enforcement service on the Apache Sitgreaves National Forest
- US National Park Service Police provide law enforcement services at the Petrified Forest and Canyon De Chelly National Monument

Fire: Apache County residents are served by nine fire departments – Alpine, Nutrioso, Eagar, Springerville, Greer, Vernon, Concho, St Johns, and Puerco Valley. White Mountain Apache Tribe and the Navajo Nation provide fire services to their jurisdictions.

Additional fire services are provides by the US Forest Service in and around the Apache-Sitgreaves National Forest, and the US National Park Service at the Petrified Forest National Park.

EMS: Apache County is served by three EMS districts:

- Puerco Valley EMS covers the Interstate 40 corridor down to the HWY 61 and HWY 191 junction at Witch Wells.
- St Johns Emergency Services covers from Witch Wells HWY 61/191 junction south to Vernon on Hwy 60.
- White Mountain EMS covers the area of Vernon and HWY 60 south, including the northern portion of Greenlee County to Hannagan Meadows on HWY 191.
- White Mountain Apache Tribe and Navajo Nation both provide EMS services in their respective jurisdictions

Transportation

Roadways: Major roadway transportation routes through the County include: Interstate 40, US Highways 60, 64, 160, 180, and 191, State Routes 61, 180A, 260, 261, 264, 273, and 473, and Indian Routes 4, 7, 12, 15, 33, 54, 59, and 63.
Railways: Burlington Northern Santa Fe Railway
Airports/Air Service: Navajo Air Transportation, Springerville Airport and St. Johns Airpark

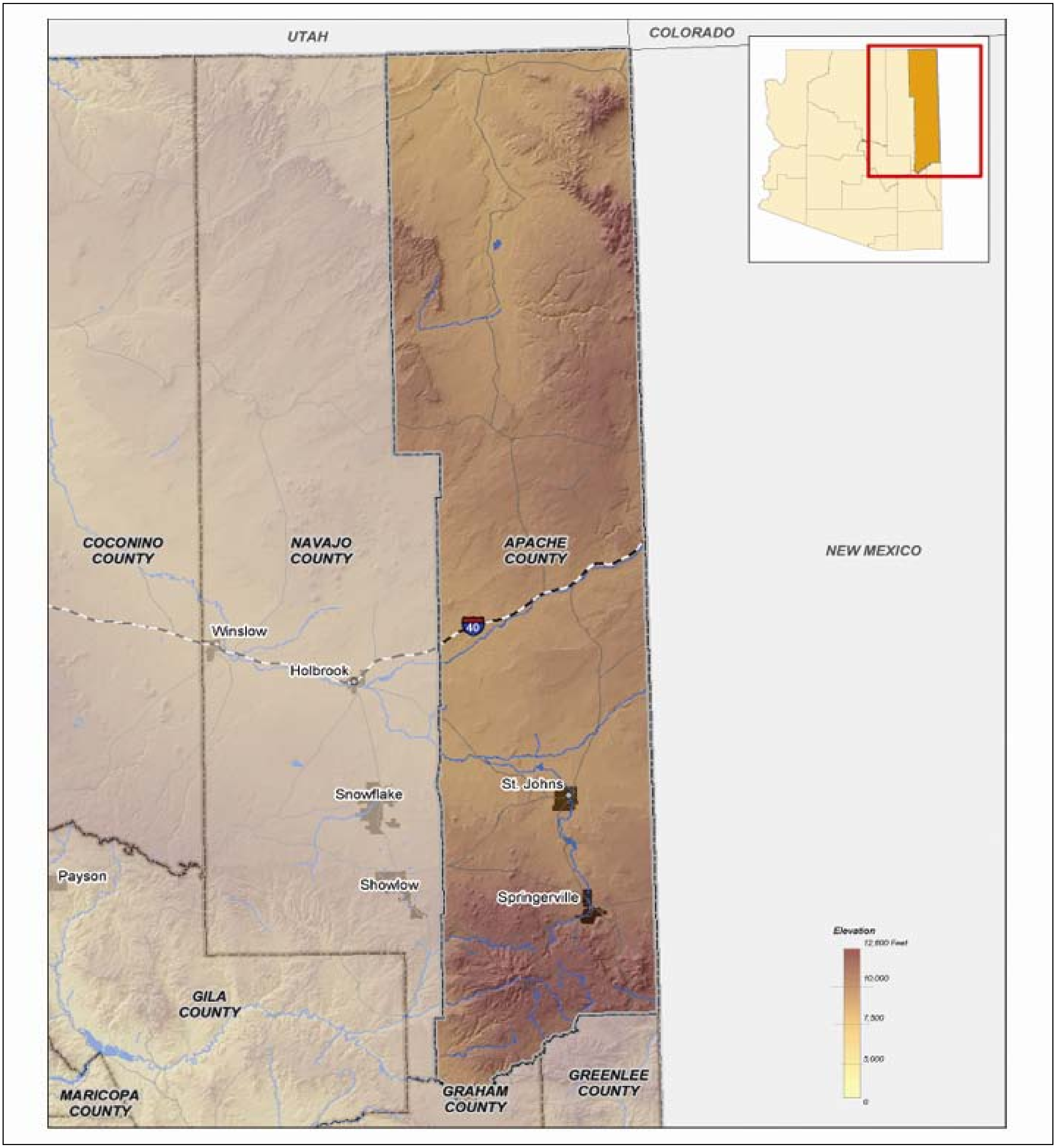
Utilities

Electric: Navajo Tribal Utility Authority, Navaopache Electric Cooperative Inc.

Gas: Ferrell Propane, Graves Propane, Sierra Propane, Navajo Tribal Utility Authority

Water/Sewer: Navajo Tribal Utility Authority

Map CD-3: Apache County



Cochise County

History / Geography

Cochise County was carved out of Pima County by an act of the 11th Territorial Assembly on January 3, 1881. Tombstone, which was then touted to be the most cultured city in the entire West or Southwest, was the first town to incorporate and served as the county seat until 1929.

Historic development of the County has primarily been precipitated by either mining or agriculture. In 1880, the then Southern Pacific Railroad opened in Benson and later in Willcox. Both communities became bustling railroad towns and destinations for acquisition of supplies and for shipping goods.

Cochise County is located in the extreme southeastern corner of Arizona, sharing boundaries with the State of New Mexico on the east and Mexico on the south. According to the Cochise County Comprehensive Plan, the County was created by an Act of the 11th Territorial Assembly in 1881, and was named after the Chiricahua Apache Chief "Cochise". Much of the County was the homeland of the Chiricahua Apache until they were relocated to Florida and then eventually to Oklahoma and New Mexico. Cochise County is now one of only three counties in Arizona without an Indian Reservation. The County is currently comprised of 6,215 square miles, with the City of Bisbee serving as the County seat since 1929.

The San Pedro River is the largest watercourse flowing through the County. Other regional watercourses include Babocomari River, San Simon River, and Whitewater Draw. The remaining watercourses are primarily ephemeral, with most being tributary to one or more of the regional rivers.

The geographical characteristics of Cochise County have been mapped into two terrestrial ecoregions, which are described below:

- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevations in this zone vary between 3,000 to 4,500 feet. The average temperatures for the Chihuahuan Desert tend to be cooler than the Sonoran Desert (see below) due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.
- **Sierra Madre Occidental Pine-Oak Forest** – this ecoregion is predominant to mountainous regions in southeast Arizona with elevations generally above 5,000 feet. The average temperatures tend to be cool during the summer and cold in winter.

Climate

Average temperatures within Cochise County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County.

Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

As of July 2010, the total population for Cochise County is projected at 131,436 residents, which is 11.4% greater than the 2000 Census of 117,755. A major portion of the citizens still live in the incorporated communities of Cochise County. The largest community is Sierra Vista. Most of the six incorporated cities and one town are located on the western side of the County. The City of Douglas is considered a border city with a major port of entry to Mexico. The other non-incorporated communities and places located throughout the county are usually situated along a major highway and are mostly comprised of only one structure or landmark.

Population Estimates for Cochise County					
Jurisdiction	**1990**	**2000**	**2010**	**2020**	**2030**
Cochise County (Unincorporated)	97,624	117,755	131,346	169,717	187,725
Benson	3,824	4,711	5,105	6,535	8,365
Bisbee	6,288	6,090	5,575	7,867	8,483
Douglas	12,822	14,312	17,378	24,986	28,685
Huachuca City	1,782	1,751	1,853	2,043	2,145
Sierra Vista	32,983	37,775	43,888	56,164	63,307
Tombstone	1,220	1,504	1,380	1,896	2,032
Willcox	3,122	3,733	3,757	4,296	4,491
Sources: US Census Bureau, AZ Dept of Economic Security, Research Administration, Population Statistics Unit, 12/01/06. SEAGO / DES Population Statistics approved June 6, 2007. City of Benson, 2012.					

Economy

Cochise County is attractive to a variety of businesses because of some of these features:

- Six (6) general aviation airports with available land.
- Robust fiber-optic infrastructure.
- Access to major east-west freeway (Interstate 10) from all communities.
- Multiple electric cooperatives with reliable and cost effective power and natural gas providers.
- Fertile agricultural land with year-round growing season.
- Proximity to the Mexican border with two international ports of entry.
- Rail access.
- Five (5) hospitals providing comprehensive healthcare.
- Higher education with campuses for Cochise College and the University of Arizona placed strategically throughout the County.
- Home of the US Army Intelligence Center and the Army Network Enterprise Technology Command.

The largest employer in the County has been and remains Fort Huachuca. The military, support staff and the contractors who support the Army Military Intelligence post consistently employ the largest percentage of the workforce in the County.

Agriculture continues to be an important segment of the Cochise County economy. Once known as the cattle capitol of the nation, livestock continues to be important to the county economy. Primary irrigated crops are cotton, wheat, corn, grain, sorghum, and alfalfa hay. More recent diversification of agriculture in the County has resulted in changes from the primary crops to apples, peaches, cherries, grapes, pistachios, pecans, lettuce, chili, and other vegetables. The area has a multitude of U-pick vegetable farms and orchards, including several organic farms. Greenhouse tomato and cucumber operations have been completed in the past few years with good success. The largest areas for these operations are the Sulphur Springs and San Simon Valleys.

Cochise County's business climate is enhanced by a year-round climate with an average temperature of 75°F. The wide-open plains and mountain reaches provide a cool respite from searing summer heat in other parts of the state. The elevations of the towns offer mild summers and temperate winters and the landscape responds to the climate with beauty and abundance. The County attracts over 300,000 visitors per year who come to experience the region's rich cultural history and myriad outdoor recreation opportunities.

The County’s moderate Arizona climate offers a multitude of opportunities year-round for individuals and families to explore and enjoy. Outdoor activities include a number of both state and federally managed park areas, to include the Chiricahua National Monument and Coronado National Memorial, as well Kartchner Caverns State Park. The high elevation of the County makes these areas available and enjoyable to visit at any time. The natural wonders of the County appeal to just about everyone with birding areas that offer a glimpse of some of the most fascinating species in the world, hiking and camping areas with breathtaking vistas of the rugged High-Sonoran beauty, along with the history and careful preservation that make these areas a treasure.

The many historic sites and museums in the County offer a history lesson opportunity to visitors and residents alike. The 11,000 year old Clovis and the Lehner-Mammoth Kill Site, where archeologists found mammoth bones, is probably the oldest representation of the county’s past. Popular Native American history museums include the Amerind Foundation Museum or the Apache Warrior Cochise Mountain hideout, or “Cochise Stronghold”. The County is also rich in military history and there are numerous sites throughout the County that pay homage and tell a story about some of the extensive military history from the area, including the US Army Military Intelligence Museum on Fort Huachuca. Finally, old west mining towns and ghost towns in the County offer anyone a glimpse into a time period in US history marked by legends and mysteries.

The County has identified seven planning areas for the unincorporated portion of the County. The following are summaries of each area taken from the various Area Plans published by the County.

Babocomari Area – the Babocomari Area is currently defined by the boundaries of the entire San Ignacio del Babocomari Land Grant east of Highway 90. The San Ignacio del Babocomari Land Grant (Babocomari or Land Grant) has been, largely and historically, a ranch that extends from the County's boundary with Santa Cruz County in the Huachuca Mountains along the Babocomari River, east for approximately 47 miles through Whetstone to the Presidential Estates, a residential community located east of the junction of SR 82 and SR 90.

J-Six/Mescal/Skyline Area – the plan area encompasses the land area of three discrete and neighboring communities: (1) the Mescal community located east of the Pima/Cochise County Line and north of State Route I-10 (the freeway); (2) the J-Six community located east of the County Line and south of the freeway; and (3) the Skyline community located west of State Route 90 and north and south of the I-10 freeway at around the Skyline Road exit.

Mid-Sulphur Springs Valley Area – this plan area includes the Pearce Townsite, Sunsites Townsite and surrounding rural areas. Exact boundaries are depicted on the *Mid-Sulphur Springs Valley Community Development Map* formally adopted by the Cochise County Board of Supervisors on November 15, 1999.

Naco Area – the plan area boundaries encompass an area extending from one mile north of Purdy Lane, south to the Mexican Border, two miles east of Naco Highway and two miles west of Naco Highway. The area includes the Naco Townsite, the golf course, Country Club estates, some rural development along Purdy Lane, vacant land, State land, a scattering of businesses and land owned by Phelps Dodge. Boundaries are depicted on the *Naco Community Development Map* which was formally adopted by the Cochise County Board of Supervisors.

Southern San Pedro Valley – the plan area boundaries are coincident with the Palominas Fire District boundaries and are depicted on the *Southern San Pedro Valley Area Plan*.

St. David Area – the St. David Area Plan would affect properties included within the following Township, Range and Sections of the St. David area:

- Township 17, Range 20, Sections 13, 24, 25, 34, 35, 36
- Township 17, Range 21, Sections 13 through 36
- Township 18, Range 20, Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, 36
- Township 18, Range 21, Sections 1 through 36, except those portions of Sections 26, 27, 34 and 35 that lie within the Curtis Ranch Master Development Plan (MDP).

Tres Alamos Area – the plan area boundaries are specifically shown on the *Tres Alamos Area Plan Map*, adopted by the board. In general, the plan boundaries follow the San Pedro River north of I-10 to Cascabel and encompass a three to five mile wide swath.

Growth in Cochise County on a whole has been moderate, and in several jurisdictions, has outpaced the projection estimates. There were also a couple of communities that have actually decreased in population over the last ten years. As of August 2011, the total labor force for the county was estimated to average 63,899 with an unemployment rate of 8.5%.

Government

The County of Cochise is governed by an elected three-person Board of Supervisors. The Board of Supervisors is responsible for unincorporated Cochise County. There are seven incorporated municipalities within the County; Benson, Bisbee, Douglas, Huachuca City, Sierra Vista, Tombstone and Willcox.

Land Use / Ownership

Cochise County covers approximately 6,200 square miles. Land ownership is comprised of 40% Private ownership, 35% State trust, 12% National Forest, 10% Bureau of Land Management, 2% Ft. Huachuca Land Reservation, .55% Willcox Bombing Range (Inactive), .4% National Park Service and .05% San Bernardino Wildlife Refuge.

Emergency Management

- Emergency management services are almost entirely provided (with the exception of the City of Sierra Vista) by the Cochise County Emergency Services (CCES). CCES provides for emergency planning, exercises, community preparedness and emergency operations center activities to enhance the disaster resilience of the County.
- Law Enforcement – Law enforcement for jurisdictions within the County is provided by the Sheriff as well as each municipality.
- Fire – There are a total of 26 fire departments or fire districts serving the incorporated and unincorporated areas of the County. Most agencies are volunteer or combination volunteer/full-time departments.
- EMS – Emergency medical services within the County are primarily provided by municipal fire departments and fire districts.
- Disaster Events – As identified in the 2012 Cochise County Multi-Hazard Mitigation Plan, the County's most significant hazards are Drought, Dust/Sand Storms, Flooding/Flash Flooding, Mine Subsidence, Thunderstorms/High Winds and Wildfire. The occurrence of Arizona major disaster declarations that included Cochise County between 1966 and 2010 were:
    - Drought (4)
    - Flooding/Flash Flooding (9)
    - Severe Wind (1)
    - Wildfire (16)

Annually during the monsoon season it is common to receive reports of flash flooding and damage/loss-of-use to private roadways. Most of this damage is due to 'washes' that temporarily render roads impassable. Public roadways in low-lying watershed areas may also become temporarily flooded and/or impassable. In June 2011, two weeks of wildfires (the Monument and Horseshoe 2 fires) consumed over 32,000 acres in the Coronado National Forest adjacent to the City of Sierra Vista. Over 90 structures were lost to the fires as well as other personal property (cars, trucks, etc.).

Transportation

Roadways: Major roadway transportation routes through the County include Interstate 10, US Highway 191, and State Routes 80, 82, 90, 92, 181 and 186.

Railroads: Union Pacific and San Pedro & Southwest Railroad.

Airports: There are eight (8) general aviation airports in Cochise County. With the exception of Huachuca city of and Willcox, each municipality in the County has an airport.

Utilities

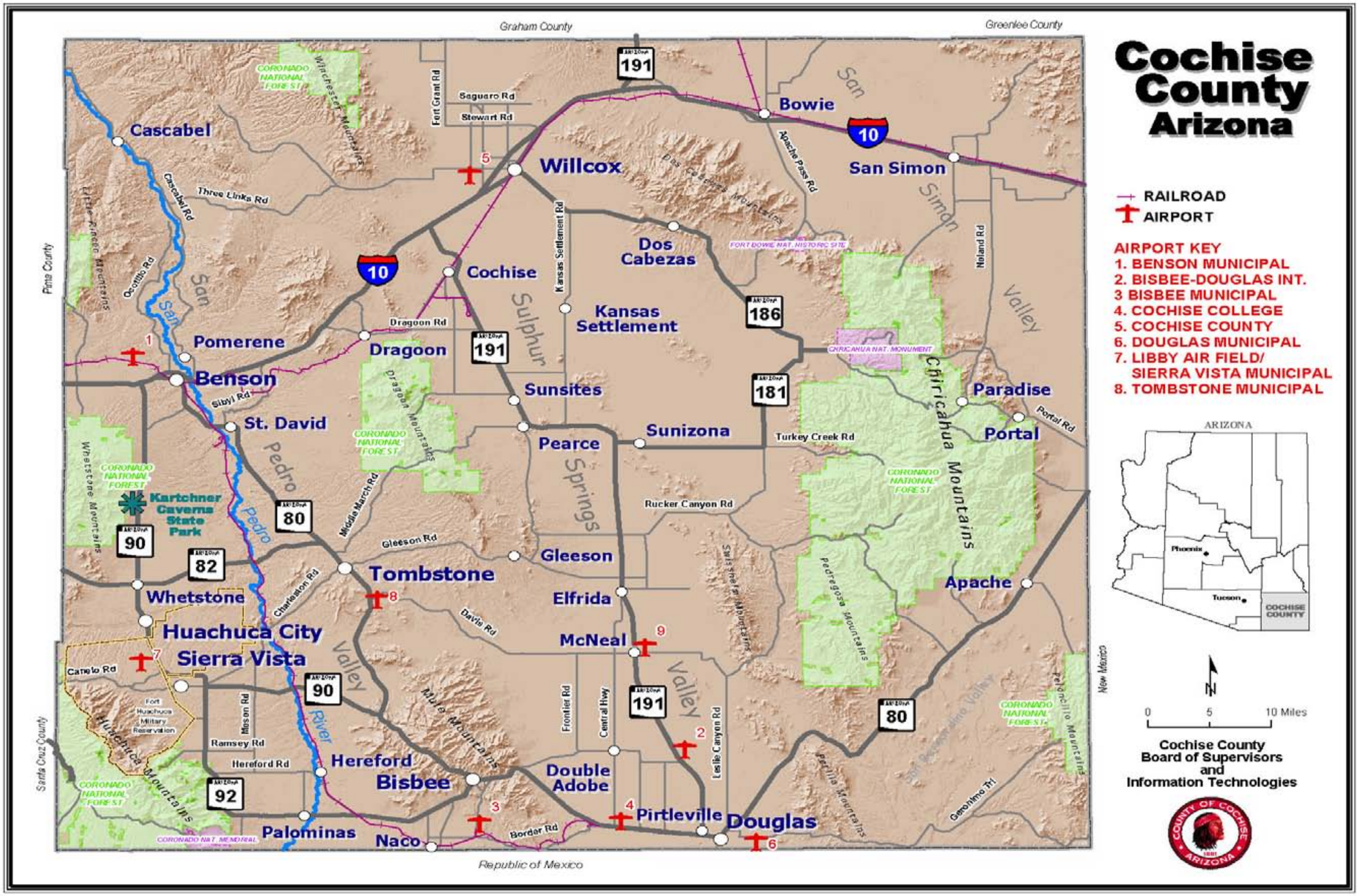
Electric: Sulfur-Springs Valley Electric Cooperative

Gas: Southwest Gas Co. (natural gas) or private propane storage

Water: Numerous for-profit private companies, individual or shared private wells, city services.

Sewer: Municipal or private septic.

Map CD-4: Cochise County



Coconino County

History / Geography

Coconino County was carved out of Yavapai County by the 16th Territorial Assembly in 1891. That same year, an election was held to determine the permanent county seat. Flagstaff, which had been designated the temporary county seat, won out over Williams by a vote of 419 to 97. In 1891, the population of Coconino County was 4,000. Flagstaff remains the county seat, and the original county courthouse, with additions, is still in use.

Coconino County is a topographically diverse area with a wide range of climatic conditions, vegetation and wildlife. Located in north-central Arizona, the County is larger than many states and encompasses over 18,600 square miles. The County is characterized by deep canyons and rugged mountains with elevations that range from 1,350 feet at the bottom of the Grand Canyon to 12,633 feet at the top of the San Francisco Peaks. The majority of the County is located between 5,000 and 7,000 feet in elevation.

The County is characterized by many watercourses. The more prominent perennial watercourses include the Colorado River, Oak Creek, Chevelon Creek, Kanab Creek, and West and East Clear Creek. There are also numerous ephemeral watercourses the drain the County to the more prominent watercourses. The County is also populated by several natural and man-made lakes that serve as critical water supply sources for both humans and wildlife.

The terrestrial characteristics of the County are quite diverse, ranging from sparsely vegetated shrublands to dense pine forests, with small areas of desert scrub at the lower altitude extremes of the county. The terrestrial and ecological characteristics of the County have been mapped into three terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, including the Mogollon Rim and the San Francisco Mountains, and covers approximately 40% of the county. The forests regions are located along the southern border of the county running diagonally from southeast to northwest, and along the upper regions of the North Kaibab Plateau. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in this ecoregion is comprised largely of a mix of Scrub Grassland, Mogollon Chaparral Scrubland, Great Basin Conifer Woodland, Rocky Mountain Conifer Forest, and Plains Grassland.
- **Colorado Plateau Shrublands** – this ecoregion covers approximately 55% of the county with elevations that average around 4,000 to 5,000 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cool winters.
- **Mojave Desert** – this ecoregion covers a very small area of the western-central county, with elevations that range from 1,500 feet to nearly 4,000 feet on some mountain locations. Typically the climate in this ecoregion is very hot and dry during the summer and comparatively warm during the winter.

Geology / Climate

The climate in Coconino County varies with location and elevation. Summer is characterized across the County range from hot and dry at the bottom of the Grand Canyon to moderate temperatures within the forested areas. Winter temperatures range from just above freezing to single digit temperatures in the upper mountain areas.

Average temperatures within the County vary widely depending upon location and elevation. County-wide, temperatures range from well below freezing during the winter months to nearly 100°F during the summer months. Average extreme temperatures can exceed either end of the spectrum by as much as 10 to 15°.

Annual precipitation across the County varies significantly with both location and elevation. Also, for most of the County, precipitation comes in the forms of rain and snow. In general, average rainfall across the County ranges from 6 to 25 inches. Average annual snowfall totals can range from zero to 100 inches and greater for locations above 7,000 feet.

From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms

Population

Coconino County includes five incorporated communities; Flagstaff, Fredonia, Page, Sedona, and Williams. Portions of the Navajo Nation, Hopi Indian Tribe, Hualapai Tribe, Kaibab-Paiute Tribe and all of the Havasupai Tribe are also located within the county boundaries. A total of 45 unincorporated communities are scattered across the County, with many being comprised of only one structure or a prominent landmark.

Population Estimates for Coconino County						
Jurisdiction	**1990**	**2000**	**2007**	**2010**	**2020**	**2030**
Coconino County	96,591	116,320	134,898	141,457	159,345	173,829
Flagstaff	45,857	52,894	64,200	66,879	76,199	83,746
Fredonia	1,207	1,036	1,135	1,167	1,260	1,335
Page	6,598	6,809	7,307	7,341	7,720	8,027
Sedona	7,720	10,192 (2,963)	11,134 (3,144)	11,629 (3,205)	12,829 (3,378)	13,776 (3,517)
Williams	2,532	2,842	3,146	3,378	3,759	4,068

Source: AZ Dept of Commerce.
Sedona figures incl both Coconino & Yavapai Co portions. Numbers in parenthesis are Coconino Co only.

Economy

Coconino County was crossed by Spanish expeditions during the 16th, 17th and 18th centuries, and by fur trappers and traders in the 1820s and 1830s. Cattle and sheep ranching were started in the 1870s, and when the railroad began serving the area a decade later, the lumber industry boomed.

The Coconino County labor force in 2007 was 70,328 with an unemployment rate of 3.7%. The major industries of the County are services and public administration. Tourism also plays a significant role in the County with such attractions as the Grand Canyon National Park, Oak Creek Canyon, Sunset Crater National Monument, prehistoric Indian ruins at Wupatki, Walnut Canyon, the Navajo National Monument, Snowbowl Ski Area, and Lake Powell. The County is also home to Northern Arizona University and Coconino Community College.

Land Use / Ownership (map)- Indian reservations comprise 46%° of the County with federal lands (US Forest Service and Bureau of Land Management) comprising 32 %. The remainder of the County is distributed between privately owned lands (13.3%), Arizona State Trust Lands (9.5%), and other public lands (National Park Service, etc.) (6.8%).

Emergency Management

- **OEM-** The Office of Emergency Management is responsible for fostering public awareness about disasters, emergency planning**,** training, and exercising. Homeland Security grants are administered through this office for these purposes. The Emergency Manager, working under the County Managers Office, is comprised of two full time people, one part time, and one intern.
- **EAS-** The National Weather Service (NWS) routinely activates the Emergency Alert System to warn the public of weather emergencies over weather radios. NWS can also activate the EAS on behalf of federal, state, county and local officials in the event of a non-weather emergency. Radio stations and media outlets in the area of the NWS station monitor the messages sent out and can decide whether the message fits established criteria for dissemination through their outlets to the public.
- In addition to the NWS warning system, the county has a contract for telephonic emergency notification system known as Ready Coconino. Emergency messages can be sent out to land line telephones, cell phones, and computers.
- **Law Enforcement-** The primary law enforcement for the county is the Coconino County Sheriff's Office. They have 62 sworn officers, are responsible for all search and rescues calls within the county and in some instances take calls for service on the Navajo Reservation. The Reservations of the Navajos, Hopis, Hualapai, and the Supai also have their own police forces. Incorporated cities of Flagstaff, Williams, Page and Fredonia have their own law enforcement and state roadways are patrolled by Arizona Department of Public Safety
- **Fire-** There are 27 fire service providers and districts in the county. The majority have fire suppression and emergency medical services. The incorporated cities have their own fire departments. Other parts of the county are serviced by their fire service providers or districts. The districts work under the State Mutual Aid Compact and local Mutual Aid Compacts to assist each other.
- **EMS-**Rescue and transport is handled by some fire districts or departments themselves. Several private companies also do rescue and transportation in and outside of incorporated cities.
- **Disaster Events-** Coconino County has experienced a wide range of disasters throughout recorded history including wildland fires, both natural and man-made, flooding, severe winter storms, tornados, earthquakes, and transportation accidents. Every summer wildland fires occur and range in size from 1 acre to the 2010 Schultz Fire which destroyed more than 15,000 acres and cost more than 9.5 million to suppress. This fire caused major flooding in residential areas as well as public infrastructure that had previously not been prone to flooding. Severe winter storms cause power outages and major transportation problems on the two major highways in the county. The mostly rural living Navajos on the reservation frequently are completely snowed into their homes. In 2010, Arizona National Guard food drops kept many people and their livestock alive when they could not drive out of their homes for supplies.

In 2008, more than 100 vehicles were involved in a pile up on I-40 near Bellemont due to blowing snow and ice on the roadway. Two people were killed, 10 were seriously injured, and 53 people went to the hospital. The roadway was closed in both directions for 9 hours.

Earthquakes have occurred in Coconino County since history the early 1900s, but none have caused deaths or injuries. The first damaging earthquake known to have centered within Arizona's borders occurred on January 25th, 1906 and the shock was violent in Flagstaff. A tremor on August 18, 1912 damaged homes in Williams. In January 1935, an earthquake awakened sleepers at the Grand Canyon causing a distinct subterranean rumble, movement of their homes, and cracked walls. In 1993 another earthquake caused minor damage at the Grand Canyon Village. The Lake Mary Fault, situated immediately south of Flagstaff represents the greatest hazard to the people of Flagstaff and environment according to Dr. David Brumbaugh of the Arizona Earthquake Information Center. In June 2011, the Arizona Integrated Seismic Network detected notable earthquakes in three areas in Coconino County: near Parks, near Tusayan, and just south of Flagstaff.

Coconino County has a few geographically young volcanic fields, mostly around Flagstaff and on the north rim of the Grand Canyon. It's been 925 years since the last one, Sunset Crater, but the damage that could be produced by an eruption cannot be ignored. An eruption is certain sometimes over the next few thousands of years. The eruption column extending into the air, sometimes miles, would cause disruption to air travel and poor air quality, most likely for areas to the east. The lava flow and cinder deposit close to the eruption would cause damage and destruction similar to that of other disasters, such as large wildland fires and flooding, which could continue for years after the eruption.

In 2010, two tornados passed through Bellemont, a community just west of Flagstaff. Seven people were injured, 200 homes were damaged, 15 were uninhabitable, and a train derailed. On that same day, 2 more tornados touched down in the County, but were in uninhabited areas.

Transportation

Roadways- Several major transportation corridors pass through the County including Interstates 17 and 40. Other major roadways include US Highways 160 and 180, State Routes 64, 66, 67, 87, 89, 89A, 98, 99, 260, and 264, and Indian Routes 2, 15 and 18.

Railways- Burlington-Northern Santa Fe (BNSF) Railway runs through the middle of the county. AMTRAK also operates on the BNSF lines and maintains depots in Flagstaff and Williams.

Airports/Air Service- The City of Flagstaff operates Flagstaff-Pulliam Airport, which is the largest commercial airport in the County. Other commercial airports are located in Grand Canyon National Park and Page. Smaller, public-use airports are located in Tuba City, Williams, and Valle.

Utilities

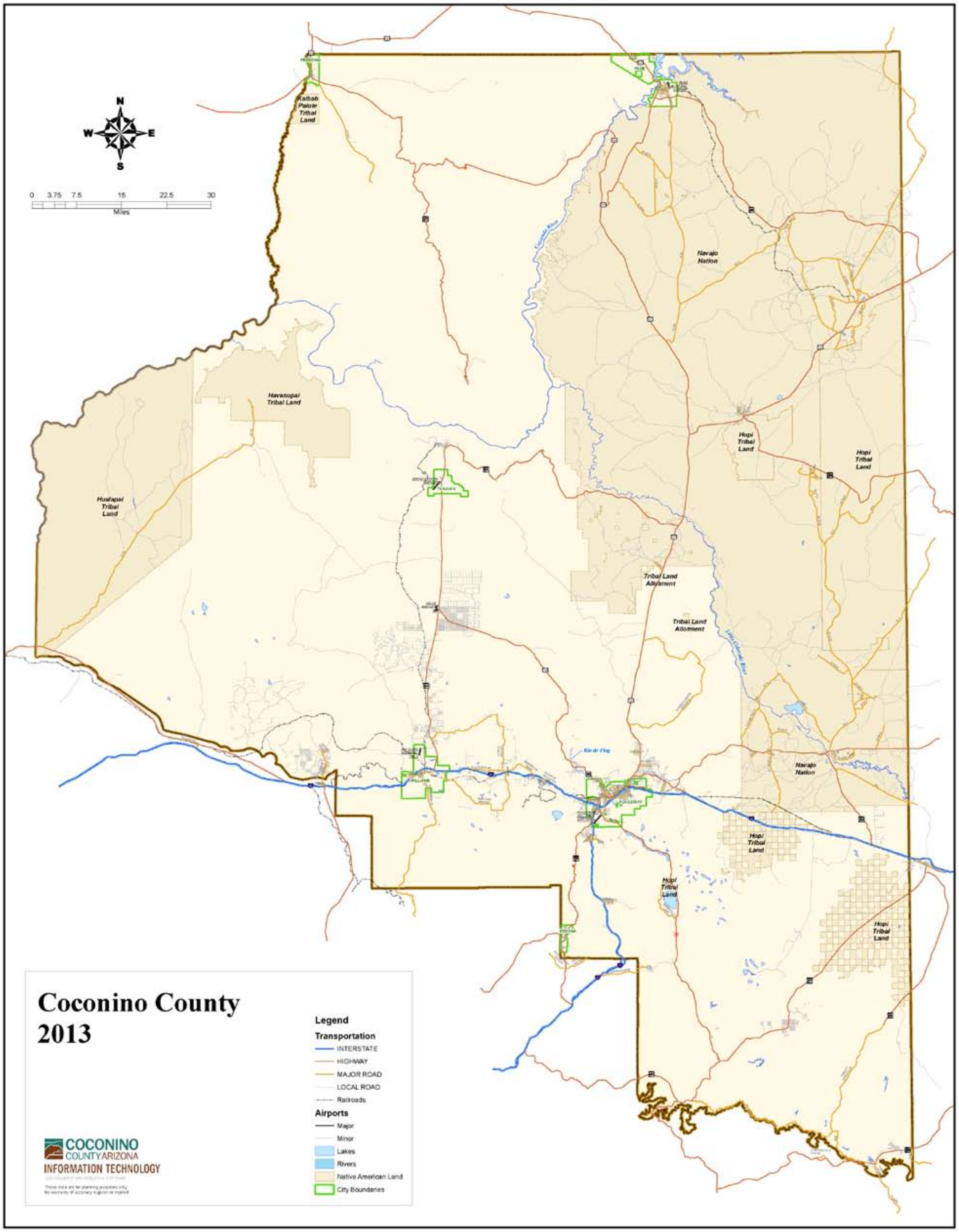
Electric: APS is the predominant provider of electricity to the County except on the Navajo Nation which has its own electricity supplier, Navajo Tribal Utility Authority.

Gas: Natural gas is provided by Unisource to many cities and areas in the southern part of Coconino County. Residents outside of this system use several companies to supply their propane tanks at residences.

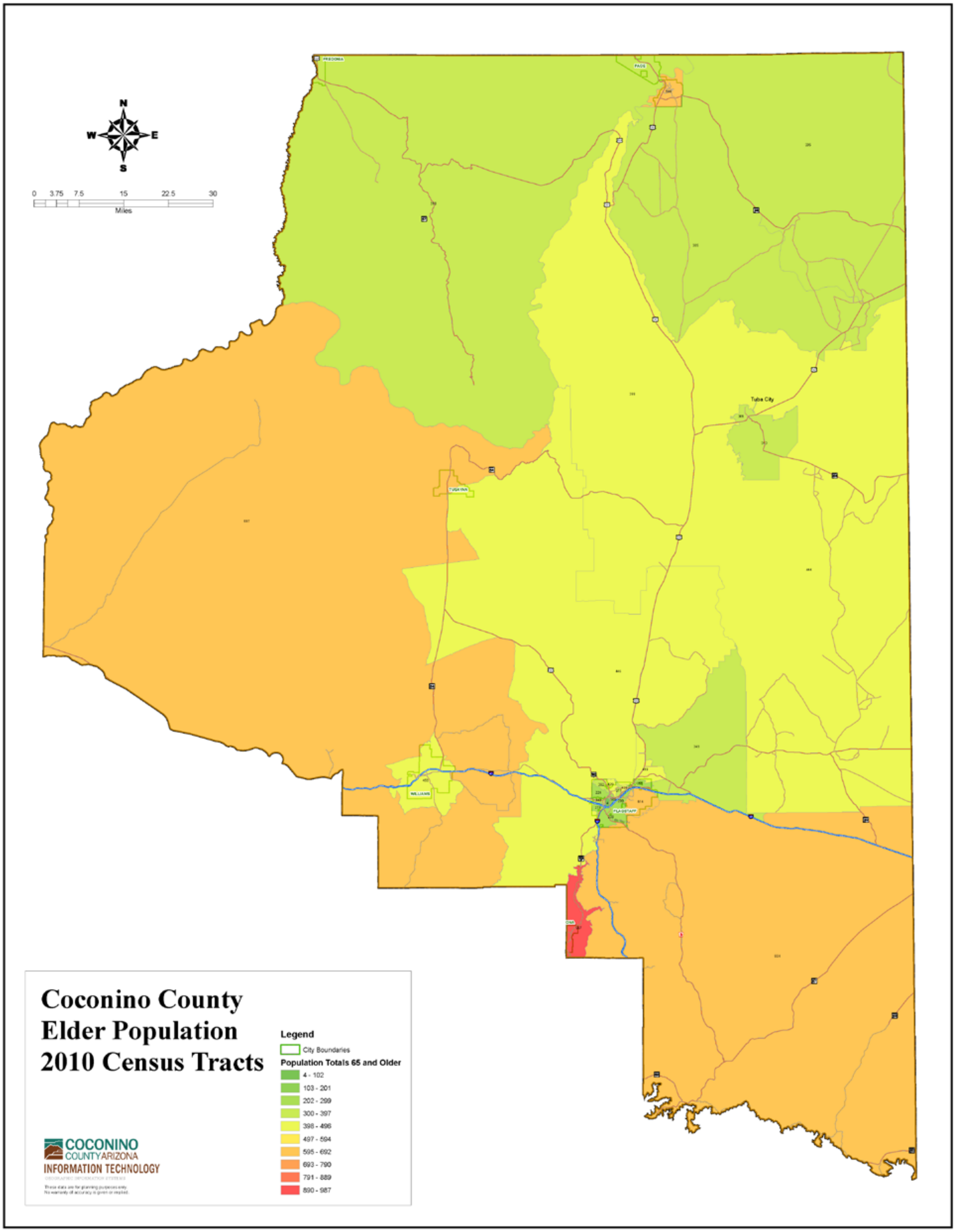
Water/Sewer: Most incorporated areas within the County have their own water system and waste water or sewer system. Water for the City of Flagstaff comes from over 40 wells;

surface water stored in Lake Mary, and a spring from the Inner Basin in the San Francisco Peaks. Williams' water comes from wells or lakes/reservoirs and after treatment is distributed to strategically placed storage tanks and then gravity fed to customers. Page receives all of their water from Lake Powell. After being treated at their city plant, it is distributed directly to their customers. Outside of these areas, residents receive their water piped from private water companies, hire commercial water haulers, or haul the water themselves. Although the incorporated areas may have waste water systems, most residents outside the cities have septic systems for sewer.

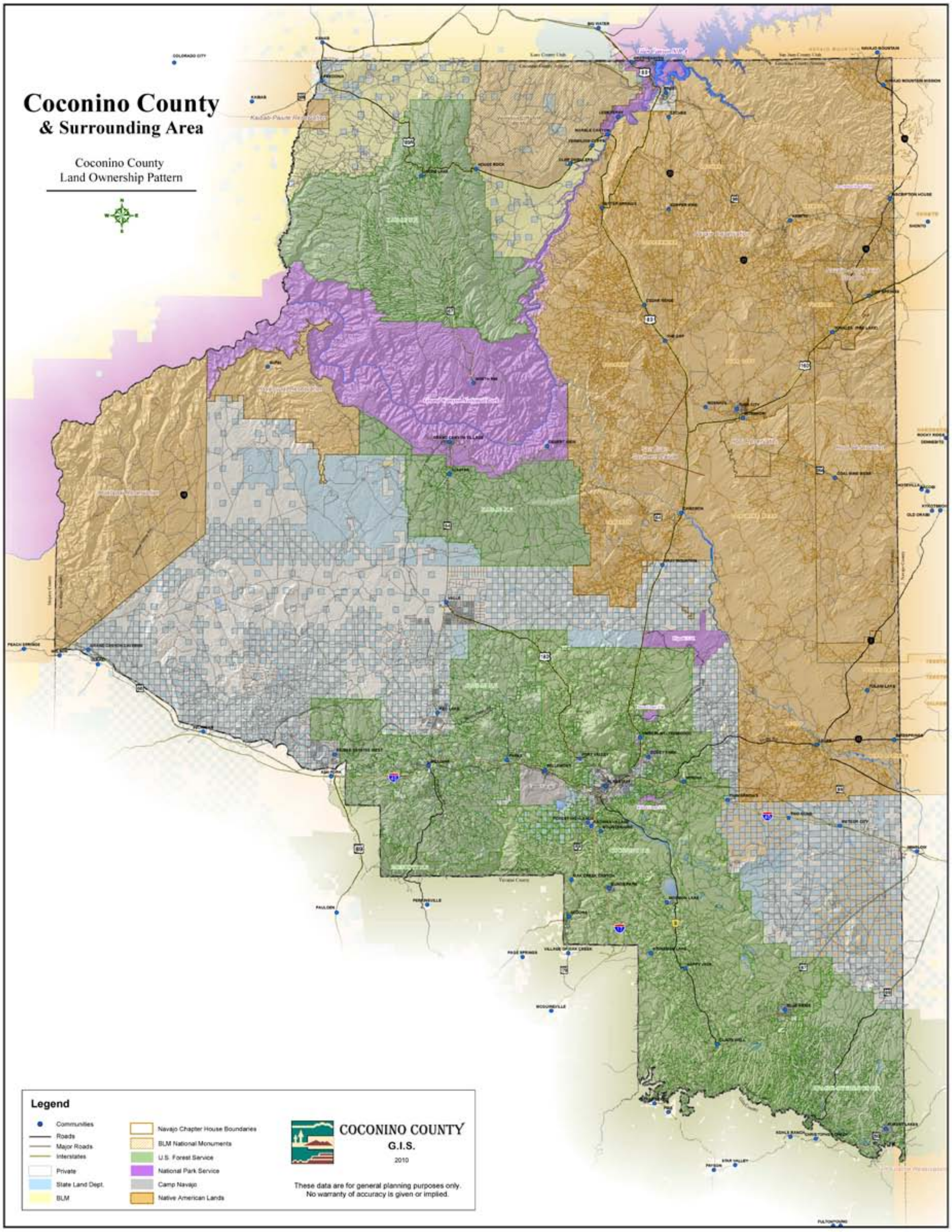
Map CD-5: Coconino County



Map CD-6: Coconino County Over 65 Population



Map CD-7: Coconino County Land Ownership



Gila County

History / Geography

The Gila County area received a large influx of miners and livestock owners during the 1870s. In 1881, Gila County was carved out of Maricopa and Pinal Counties by the Arizona Territorial Legislature to respond to the need for organized government and law enforcement. Named for the Gila River which creates the southeast border, Gila County extended its boundary when Yavapai County sold off an additional 1,500 square miles in 1889. Today, Gila County covers 4,752 square miles and is located in the central to eastern portion of the State.

Gila County is home to portions of five rivers. The Gila River makes up part of the southern boundary of the County. The San Carlos Reservoir was created on the historic confluence of the Gila River and the San Carlos River upon the closure of the Coolidge Dam in 1928. Theodore Roosevelt Lake is located at the historic confluence of the Salt River and the Tonto Creek. The East Verde River in northern Gila County flows west into the Verde River. The Mogollon Rim forms the northern edge of Gila County and is the southern boundary of the Colorado Plateau. Other dominant topographic features include the Naegelin Rim, Sierra Ancha, Pinal and Mazatzal Mountains.

The geographical characteristics of Gila County have been mapped into three terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Native vegetation in these areas is largely high altitude grasses, shrubs, brush, and conifer forests.
- **Sonoran Desert** – this ecoregion is an arid environment that covers much of southwestern Arizona. The elevation varies in this zone from approximately sea level to 3,000 feet. Native vegetation in this zone is comprised mainly of Sonoran Desert Scrub and is one of the few locations in the world where saguaro cactus can be found. The climate is typically hot and dry during the summer and mild during the winter.
- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevation in this zone varies between 3,000 to 4,500 feet. The average temperatures for the Chihuahuan Desert tend to be cooler than the Sonoran Desert due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.

Geology / Climate

The majority of Gila County can be classified as Arizona Mountain Forest; however, the lower part of the County, including the Town of Hayden and the Town of Winkelman, are in the Sonoran Desert. The elevation range for these two ecoregions in the County is from approximately 2,000 to 7,000 feet. Such a range in elevation results in differences in climate. Average temperatures within the County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County.

Precipitation throughout Gila County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild to severe precipitation events, including snow, in the Pinal Mountains, Four Peaks, and Mazatzal Mountains, and along the Mogollon Rim. Summer storms between the months of May and October result in heavy downpours that make up almost half of Gila County's annual precipitation. Summer monsoons are created when moisture-bearing weather systems move into Arizona from the Gulf of California and from the Gulf of Mexico causing a shift in wind direction. The monsoons are often accompanied by thunder and lightning storms caused by excessive heating of the land surface uplifting moisture-laden air.

Population

Gila County is home to 53,597 residents, who primarily reside in six incorporated communities, with the majority of the population living in the Town of Payson and unincorporated areas of the County. The population of the County is estimated at 4.4% growth from 2000 to 2010, with the majority of growth occurring in Payson. The County has grown steadily since 1900 with the exception of a decline in the 1940s and 50s.

Population Estimates for Gila County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Gila County (total)	40,300	51,335	53,597	61,128	64,396
Globe	6,070	7,486	7,532	7,974	8,223
Hayden	910	892	662	860	860
Miami	2,020	1,936	1,837	2,022	2,053
Payson	8,410	13,620	15,301	18,603	20,132
Star Valley	n/a	n/a	2,310	3,893	4,401
Winkelman (Gila part only)	675	439	353	430	430
Unincorporated	n/a	n/a	19,026	19,486	19,915
Fort Apache Tribe (part)			1,678	1,776	1,874
San Carlos Apache Tribe (part)			5,514	5,931	6,349
Tonto Apache Tribe (part)			147	153	159
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates and AZ Dept of Administration – Office of Employment and Population Statistics. http://www.workforce.az.gov/population-projections.aspx					

Economy

The first settlers entered Gila County (then Pinal and Maricopa County) in 1870, prospecting mining operations in the Globe area. The growth in Globe promoted the settlement of other communities in the surrounding area including Miami in 1870, Hayden in 1909, and Winkelman in 1911. Ranching communities found good pastureland in northern Gila County. Payson was originally established as a mining camp, but didn't incorporate until 1973, as a result of development pressure.

The Gila County average labor force in August 2011 was 23,157 with an unemployment rate of 10.2%. The major industries of the County include Public Administration, Retail Trade, Accommodations, Food Services and Mining industries. Community economics are directly related to regions of the county; in the north communities rely heavily on tourism while in the south the economy is most directly affected by the mining industry. Communities such as Tonto Basin and Young are primarily residential and rely mostly on tourism.

Land Use / Ownership

The US Forest Service owns 56% of the land in Gila County. Approximately 38% belongs to the Apache Tribe. Individuals and corporations own 2% of the land; the US Bureau of Land Management, 2%; and the state of Arizona, 1% of the land; and other public lands comprise the remaining 1%.

Emergency Management

OEM - Gila County Emergency Management is a department in the Division of Health and Emergency Services. The department is responsible for Emergency Operations coordination activities, development and maintenance of emergency operations plans, training schedules and exercise coordination.

EAS - The Emergency Alert System is coordinated by Gila County Emergency Management.

EMT - Emergency Medical Technician services are provided through fire departments and/or fire Law Enforcement districts and other commercial providers such as air transport.

- The Gila County Sheriff's Office manages two county PSAPs-Public Safety Answering Points or dispatch centers and provides dispatch services for a number of fire departments.

Fire – Most county municipalities operate one or more fire departments or contracts with a fire department or fire district for services. Most areas in unincorporated Gila County are within fire districts that employ one fire chief and one deputy chief and are staffed by volunteers.

EMS - Emergency Medical Services are provided through fire departments and/or fire districts and/or commercial providers such as air transport.

Hospitals - Two privately owned hospitals currently operate in Gila County: Payson Regional Medical Center and Cobre Valley Regional Medical Center.

Disaster Events

The most common hazards are natural weather related events: severe winter storms, monsoon rains, drought, wildland fires and high winds.

- Severe winter storms that involve heavy snow cause extended isolation in remote communities by blocking main roadways, causing power outages and communication failures. It is very common for the community of Young to experience isolation of some kind the three days after a heavy snow event.
- Snow storms along the Mogollon Rim also have a delayed consequence of snow melt and runoff that can cause flooding of Tonto Creek and extended isolation conditions in the community of Tonto Basin. To date the longest report isolation event was 16 weeks after the January 2010 Winter Storm.
- Monsoon activities in Gila County cause severe flash flood events, often due to storm cells that become stationary over a normally dry watershed.
- Drought conditions are an ongoing hazard that has had the most significant consequence of widespread Bark Beetle kill in many areas of northern Gila County, creating an abundance of wildland fire fuel.
- Wildland fires are an ongoing hazard and can happen in any season, as was the case in February 2007. Short term, wildland fires cause incidents of temporary evacuation, disruption of utilities and communications. Long term, loss of life and/or property and damage to watersheds that are now prone to flash flooding in areas that were previously less vulnerable.
- High winds cause power and communications outages. Most recently, high winds damaged tribal electrical utilities affecting the San Carlos Apache Tribe for three days, disrupting potable water services and communications.

Additionally, the most common human caused disaster is transportation related, although this is often a consequence of one or more weather hazards.

Transportation

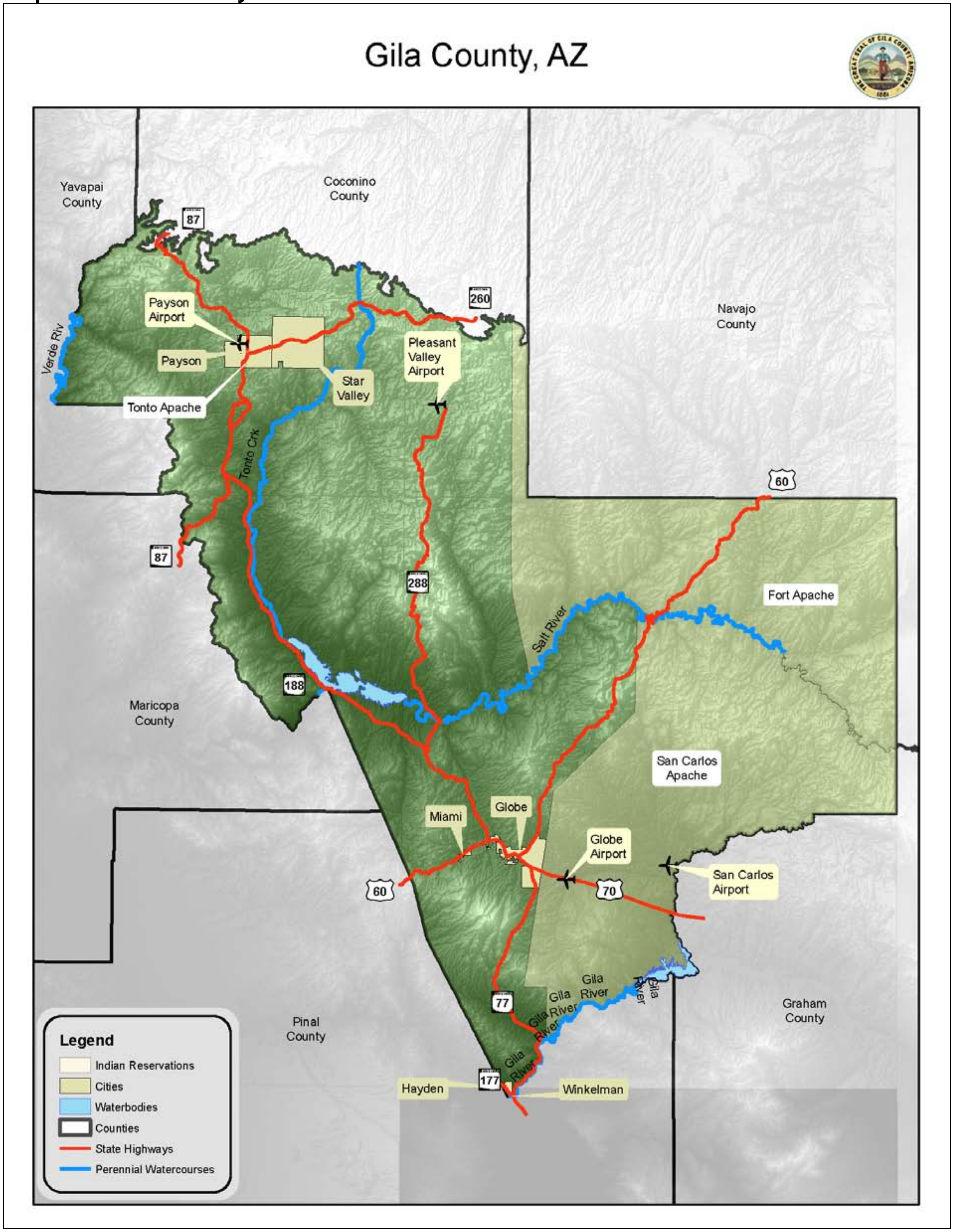
Roadways: Major roadway transportation routes through the County include US Highways 60 and 70, State Highways 73, 77, 87, 88, 170, 188 and 260.

Railways: Railways include the Arizona Eastern Railroad.

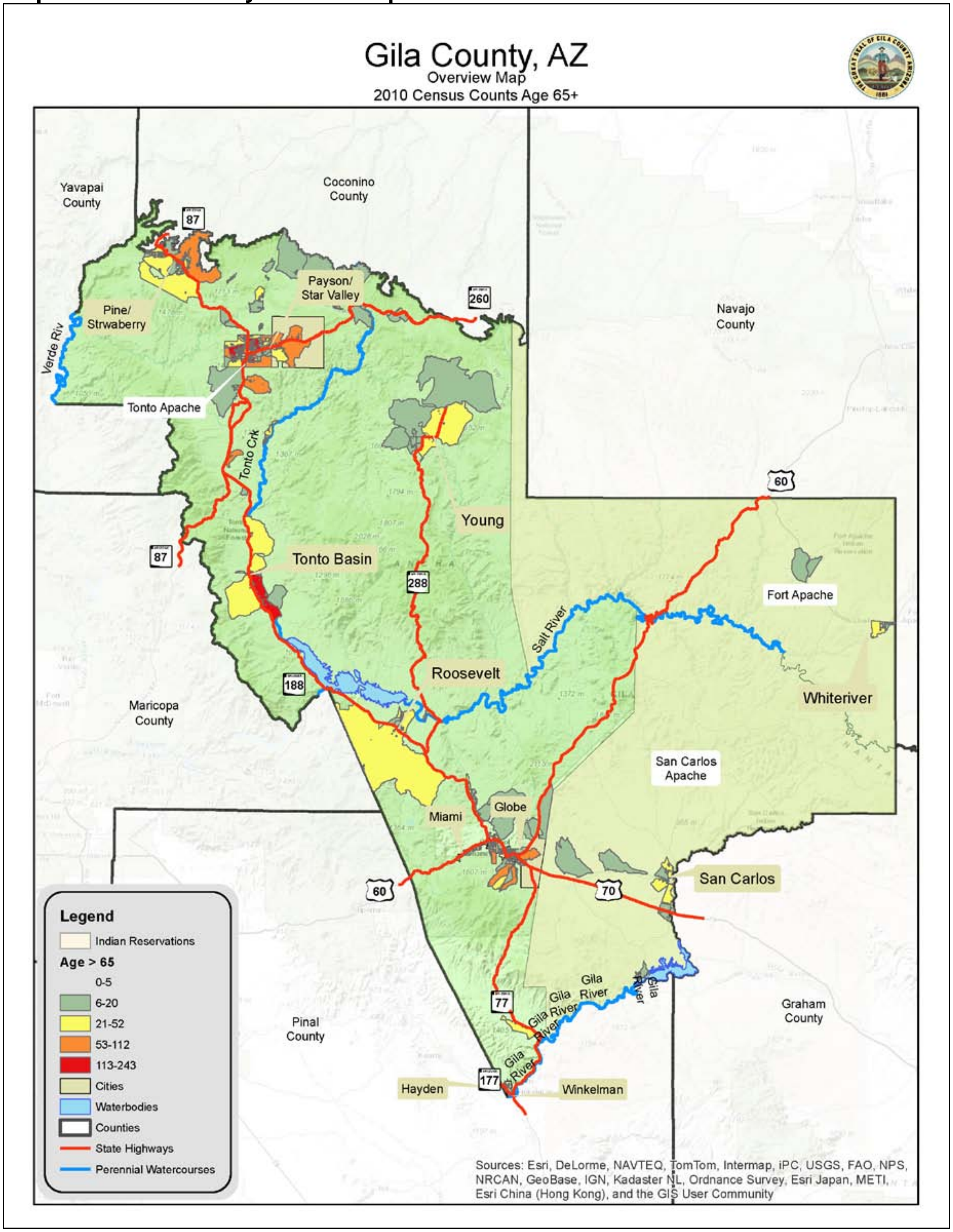
Utilities

Electric:
APS
SRP
SCIP
Gas:
Southwest Gas
Water/Sewer:
Arizona Water
City of Globe-Water & Sewer
Town of Miami-Sewer
Tri-City Sanitary District
Town of Payson-Water
Brooks Utilities
Northern Gila County Sanitary District

Map CD-8: Gila County



Map CD-9: Gila County Over 65 Population



Graham County

History / Geography

Graham County is located in southeastern Arizona and was formed in 1881 by the 11th Territorial Legislature. The county was named after Mount Graham, which is the highest peak in the area, and which was named after Lieutenant Colonel James Duncan Graham, a senior officer in the US Army Corps of Topographical Engineers. The City of Safford serves as the county seat and has done so since 1915.

The county encompasses approximately 4,630 square miles.

The terrestrial characteristics of Graham County are quite diverse, ranging from the gradually sloping riparian corridor of the Gila River Valley with its adjoining agricultural areas, to the steeply inclined pine-oak forests located on Mount Graham and other parts of the Pinaleno and Santa Teresa Mountains. The majority of the county is comprised of high desert plains and foothills that are typical to the Sonoran and Chihuahuan Deserts.

The geographical characteristics of Graham County have been mapped into four terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely high altitude grasses, shrubs, brush, and conifer forests.
- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevation in this zone varies between 3,000 to 4,500 feet. The average temperature for the Chihuahuan Desert tends to be cooler than the Sonoran Desert (see below) due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.
- **Sierra Madre Occidental Pine-Oak Forest** – this ecoregion is predominant to mountainous regions in southeast Arizona with elevations generally above 5,000 feet. The average temperatures tend to be cool during the summer and cold in winter.
- **Sonoran Desert** – this ecoregion is an arid environment that covers much of southwestern Arizona. The elevation varies in this zone from approximately sea level to 3,000 feet. Vegetation in this zone is comprised mainly of Sonoran Desert Scrub and is one of the few locations in the world where saguaro cactus can be found. The climate is typically hot and dry during the summer and mild during the winter.

The primary watercourse within Graham County is the Gila River, which is one of the few designated riparian corridors within the State. Other major watercourses within the county include, but are not limited to the Black River, Bonita Creek, Aravaipa Creek, Eagle Creek, and San Simon Creek. There are also numerous other ephemeral washes and watercourses that primarily convey flood waters. The Gila River and groundwater serve as the primary sources for agricultural irrigation. Potable water is primarily obtained from groundwater and developed springs.

Geology / Climate

For the majority of Graham County, the climate, when compared to other regions in the State of Arizona, is relatively moderate. Average temperatures within the County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the county. For instance, temperature extremes at the top of Mount Graham are significantly different from those for the Gila River Valley.

Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

As of July 2009, Graham County was home to 39,792 residents, which represents a growth of approximately 15% from July 2003 statistics. The majority of these citizens live in the incorporated communities or reservation portion of the County. The largest community is the City of Safford, which is the home of the county seat. All three incorporated cities are located within the Gila River Valley and are located relatively close to each other. There are also 21 other “places” located throughout the county, with most situated along Highway 70 and mostly comprised of only one structure or landmark. Over a third of the county is occupied by the San Carlos Apache Indian Reservation.

Population Estimates for Graham County					
Jurisdiction	**1990**	**2000**	**2009**	**2010**	**2020**
Graham County	26,611	33,495	39,792	37,441	41,119
Pima	1,725	1,989	2,442	2,182	2,362
Safford	7,359	9,232	10,094	9,489	9,729
San Carlos Apache Tribe	7,110	9,385	No Data	No Data	No Data
Thatcher	3,763	4,022	5,819	5,083	6,071
Sources: US Census Bureau, http://www.arizonaindicators.org/pages/economy/demographics/population.html, AZDES Population Statistics approved June 6, 2007 and AZ Dept of Commerce, July 2009					

Land Use / Ownership

Federal and State government entities own 56% Graham County land, including the US Bureau of Land Management and the US Forest Service (38%), and the State of Arizona (18%). An additional 9.9% is publicly owned, and 36% is Indian reservation land.

Emergency Management

OEM – Graham County Office of Emergency Management

Law Enforcement – Graham County Sheriff’s Department, City of Safford PD,

Town of Thatcher PD, Town of Pima PD.

Fire – Safford Volunteer Fire Department, Thatcher Volunteer Fire Department, Pima Volunteer Fire Department and Ft. Thomas Volunteer Fire Department

EMS – Southwest Ambulance based in Safford, AZ

Transportation

Roadways: Major transportation routes through the area are US Highway 70, US Highway 191, State Route 170, State Route 266 and State Route 366.

Railways: Arizona Eastern Railroad.

Airports/Air Service: Safford Regional Airport

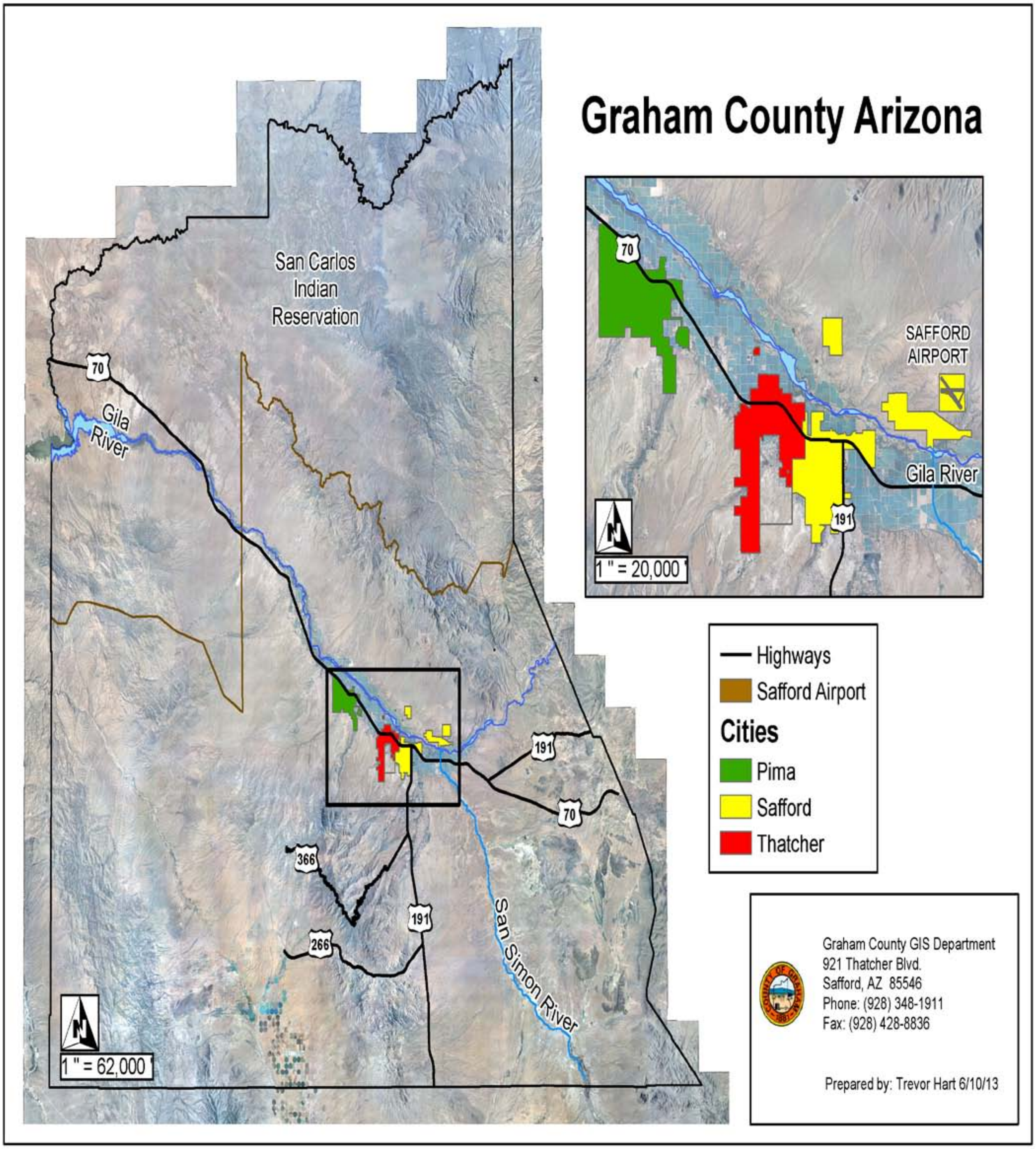
Utilities

Electric: City of Safford and Graham County Co-op

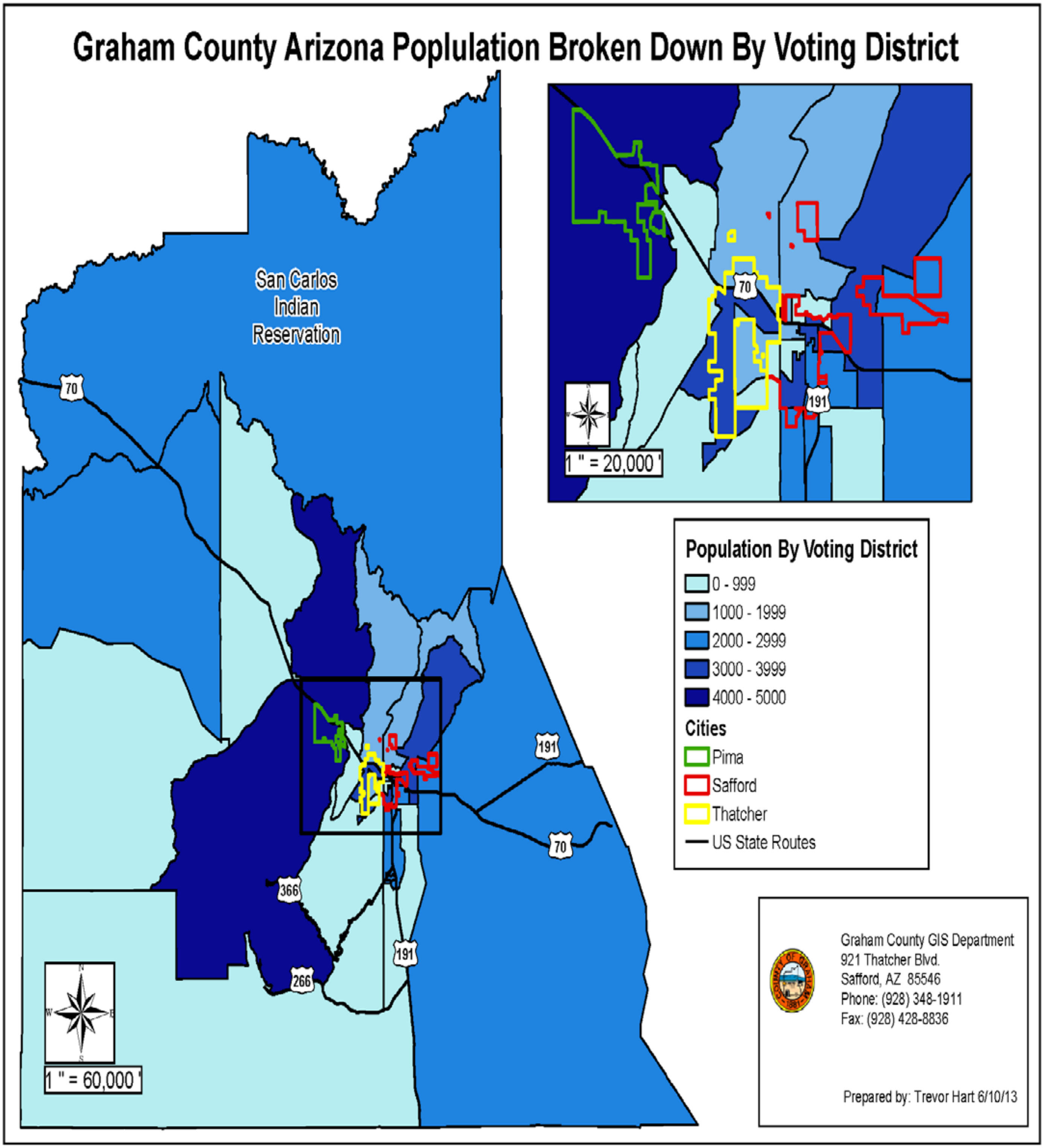
Gas: El Paso Gas

Water/Sewer: City of Safford, Town of Thatcher, Town of Pima

Map CD-10: Graham County



Map CD-11: Graham County Population



Greenlee County

History / Geography

In 1872, a group of soldiers from Silver City, New Mexico, lead by Captain Chase were seeking renegade Apaches, in the group were Jim and Bob Metcalf. While passing through the canyon the Metcalfs noticed rich copper deposits in the walls close to the present day town of Clifton and Morenci. The troops never found the Apaches and returned to Silver City. The Metcalf brother later returned to prospect and staked a claim where they located rich copper deposits. The remoteness of the area and the ever present threat of Indian attacks meant that developing these resources would require large sums of money. Henry Lesinsky, a successful Jewish merchant of Las Cruces and Silver City, New Mexico, decided to invest as a partner of Robert Metcalf, one of the original prospectors of the Longfellow claim. Lesinsky recruited miners from Mexico to do the smelting of copper ore in this new enterprise. Thus, was born the Longfellow Copper Mining Company. After several rather unsuccessful attempts, a crude, but workable smelter (three mud and rock furnaces fired by mesquite charcoal and hand bellows) was built between the confluence of Chase Creek and the San Francisco River. A small settlement of miners developed near the city (a state census record for 1874 shows a population of 132). From that day to the present, the vast majority of people from Clifton, Morenci and Duncan have depended on the mining industry for their livelihood.

Three large copper mining companies, Arizona Copper Mining Company, Detroit Copper Mining Company (Phelps Dodge) and Shannon Copper Mining Companies were all operating at once. James Colquhoun, an engineer and General Manager of the Arizona Copper Company (the A.C. Company had bought Lesinsky's property in 1882). Mr. Colquhoun pioneered a plan for concentrating low grade copper and developed the principles of leaching that led to the profitable use of low grade ores.

Clifton has been under the jurisdiction of several counties. In 1872 they were recorded in Prescott, the county seat of Yavapai County. Later the territory was placed under the jurisdiction of Apache County. In 1881 Graham County was created from parts of Apache and Pima Counties. Clifton was in the part of Apache County that was ceded to Graham County. The people were glad because now their county seat was only 45 miles away at Solomonville. Being a wild mining town, Clifton was not interested in government or they would have fought for the county seat, because Clifton had far more population than Solomonville. By the turn of the century the people of Clifton began to fight for the establishment of a new county. Clifton and Morenci had a combined population of 10,000 while Safford and Solomonville had about half that number. The people of Clifton-Morenci felt that it was the old story of taxation without representation since most of the county officers were chosen by the political machine at Safford. The Clifton and Morenci mines were paying most of the county's taxes.

In the early 1900's the fight for county division was renewed. The managers of the three mining companies had taken up the fight. The Arizona Copper Company wished to name the county after Mr. Colquhoun, who was the head of the company. The leaders in Morenci wanted the name to be Douglas in honor of Dr. James Douglas, superintendent of the Detroit Copper Company of Morenci. This proposal caused the Clifton leaders to give up their proposed name of Colquhoun and substitute Lincoln instead. They sent John R. Hampton a young, able lawyer who worked for the Shannon Copper Company, to the state legislature. He organized the fight at the territorial capital, which led to the establishment of Greenlee County. The mining companies decided to send a large delegation of local men to Phoenix to lobby for division. In Safford and Solomonville a fight was led by Charles Solomon, a banker, against the county division. When the bill was introduced before the legislature, many farmers and townspeople from Graham County made the trip to Phoenix to lobby against it. The bill was introduced on

February 25, 1909 as council bill 94. It passed by a majority of 10 to 1. The bill went to the house where it was passed with an amendment to change the name from Lincoln to Greenlee. This was done to delay the final passage of the bill, the amendment lost by a vote of 5 to 4. Mr. Mills, General Manager of the Detroit Copper Company made a trade with the Safford opponents where the final division would be delayed for two years. This agreement and the assumption of all Graham county debts, which were $146,000, by the new county appeased the Safford delegation. Nearly all opposition ceased and the bill passed the next day by a vote of seven to two in the Council. The bill to create a new county was approved March 10, 1909 by Governor Joseph H. Kibbey. It was one of the smaller counties, being only 120 miles long and 20 miles wide containing 1,037,713 acres. With only four populated towns the new county had a population of about 12,000 to 13,000 people.

Both Clifton and Duncan fought to become the county seat. The citizens of Duncan argued that since Duncan was the county's outlet to the rest of the world, and more accessible to the rest of the world, it should become the County's seat. Clifton argued that it was nearer the geographical center of the county and nearer to the population centers of Morenci and Metcalf. Clifton won the fight and the seat was located there.

Besides the Copper Mines of the Clifton-Morenci-Metcalf area, there are mines in the Duncan District of the Gila Valley. Precious metals have been produced at Ash Peak and from the mines in the mountains east of Duncan. Duncan is considered a farming and ranching area. Ranching on Blue River, Eagle Creek, and the "Frisco" River has added to the County economy since the 1870's. One of the three largest cattle company to operate in Arizona was the Double Circle with ranch headquarters on Eagle Creek.

The first mineral discoveries in the Clifton-Morenci District were made around 1856 when a group of California volunteers pursuing renegade Apache Indians came through the area and wrote about the colorful mineral outcrops. In 1872 a group of soldiers from New Mexico were seeking renegade Indians, among the group were Joe Yankie, Robert and James Metcalf. They later returned to the area searching for placer gold. Although very little gold was found, they located the Longfellow, Arizona Central and Metcalf claims which later become the mines around the town of Metcalf and Morenci.

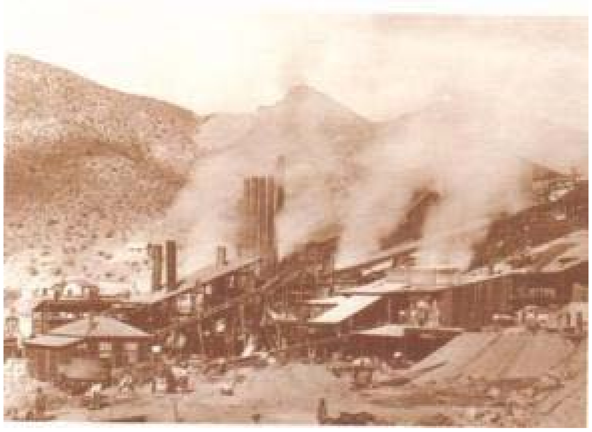
Two mining companies were organized in the Clifton-Morenci District in the early 1870's; the Longfellow Copper Company (which later became the Arizona Copper Company) and the Detroit Copper Company (later became Phelps Dodge, Morenci Branch). The first ore mined from the Longfellow mine assayed as high as 80% copper, and averaged 20% copper over the first 10 years of mining. The first copper furnace was built in Chase Creek, about 800 feet below the Longfellow Mine so the ore had to be lowered by cable in ore cars. Horse and mule-drawn wagons transported ore before the coming of the railroad in 1879. They hauled in all supplies and carried out the limited amount of copper from the crude smelters. The wagons then hauled the copper to the railroads that carried them to markets as far away as San Francisco and Kansas City or Kit Carson, Colorado, which was the nearest railroad.

Although the ore contained very high copper grades, the early mining in the district had three major problems. The early smelters lasted only a few weeks (sometimes only days) before they had to be rebuilt. The transportation costs of the ore from the mine to the smelters, to the railhead for delivery and then to the market was expensive and often unreliable. The constant threat of Indian raids often caused temporary production losses.

Early mining by the Detroit Copper Company ceased after a short time because of the dangers of Indian raids and the remoteness of the mines. It was reactivated a few years later with the arrival of William Church. In 1880, Church decided to build a smelter to handle the ore from his mines. He didn't have the required capital, so he went to New York to seek a loan. On a historic day in 1881, Church entered the office of Phelps Dodge and Company in New York City and asked for a loan. Phelps Dodge at this time was not in the mining business, but rather involved in exporting commodities such as cotton, and importing metals, primarily tin, copper, brass, and zinc. Phelps Dodge did not immediately extend the loan, but asked Dr. James Douglas, a renowned metallurgist to examine Church's claims. Douglas reported favorably and recommended that Phelps Dodge invest in mining properties in Bisbee, Arizona that same year. Because of Douglas favorable report, Phelps Dodge and Company advanced $50,000 to Church and became part owners of the Detroit Mining Company. The year 1881 thus became the year Phelps Dodge entered Morenci and began mining copper.

In 1882, the Detroit Copper Company smelter was shut down because an Apache Indian raid killed several workers, stole the supplies and left the smelter riddled with bullet holes. Because of the difficulties with the Indians, the high cost of ore transportation to the smelter in Clifton, the smelter was relocated in 1883 closer to the mining in Copper Mountain. As part of the move the name "Morenci" was given to this new area, replacing the old name of "Joy's Camp".

The Detroit Copper Company smelter in 1896. This site is now under a mine dump on the south side of the Morenci pit.



In 1892, the Detroit Copper Company was forced to shut down because the price of copper dropped to six cents per pound. An attempt to start back by building a concentrator to handle lower grade sulfide copper ore was unsuccessful. In 1897, Church sold the remainder of the Detroit Copper Company to Phelps Dodge and Company for $1,600,000. Underground mining was renewed, a new concentrator was built and the Company again prospered.

The three major operators in the early 1900's were the Detroit, the Arizona, and the Shannon Copper Companies. In the towns of Metcalf were the Arizona and Shannon Copper Company mines; Morenci had the Arizona Copper Company mines and concentrator and the Detroit Copper Company mines, concentrator and smelter. Clifton with the Arizona Copper Company and the Shannon Copper Company concentrators and smelters were all thriving.

In 1921, Phelps Dodge became sole owner of the entire mining District through its purchase of the Arizona Copper Company which had been the largest copper operation in the Clifton-Morenci District since 1882. Most of the ore mined by the underground methods after 1921 was sulfide copper ore from the Humboldt Mine and assayed 2% to 4% copper. By 1928 and 56 years of operation, the Morenci district had produced almost two billion pounds of copper.

Between 1928 and 1930, Phelps Dodge drilled many test holes in the "Clay" deposits. Although huge tonnages of ore were indicated, the grade of the ore was too low to be mined profitably by underground methods. In 1932, all underground mining ended in Morenci because the depression had dropped copper prices to less than six cents per pound.

In 1937 mining was again started in Morenci, not by underground methods, but rather by open pit methods. Stripping of waste from the top of the ore body lasted until 1942 when the first ore was delivered to the new Morenci concentrator and a new era of mining in the Morenci district began.

Geology / Climate

Greenlee County is located in eastern Arizona on the state line with New Mexico. The County was created by an Act of the 25th Territorial Assembly in 1909, by a division of Graham County and comprised of 1,838 square miles, with the Town of Clifton serving as the County seat since inception.

The Gila River, San Francisco River, Blue River, Black River and Eagle Creek are the primary perennial watercourses located within the County. The Black River also forms a portion of the northwest boundary of the County. The remaining watercourses are primarily ephemeral washes.

The geographical characteristics of Greenlee County have been mapped into three terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely high altitude grasses, shrubs, brush, and conifer forests.
- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevations in this zone vary between 3,000 to 4,500 feet. The average temperatures for the Chihuahuan Desert tend to be cooler than the Sonoran Desert (see below) due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.
- **Sierra Madre Occidental Pine-Oak Forest** – this ecoregion is predominant to mountainous regions in southeast Arizona with elevations generally above 5,000 feet. The average temperatures tend to be cool during the summer and cold in winter.

For the majority of Greenlee County, the climate when compared to other regions of the State, is relatively moderate. Average temperatures within Greenlee County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County. Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges.

Population

Greenlee County is the smallest county in terms of population in the State and is the most geographically isolated from a major metropolitan service center (Phoenix). In fact, based on the consensus definition that has been formally adopted by the National Rural Health Association, the Western Governors Association and the Department of Health and Human Services (HHS) office of Rural Health Policy, Greenlee County is a 'frontier' with 4.6 people per square mile. Greenlee County has a population of 8,802 (2012 Arizona Dept of Commerce). The county seat, Clifton, has a population of 3,311, Duncan's population is 825 and Morenci has a population of 1,882.

Economy

Greenlee County, Arizona's 14th county, was created from the eastern part of Graham County by an act of the 25th territorial assembly on March 10, 1909. There was great resistance to the formation of this new county because Graham County would lose considerable copper mining revenue. However, the citizens in the Morenci mining district of eastern Graham County wanted a more localized governing area. As a compromise, Greenlee County assumed $146,000 of Graham County's debt and Greenlee County was made smaller than originally proposed. The County was named after Mason Greenlee, an early day mining man. In 1921, Phelps Dodge became sole owner of the entire mining district through its purchase of the Arizona Copper Company which had been the largest copper operation in the Clifton-Morenci District since 1882. Most of the ore mined by the underground methods after 1921 was sulfide copper ore from the Humboldt Mine and assayed 2% to 4% copper. By 1928 and after 56 years of operation, the Morenci district had produced almost two billion pounds of copper. Between 1928 and 1930, Phelps Dodge drilled many test holes in the "clay" deposits. Although huge tonnages of ore were indicated, the grade of the ore was too low to be mined profitably by underground methods. In 1932, all underground mining ended in Morenci because the depression had dropped copper prices to less than six cents per pound. In 1937, mining was again started in Morenci, but not by underground methods. This era of mining saw the introduction of open pit methods. Stripping of waste from the top of the ore body lasted until 1942 when the first ore was delivered to the new Morenci concentrator and a new era of mining in the Morenci district began.

Duncan was originally established as a shipping point for cattle. Around Duncan, substantial agriculture has developed in the rich soils of the well watered Gila River Valley. Farming and ranching continue to be the primary industries for the small community.

Growth in Greenlee County has been very slow and is closely tied to the copper mining industry. During the period of 1990 to 2000, census data housing unit counts indicate an average annual growth rate of less than 0.8%.

Land Use / Ownership

Greenlee County covers 1,837 square miles. The vast majority of land is government-owned. The US Forest Service controls 63.5%; the US Bureau of Land Management, 13.6%; and individual or corporate ownership, only 8.1%.

Disaster Events

Flooding is clearly a major hazard in Greenlee County. The County has been part of 16 disaster declarations for clouding, with three (3) of those declarations occurring in the past five (5) years. There have been at least five (5) other undeclared events of reported flooding incidents.

Greenlee County has had several wildfires, including the Wallow Fire in 2011, which became the largest fire in Arizona history.

Transportation

Roadways: Major roadway transportation routes through the County include US Highways 70 and 191, and State Routes 75 and 78.

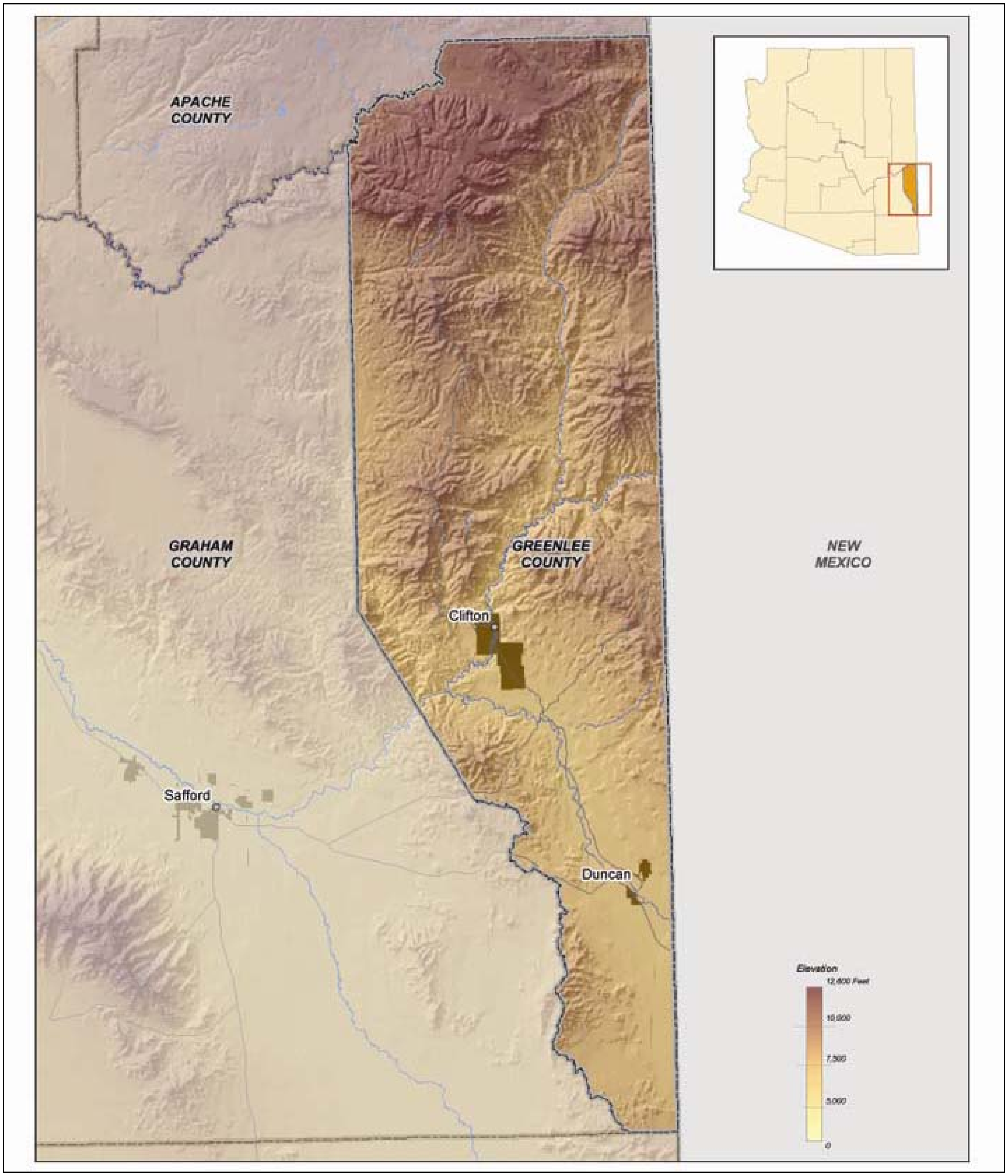
Railways: Railways through the County include the Southern Pacific Railway and the Freeport McMoran Industrial Railroad, which services the Morenci Copper Mine.

Airports/Air Service: Greenlee County Airport

Utilities

Morenci Water and Electric
Duncan Valley Electric
Town of Duncan
Town of Clifton

Map CD-12: Greenlee County



La Paz County

History / Geography

La Paz County is Arizona's 15th and newest county. It is located in central-western Arizona and shares a boundary with the State of California on the west and the Arizona Counties of Yuma on the south, Maricopa, and Yavapai on the east, and Mohave on the north. According to the La Paz County Comprehensive Plan, the County was created from the northern portion of Yuma County in January 1983, based on a voter initiative that was passed in May 1982. The County is currently comprised of 4,513 square miles, with the City of Parker serving as the County seat since inception.

The Colorado River, which generally forms the County's western boundary, is the largest watercourse flowing through the County. Other significant watercourses include Bill Williams River, Bouse Wash, Centennial Wash, Cunningham Wash, and Tyson Wash. The remaining watercourses are primarily small to medium sized ephemeral washes.

La Paz County is located within the Sonoran Desert terrestrial ecoregion, which is described as:

…an arid environment that covers much of southwestern Arizona. The elevation varies in this zone from approximately sea level to 3,000 feet. Vegetation in this zone is comprised mainly of Sonoran Desert Scrub and is one of the few locations in the world where saguaro cactus can be found. The climate is typically hot and dry during the summer and mild during the winter.

Geology / Climate

Average temperatures within La Paz County range from near freezing during the winter months to over 110°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County.

Precipitation throughout La Paz County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast . The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

According to the 2010 Census, La Paz County is home to 20,489 residents, with the majority of the population living in the unincorporated areas of the county. The population of the County has grown by 2.7% growth from 2000 to 2010, with the majority of growth occurring in Quartzsite. It is noted that these numbers reflect the full-time residents of the county and are not indicative of the tremendous influx of winter visitors, and especially in Quartzsite.

Population Estimates for La Paz County				
Jurisdiction	**1990**	**2000**	**2010**	**2020**
La Paz County	13,900	19,935	20,489	25,487
Parker	2,897	3,140	3,083	3,688
Quartzsite	1,876	3,354	3,677	4,317
Source: http://www.azcommerce.com/econinfo/demographics/Population+Estimates & http://www.workforce.az.gov/population-projections.aspx				

Economy

Settlement of La Paz County began with the Town of La Paz, which was founded in 1862 after the discovery of rich gold deposits nearby. Within one year (1863), the gold mines attracted over 5,000 people. The depletion of gold and a shift of the Colorado River caused a major decline in the town's prosperity and population. Similar stories of boom to bust are told for other communities throughout the County. By the early 1900's, most of the mining communities were abandoned or dying.

The next major incentive for development of the area was the construction of a series of dams and reservoirs along the Colorado River which provided recreational and irrigation opportunities. Parker Dam, which created Lake Havasu, was completed in 1928 and regulates the flow of Colorado River water through the County. The Town of Parker, incorporated in 1948 as part of Yuma County, became the La Paz County seat when the County was created in 1983. The Town of Quartzsite incorporated in 1989, and is the only other incorporated community in the County.

The La Paz County average labor force in August 2011 was 7,143 with an unemployment rate of 10.9%. With the draw of the Colorado River, several wildlife refuges, mild winter climates, and unique and varied rugged geologic formations attracting visitors, tourism ranks as the top economic industry for La Paz County. Agriculture is the next largest economy base for the County, with both crop and livestock sectors contributing. The Arizona portion of the Colorado River Indian Tribe Reservation is also wholly located within the County.

Land Use / Ownership

There are a total of two incorporated and 11 unincorporated communities scattered across the County. Many of the unincorporated communities or places may be comprised of only one structure or a prominent landmark. Prominent land-holders within La Paz County include the Bureau of Land Management (58%), other public lands, (19%); Colorado River Indian Tribes, (8%); and 5.3% of the land is owned privately or by corporations.

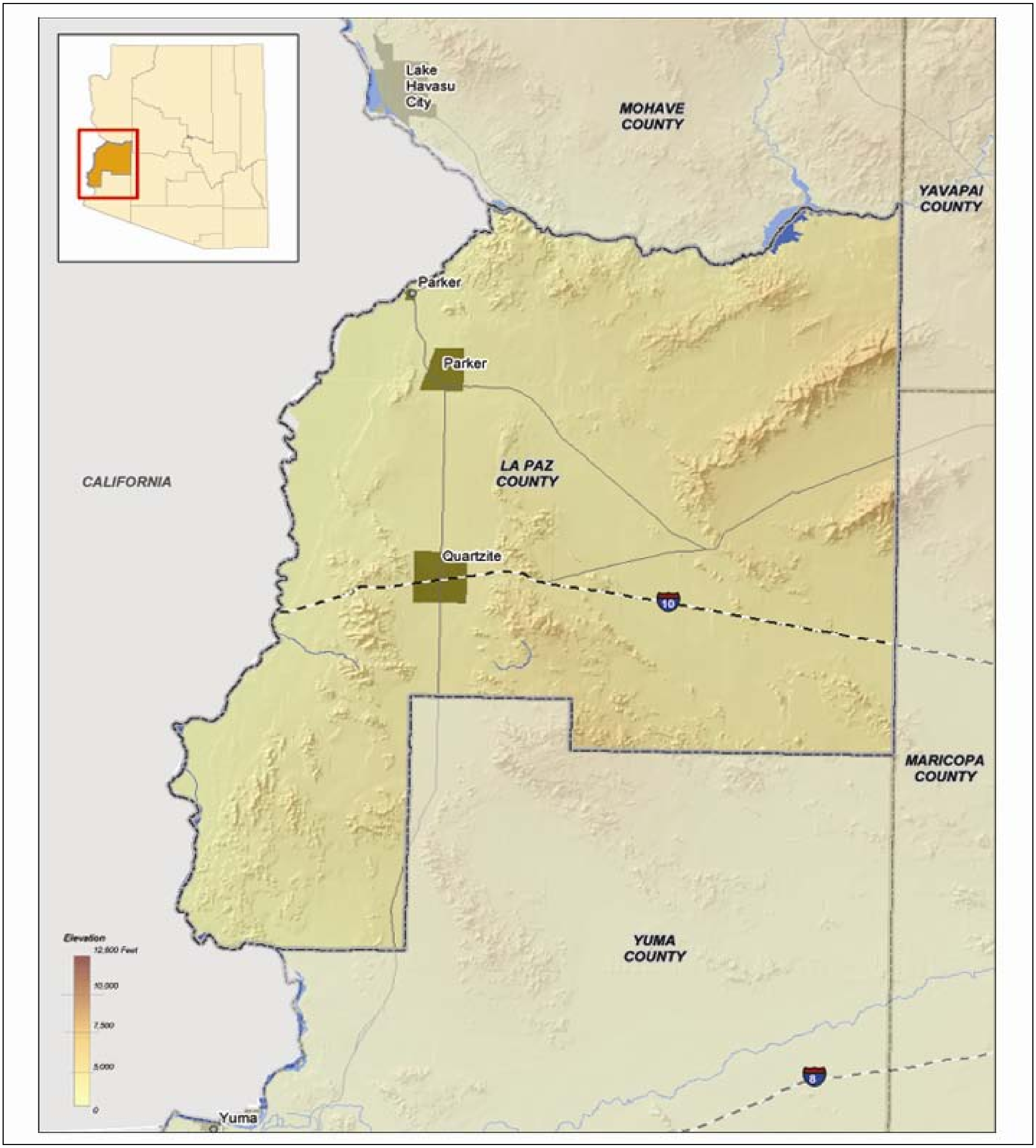
Transportation

Roadways: Major roadway transportation routes through the County include Interstate 10, US Highway 60 and 95, and State Routes 72 and 95.

Railways: The Atchison Topeka and Santa Fe Railroad (ATSFRR) passes east-west through the county parallel to US Highway 60 and State Route 72.

Airports/Air Service: There are also three private and one public airport/airfield servicing the County.

Map CD-13: La Paz County



Maricopa County

History / Geography

Maricopa County is located in central Arizona and encompasses 9,226 square miles. Situated in the upper Sonoran Desert and varying in elevation from 436 feet above sea level in the southwest to 7,645 feet at the northeast, the county contains several plant communities. At the lower elevations, desert scrub punctuated with saguaro cactus predominate. The higher elevations contain woodlands and sparse forests. Along the rivers, streams, and washes, riparian communities flourish and sustain the majority of the diverse plant and animal life found in the county. The Salt and Verde Rivers enter the County at the northeast quadrant, combine, and continue on a bisecting path as the Salt River until confluencing with the Gila River in the central portion of the County near Avondale. The Gila River then continues bisecting the County as it journeys southwesterly towards the confluence with the Colorado River in Yuma, Arizona. The life-sustaining water this extensive river system brings to the region has defined life in Maricopa County from the earliest Native American settlements to the present day. Maricopa County has one of the most ample water supplies of any desert region in the west. The watershed of the Salt and Verde Rivers is impounded behind the dams of the Salt River Project. The Central Arizona Project canal which brings water from the Colorado River, can supply more than a fifth of the total water for the county. In addition to this supply, the metropolitan area is situated over a prolific aquifer. To assure an adequate water supply for future generations, the state legislature adopted the Groundwater Management Act in 1980. This act requires careful water management and conservation measures to ensure water will be available for the influx of people expected in the next 20 years and beyond.

Geology / Climate

The climate in Maricopa County is characterized by the mild winters and hot summers typical of the upper Sonoran Desert regions. Temperatures and precipitation across the County vary somewhat due to the changes in elevation and orographic influences of local mountains and valleys.

Average temperatures within the County range from near freezing during the winter months to over 110°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County. For instance, temperature extremes in the northeastern portion of the County are notably different from those for the lower Gila River valley.

Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing longer duration precipitation events with low intensity rainfall and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

Maricopa County is home to more than half of Arizona's overall population, with the 2008 count estimated at nearly 4 million. In the 1990's, the County was the fastest growing county in the United States, gaining nearly 1 million new residents with a growth rate of 44.8% during that decade. Maricopa County is expected to have over 4.2 and 5.2 million residents by the years 2010 and 2020, respectively.

Population Estimates for Maricopa County					
Jurisdiction	**1990**	**2000**	**2008**	**2010**	**2020**
Maricopa County	2,122,101	3,096,600	3,987,942	4,216,499	5,230,300
Avondale	16,169	35,833	76,648	83,856	105,989
Buckeye	5,038	6,537	50,143	74,906	218,591
Carefree	1,666	2,920	3,948	4,418	5,816
Cave Creek	2,925	3,685	5,132	5,781	7,815
Chandler	90,533	185,300	244,376	265,107	282,991
El Mirage	5,001	7,518	33,647	38,620	38,717
Fountain Hills	1,030	20,199	25,995	27,166	33,331
Fort McDowell Yavapai Nation	640	829	824	839	1037
Gila Bend	1,747	1,944	1,899	2,575	3,950
Gilbert	29,188	109,935	214,820	218,009	285,819
Glendale	148,134	230,300	248,435	279,807	315,055
Goodyear	6,258	18,779	59,436	71,354	174,521
Guadalupe	5,458	5,228	5,990	5,790	5,982
Litchfield Park	3,303	3,813	5,093	5,140	7,000
Unincorporated Maricopa County	173,612	125,925	246,701	86,423	110,285
Mesa	288,091	441,800	459,682	518,944	565,693
Paradise Valley	11,671	13,629	14,444	14,790	15,224
Peoria	50,168	114,100	155,557	172,793	236,154
Phoenix	983,403	1,350,500	1,561,485	1,695,549	1,990,450
Queen Creek	2,667	4,317	23,329	34,506	55,529
Salt River Pima-Maricopa Indian Comm	4,852	6,403	6,822	7,087	7,308
Scottsdale	130,069	204,300	242,337	249,341	269,266
Surprise	7,122	30,886	108,761	146,890	268,359
Tempe	141,865	158,900	172,641	177,771	191,881
Tolleson	4,434	4,963	6,833	7,748	9,646
Wickenburg	4,515	5,050	6,442	11,022	13,311

Youngtown	2,542	3,007	6,522	6,820	7,275
Source: Arizona Department of Commerce. Litchfield Park 2010 and 2020 estimates provided by Litchfield Park					

Economy

Maricopa County was originally inhabited by Native Americans, who abandoned the area during the 1300's for unexplained reasons. Agriculture was the prominent activity in the region and was reestablished during the 1860's as the first European settlers migrated to the Salt River Valley. Rapid growth and robust development have been the hallmark of Maricopa County ever since. In 1870 the town site of Phoenix was established, and on February 14, 1871, the Territorial Legislature created Maricopa County. By 1872, there were over 700 people in the county with 5,000 acres under cultivation. The arrival of the railroad in 1877 caused a surge in economic activity. In the early 1900s, the larger farm parcels scattered throughout the region were divided into small farm communities such as Chandler, Gilbert, and Tolleson. In 1902—at the request of President Theodore Roosevelt—after a series of devastating floods, Congress passed the Reclamation Act of 1902. Shortly thereafter, the US Bureau of Reclamation started construction on Theodore Roosevelt Dam east of Phoenix. Irrigated agricultural production and population exploded after the completion of Roosevelt Dam in 1912, providing the region with a reliable water supply. The County quickly became one of the leading agricultural producing counties in the United States. During this period, the County also became a winter haven for tourists.

Growth in the area continued as tourism, automobile travel, military, and industrial activities came to the County. Construction continued on residential developments, highways, and commercial districts, making Maricopa County an increasingly popular place to live. Until the end of World War II, the traditional economic engines of both the State of Arizona and Maricopa County were known as the five “C’s”: Cotton, Copper, Cattle, Climate, and Citrus. Newly established wartime industries fueled the monumental growth of the county in the post-war era. By 1960, the population was over 660,000 people, and reached one million residents in the early 1970s. Combined with the general economic expansion of the 1980s and the rush to the Sun Belt, Maricopa County claimed over 2.2 million residents by 1990. Even with economic sluggishness in the early 1990s, the region continued to grow through 2007 at rate of about four times the national average. Average and per capita 2007 incomes of $76,465 and $26,132 per year for the greater Phoenix area, tracked closely with national averages.

In the last couple of years, economic growth and employment within the County have declined significantly. For the Greater Phoenix area, the seasonally adjusted employment rate stands at 7.3% as compared to less than 3% for years prior. For many of the construction and employment service trades, the unemployment rates are as high as 40%.

Land Use / Ownership

Federal and State government entities own 50% of Maricopa County land, including the US Bureau of Land Management (28%), the US Forest Service (11%), and the State of Arizona (11%). An additional 16% is publicly owned, and 5% is Indian reservation land.

Emergency Management

MCDEM - The Maricopa County Department of Emergency Management is responsible for the planning, coordination, and implementation of emergency management related activities for Maricopa County. The Mission of MCDEM is to lessen the loss of life and reduce injuries and property damage during natural or man-made incidents through prevention, protection, mitigation, response, and recovery actions taken in accordance with the National Preparedness Goal and the Maricopa County Emergency Operations Plan.

MCDEM also coordinates the activities for the County’s Emergency Operations Center (EOC). The EOC, when activated is a central location where representatives of local government and private sector agencies convene during disaster situations to make decisions, set priorities and coordinate resources for response and recovery.

EAS - Emergency Alert System (EAS) advisories for Maricopa County is an all hazards alert and warning system that provides warnings throughout the county via radio, television, cable TV service, and the Phoenix National Weather Service NOAA Weather Radio. Pre-scripted, Palo Verde Messages are in place for use over the EAS. Emergency public advisories and messaging are coordinated through Joint Information Systems and Joint Information Centers to cover major broadcast and print media. Other means of informing the public of emergencies include: Social media, such as, Twitter, Instagram and Facebook.

In order to reach people with Functional Needs, the use of closed captioning and sign-language is encouraged during news broadcasts and during any official media briefings

Law Enforcement - Maricopa County law enforcement services are provided by jurisdictional law enforcement agencies at the municipal, tribal, county, state and federal levels.
Law enforcement provides routine patrol, traffic enforcement/control, response to emergencies and search and rescue. Special law enforcement responses to hostage situations, unusual acts of violence, civil unrest, riot, demonstrations and other unusual situations are handled by Special Weapons and Tactics (SWAT) Teams and K-9 Units throughout the county. Counter-terrorism planning and response is handled through a multi jurisdictional, multi agency Fusion Center (ACTIC) located in Maricopa County. Law Enforcement air assets are used to provide evacuation, video downlinks and aerial surveillance during disaster conditions.

Fire - Fire suppression and prevention agencies in Maricopa County include governmental fire departments and fire districts, as well as, a private-sector fire department for those areas of Maricopa County not covered by another fire agency. Fire suppression capabilities include both structural and wildland fires. Fire departments/districts are supported by a regional Automatic Aid Consortium which increases response, collaboration, cooperation and communication between all fire agencies in Maricopa County and is a model for the Fire Service in America.

EMS - Emergency Medical Services (EMS) are provided by all fire departments, fire districts and three private ambulance companies. Local fire agencies and ambulance companies provide Paramedics and Emergency Medical Technicians (EMTs) on their response and transportation teams. Some Fire Districts and Municipal Fire Departments provide Emergency Transport for their communities as well as Physician Assistants who respond to citizen's homes.

Disaster Events

Within the past 10 years, Maricopa County has experienced flooding, wildland fire (Cave Creek Complex fire), severe thunderstorms, blowing dust, high winds, and winter freezes. There have been several releases and spills of hazardous materials due to improper handling and transportation accidents.

Transportation

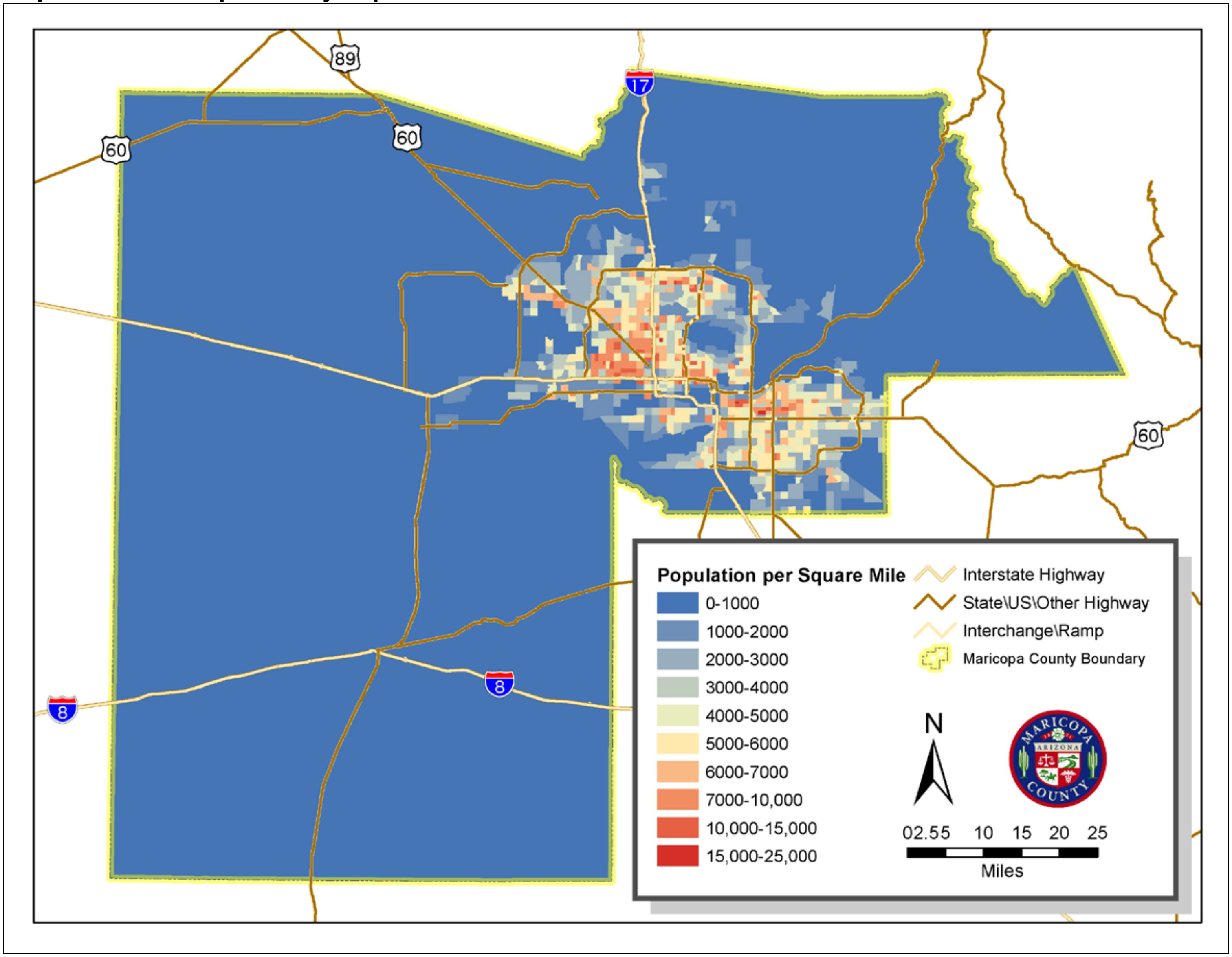
Roadways: Several major roadways support both local and regional transportation needs in Maricopa County. Interstates 10, 17, and 8 all intersect in or near Phoenix, and provide access to surrounding states. Several other State and US Highways provide local and regional access throughout Arizona.

Airports/Air Service: Sky Harbor International Airport, located in central Phoenix, is one of the busiest air travel facilities in the United States.

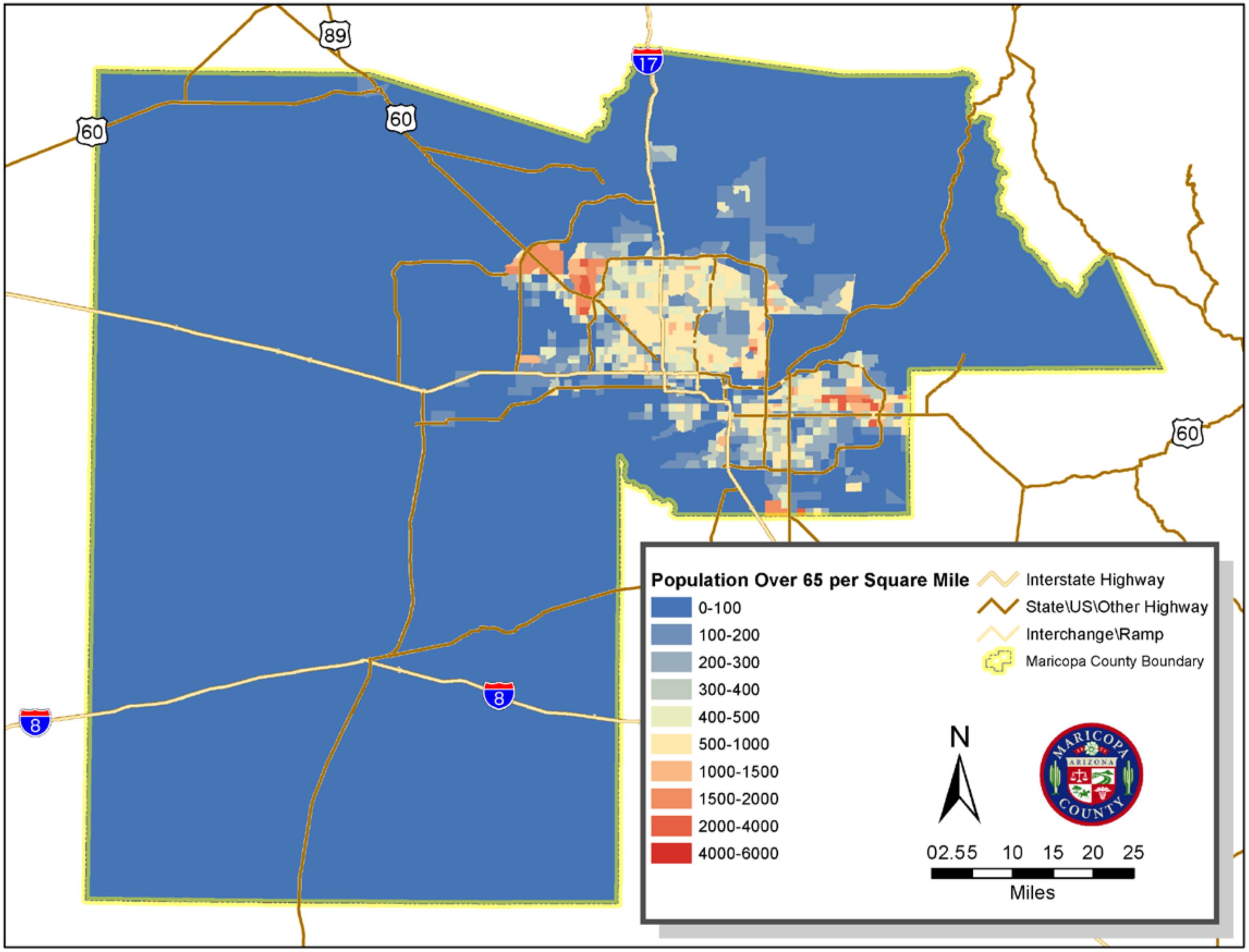
Utilities

There are two main electric providers within Maricopa County, Arizona Public Service (APS) and Salt River Project (SRP) both regulated under the Arizona Corporation Commission. Natural gas providers include Southwest Gas, El Paso Natural Gas, and City of Mesa. There are a myriad of water, wastewater, solid waste utility providers.

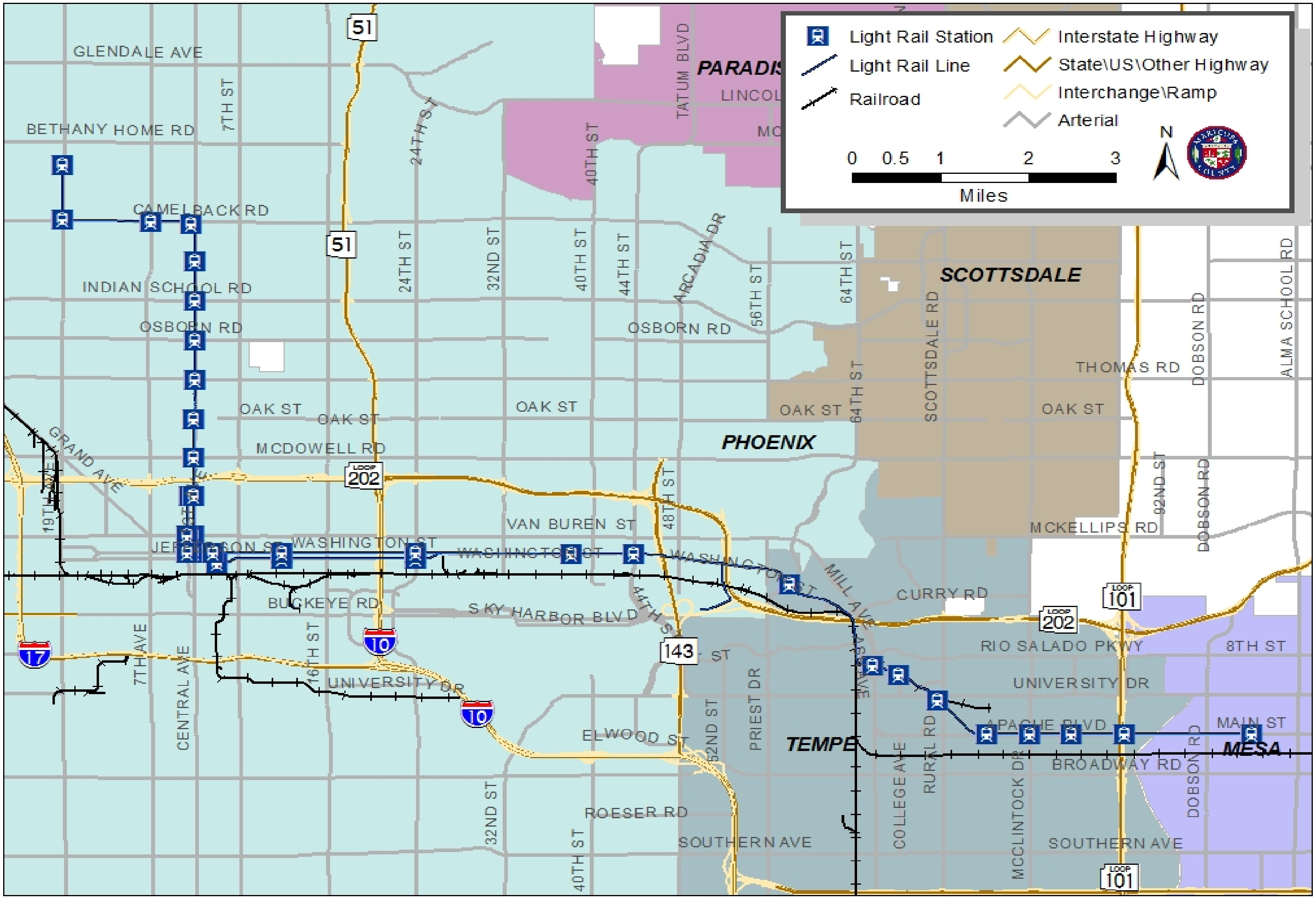
Map CD-14: Maricopa County Population



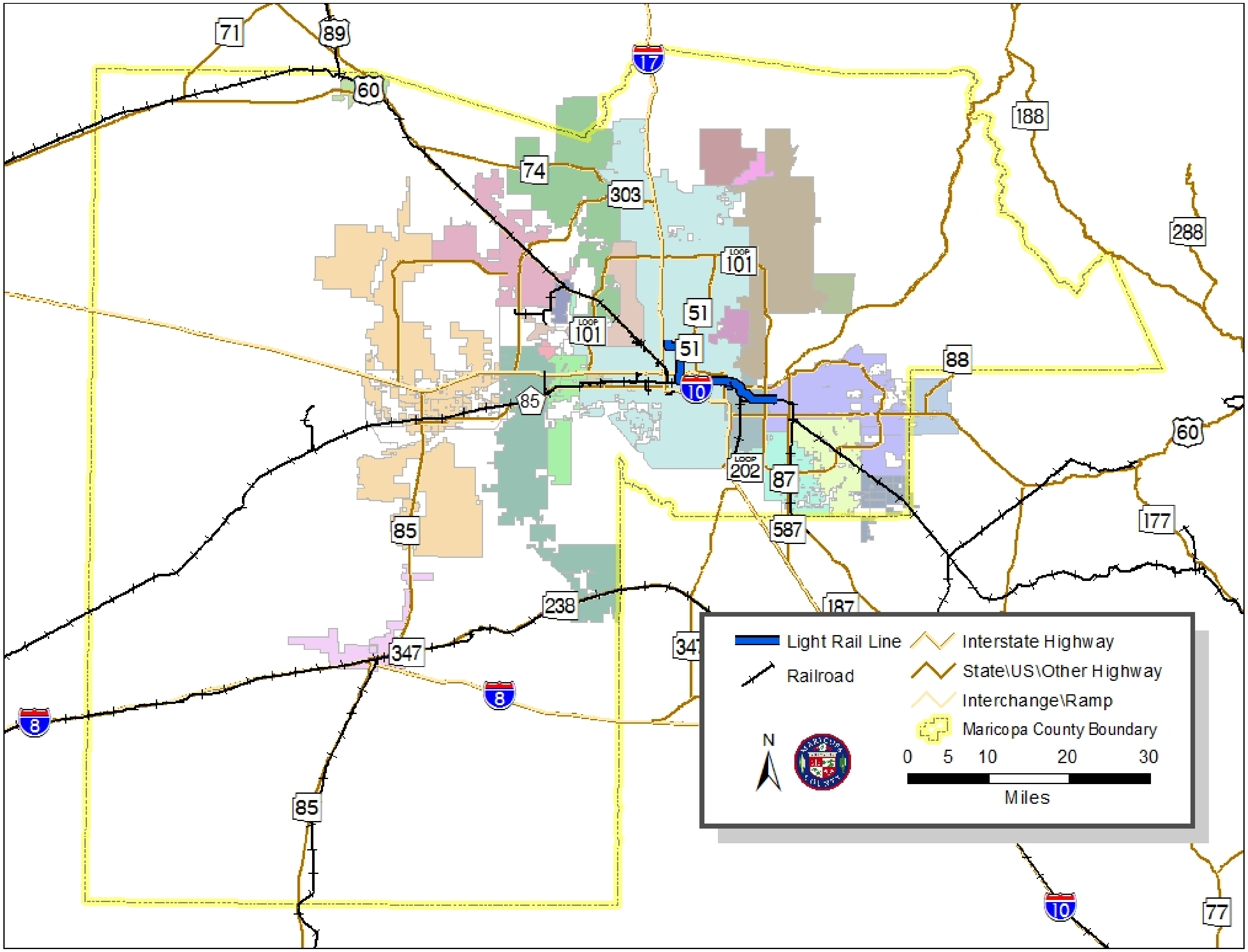
Map CD-15: Maricopa County Over 65 Population



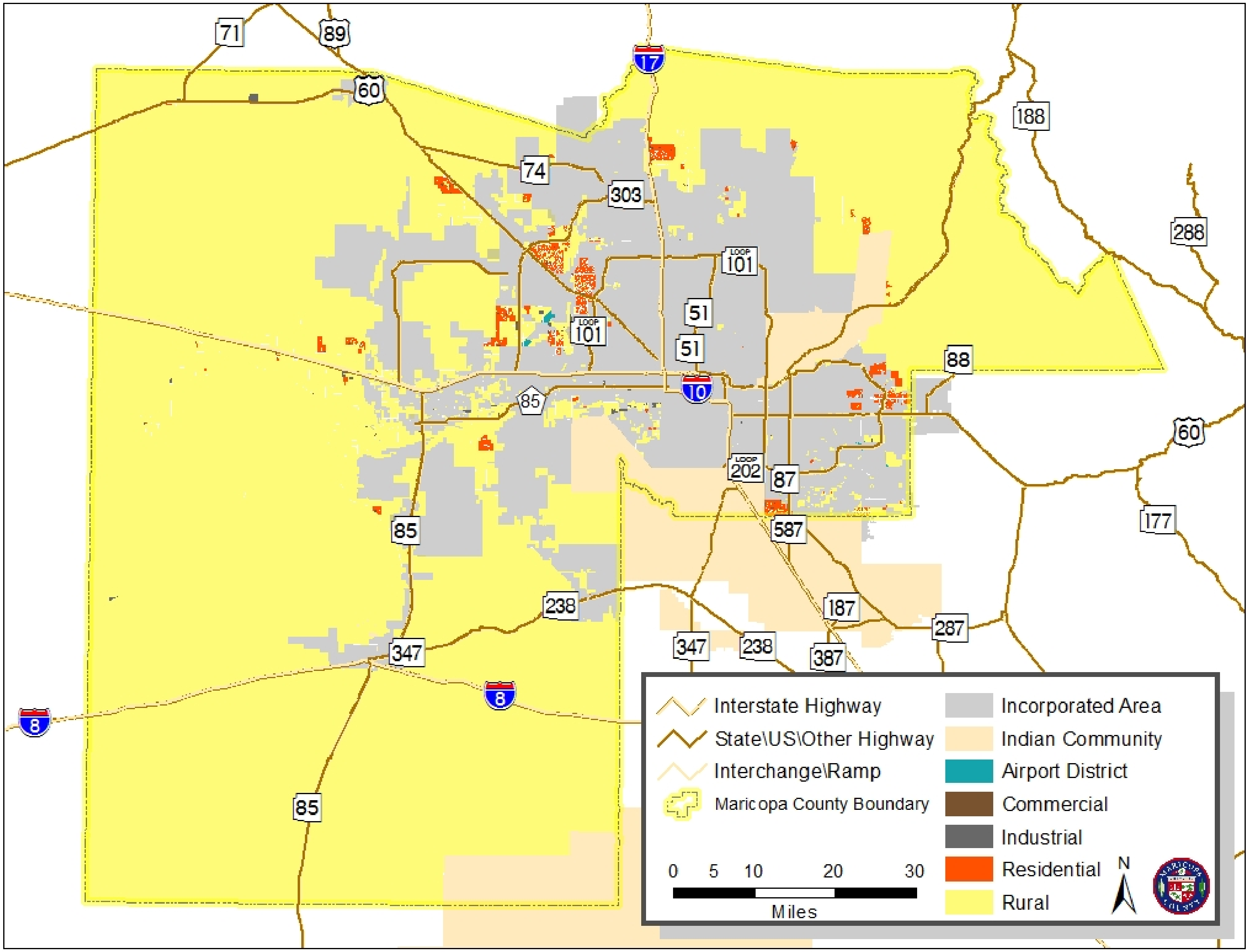
Map CD-16: Maricopa County Light Rail



Map CD-17: Maricopa County Light Rail Lines



Map CD-18: Maricopa County Zoning



Mohave County

History / Geography

Mohave County is located in northwest corner of Arizona and shares a border with California and Nevada along the Colorado River to the west, and Utah to the north. Its southern border is the Bill Williams River and La Paz County, with Coconino County and Yavapai County sharing the boundary to the east. Mohave County is the second largest county in Arizona, covering 13,479 square miles and is also a great water sports center with over 186 square miles of water and 1,000 miles of shoreline.

Mohave County is bisected in the northern portion by the Grand Canyon and varies in elevation ranging from 500 at the Colorado River to 8,000 feet atop Hualapai Peak. The topography varies from flat desert ranges in the eastern portion of the county to rolling, mountainous terrain and deep canyons of the western and northern areas.

Mohave County lies entirely within the Upper and Lower Colorado River Basins. The Upper Colorado River Basin includes the Grand Canyon and Lake Mead. Mountain ranges include the Virgin, Black, and Cerbat ranges. The lower basin includes Lakes Mead and Havasu on the Colorado River and Lake Alamo on the Bill Williams River, a tributary to the Colorado. The lower basin also includes the Hualapai, Peacock, Cottonwood, Aquarius, Bill Williams, Mohave, McCracken, Rawhide, and Artillery Mountains.

Geology / Climate

The climate across Mohave County differs significantly due to its varied terrain and geography. Temperatures within Mohave County range from below freezing during the winter months to over 112°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the county. For instance, temperature extremes at Kingman are more moderate than those for the Bullhead City area on the Colorado River.

Precipitation throughout Mohave County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges.

Estimated Population

Population Estimates for Mohave County				
Jurisdiction	**1990**	**2000**	**2010**	**2012**
Mohave County	93,497	155,032	200,186	203,334
Bullhead City	21,951	33,769	39,540	39,571
Colorado City	2,426	3,334	4,821	N/A
Kingman	13,208	20,069	28,068	28,336
Lake Havasu City	24,363	41,938	52,532	52,819
Hualapai Indian Tribe	822	1,353	1335	N/A
Fort Mojave Indian Tribe	454	773	N/A	N/A
Kaibab Paiute Indian Tribe	165	196	240	N/A

Economy

The County's major industries are retail, health care, social assistance and construction. The large population centers can attribute much of the growth to tourism and recreational activities along the Colorado River and lakes, the seasonal and full-time migration of retirees, and the rapid growth of the employment opportunities in the gaming industry of Laughlin and Las Vegas, Nevada. The primary employment sectors are trade, transportation, utilities, government, education and health services. Several mines are in operation or being planned.

In 2012, the total labor force for Mohave County was estimated to average 85,127 with an unemployment rate of 9.9%.

For the unincorporated areas of the county, the Mohave County General Plan recognized high rates of growth in the South Mohave Valley, Golden Valley and areas surrounding Bullhead City, Kingman and Lake Havasu City prior to the economic downturn. Over 85% of the land in the County is owned by federal and state governments. Because of the vast size of the County, the public lands do not normally restrict or constrain growth, except where alternating sections of public ownership increases cost of development. The availability or access to water and sewer is the primary restraint of growth.

Government

Mohave County has a five member Board of Supervisors and a County Administrator. City councils with mayors govern the four incorporated cities, and tribal councils govern the three tribal reservations.

Land Use / Ownership

Land ownership within Mohave County is divided between Bureau of Land Management (57.6%), National Parks (13.0%), Private (12.0%), Indian Reservations, (8.3%); US Forest (4.6%), State of Arizona Trust Lands (4.3%), and other (0.5%).

Emergency Management

OEM

Mohave County Division of Emergency Management (MCEM) provides coordination of emergency planning, training, and exercises among all county jurisdictions and emergency services agencies. The four incorporated cities and the three Indian Tribes have designated emergency managers that interact with MCEM and conduct jurisdictional planning.

EAS

The Emergency Alert System can be activated by the Mohave County Sheriff's Office 911 Center, Bullhead City Police Department Dispatch, or Las Vegas National Weather Service to two commercial radio stations with backup power capability for further transmission to all local stations. An automated phone warning system for the public will be operational in 2013.

EMT/EMS Services

EMT/EMS services are provided by several fire departments and one private company. Several air ambulance companies service the county.

Law Enforcement

Mohave County Sheriff's Office covers the unincorporated areas and Colorado City and coordinates with the Lake Havasu City, Bullhead City, and Kingman Police Departments, as well as the three Tribal Police Depts.

Fire

There are two city fire departments and 14 fire districts in the county. The Hualapai Indian Tribe has a tribal FD, and the Ft. Mojave Indian Tribe contracts fire services from one of the fire districts. There are three fire department Hazmat teams with a significant number of trained Hazmat technicians in other departments.

Disaster Events

From 2005 to 2013, Mohave County received three federal and one state disaster declarations for major flooding events. Most damage occurred in the three events that impacted the unincorporated Beaver Dam / Littlefield communities in northwest Mohave, including the loss of 16 houses in 2005. Smaller flash flooding events occur in most years but usually result in temporary road closures with little infrastructure damage.

Major wind damage, primarily from microbursts, has caused occasional but significant damage to homes, trailers, and utility lines in the Golden Shores, Mohave Valley, Ft. Mohave, and Bullhead City areas. Occasional Water and electric outages during the summer have caused concerns for heat related illnesses but are usually too short-term to cause major problems.

The most well known historical disaster is the 1973 tank car BLEVE in Kingman that killed 11 firefighters and one civilian. This emphasizes the potential dangers of the large amounts of hazardous materials currently transiting the county on I-40, US 93, and the BNSF Railroad. There are a number of fixed facilities with hazardous materials, including two power plants and a chemical plant, and a significant amount of Hazmat training and planning occurs among all stakeholders.

A major Colorado River flood occurred in the Mohave Valley area in 1983 due to release of water from Davis and Hoover Dams. As of 2013, Lake Mohave and Lake Mead levels are very low, and several years of abundant snowfall in the Rockies will be needed before levels approach the ones that necessitated the 1983 releases. Planning efforts with the Bureau of Reclamation for warning and response to uncontrolled releases from either dam are ongoing, and emergency evacuation plans for individual jurisdictions are in place.

Wildfires are a significant danger to the county, particularly in the Hualapai Mountains where a 2002 fire nearly caused the evacuation of the Pine Lake community and Hualapai Mountain Park.

Transportation

Roadways: Interstate Highways 40 and 15, US Highway 93 and State Routes 95, 66, 68 and 389. I-40 crosses into California alongside the BNSF and several gas pipelines at Topock. I-15 traverses a potential bottleneck over several bridges in the Virgin River Gorge in northwest Mohave County. US 93 is the most direct highway route between Las Vegas and Phoenix. Large numbers of tourist buses utilize US 93 from Hoover Dam to Dolan Springs and then Pierce Ferry and Diamond Bar county roads to reach the Grand Canyon West Resort and the Skywalk.

Railways: Burlington Northern Santa Fe Railroad transits the county through Peach Springs on the Hualapai Reservation and Kingman, paralleling Route 66 or I-40 for long stretches. Traffic comprises about 60 trains a day with considerable hazardous material. Amtrak trains also transit the county with a stop in Kingman; a major Amtrak derailment with numerous minor injuries but no fatalities occurred near Kingman in 1997.

Airports/Air Service: There are large but relatively low traffic airports at Kingman, Bullhead City, and Lake Havasu City, and small airports in the Mohave Valley and White Hills area. Commuter flights service the Kingman airport, and large charter airliners, with a potential for regularly scheduled service, utilize the Laughlin/Bullhead City Airport to serve the Laughlin tourist trade. The Grand Canyon West Resort on the Hualapai Indian Tribe Reservation has a fixed wing and helicopter airport with considerable tourist flight traffic.

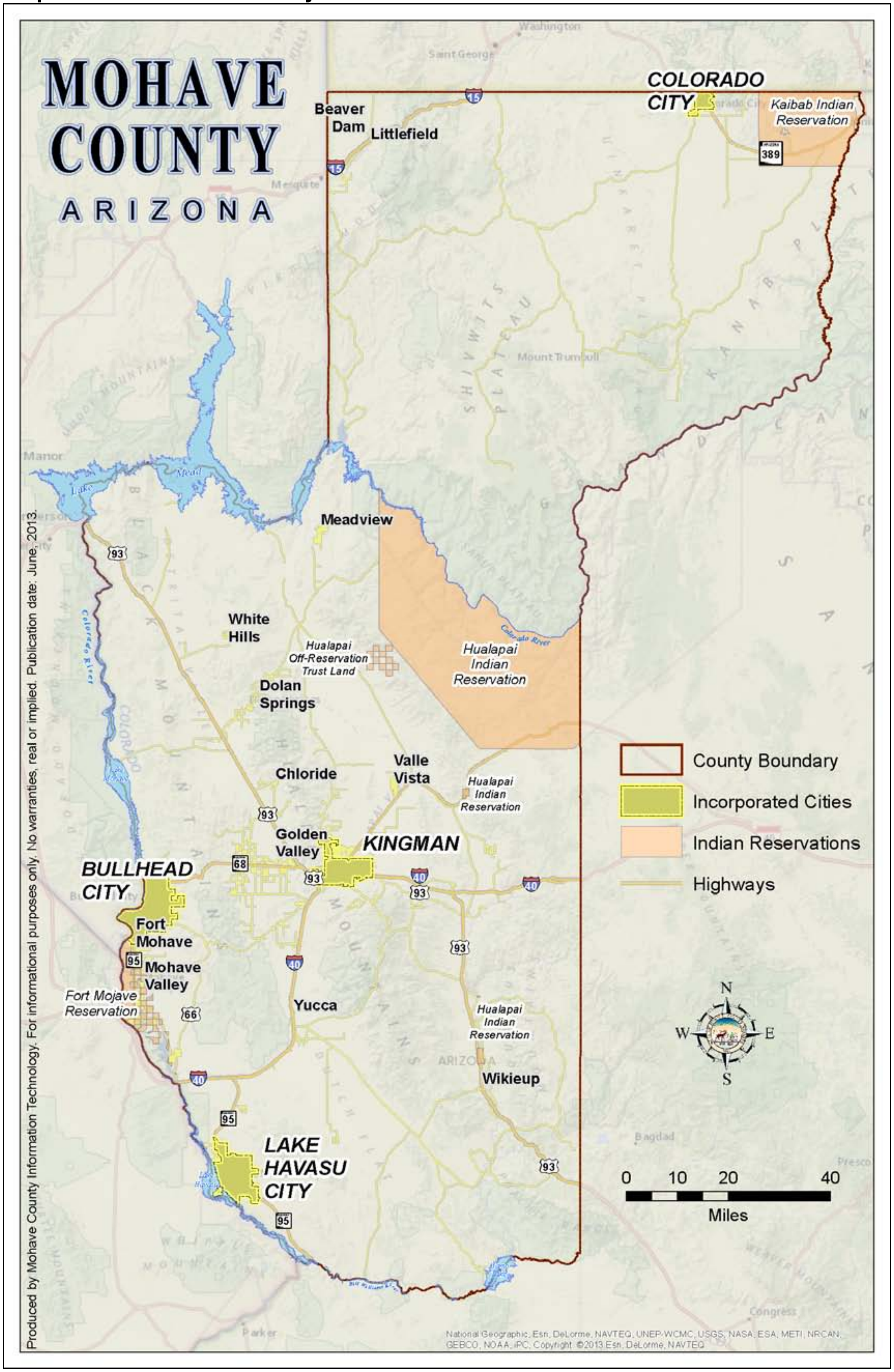
Utilities

Electric: Unisource Electric, Mohave Electric Cooperative, Aha Macav Power

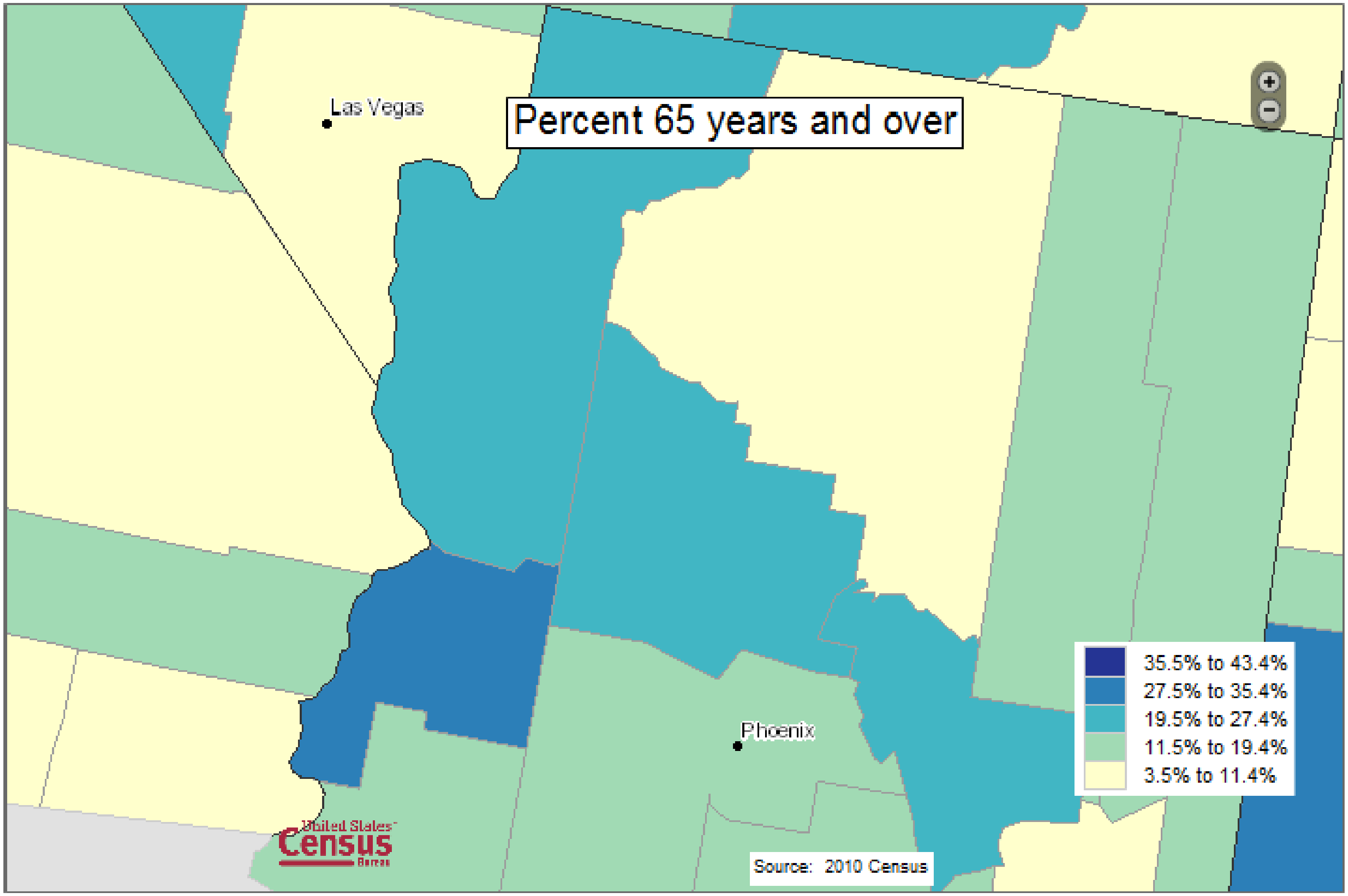
Gas: Unisource Gas, Southwest Gas

Water/Sewer: The four incorporated cities and the three tribes maintain services for their jurisdictions; in addition there are two county operated water districts. There are numerous private water companies that service rural areas of the county, primarily north and west of Kingman and in the areas south of Bullhead City.

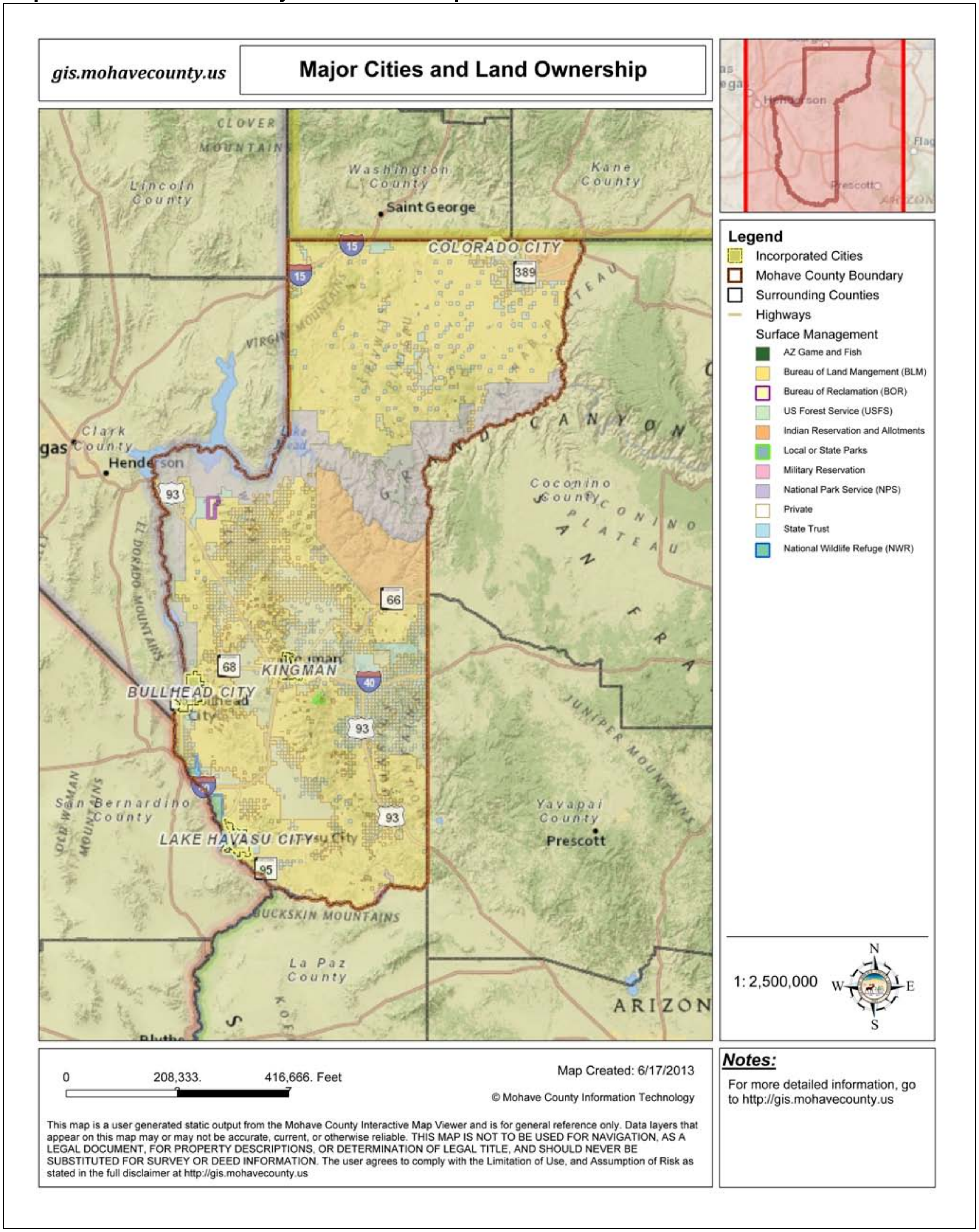
Map CD-19: Mohave County



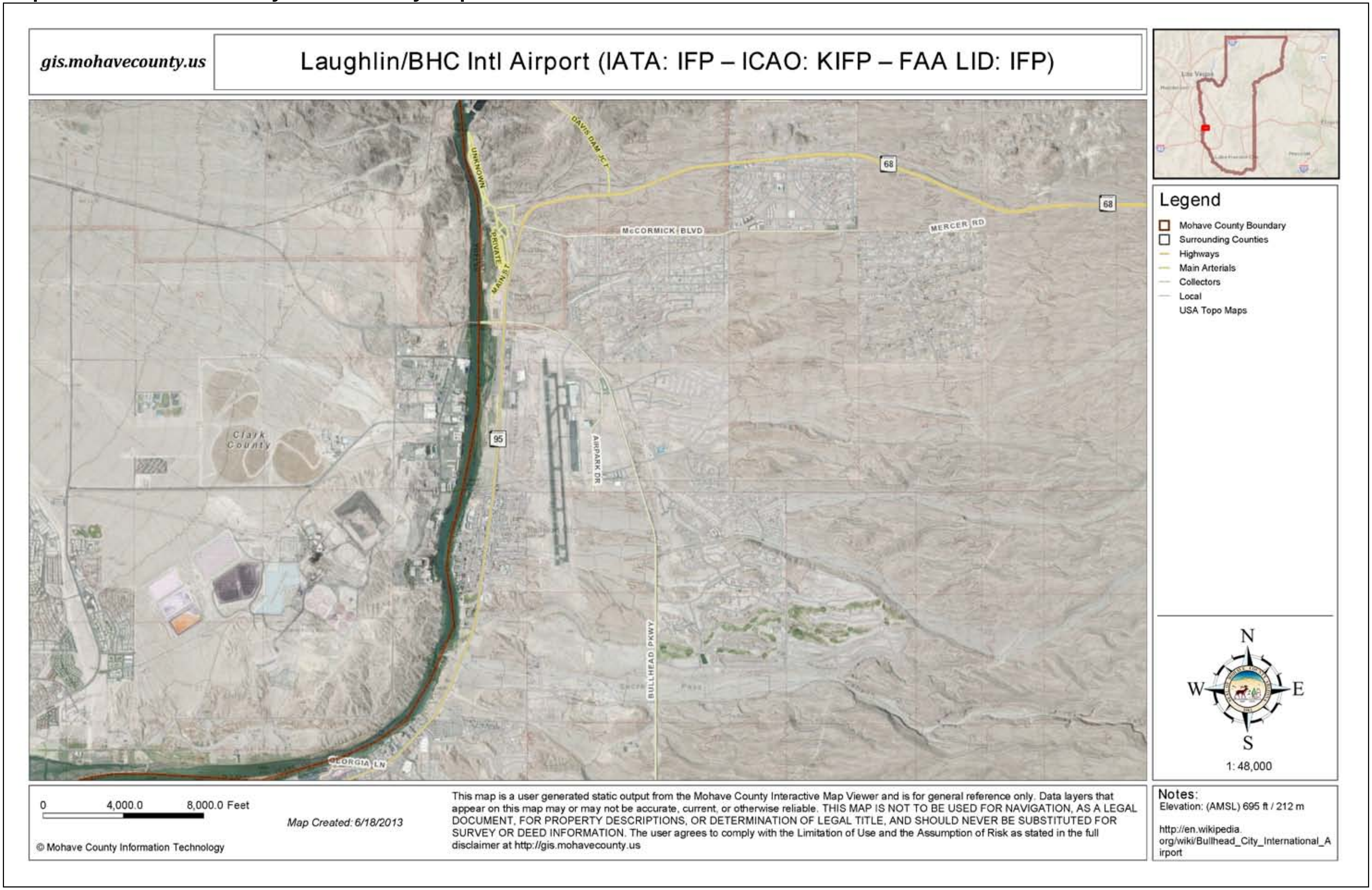
Map CD-20: Mohave County Over 65 Population



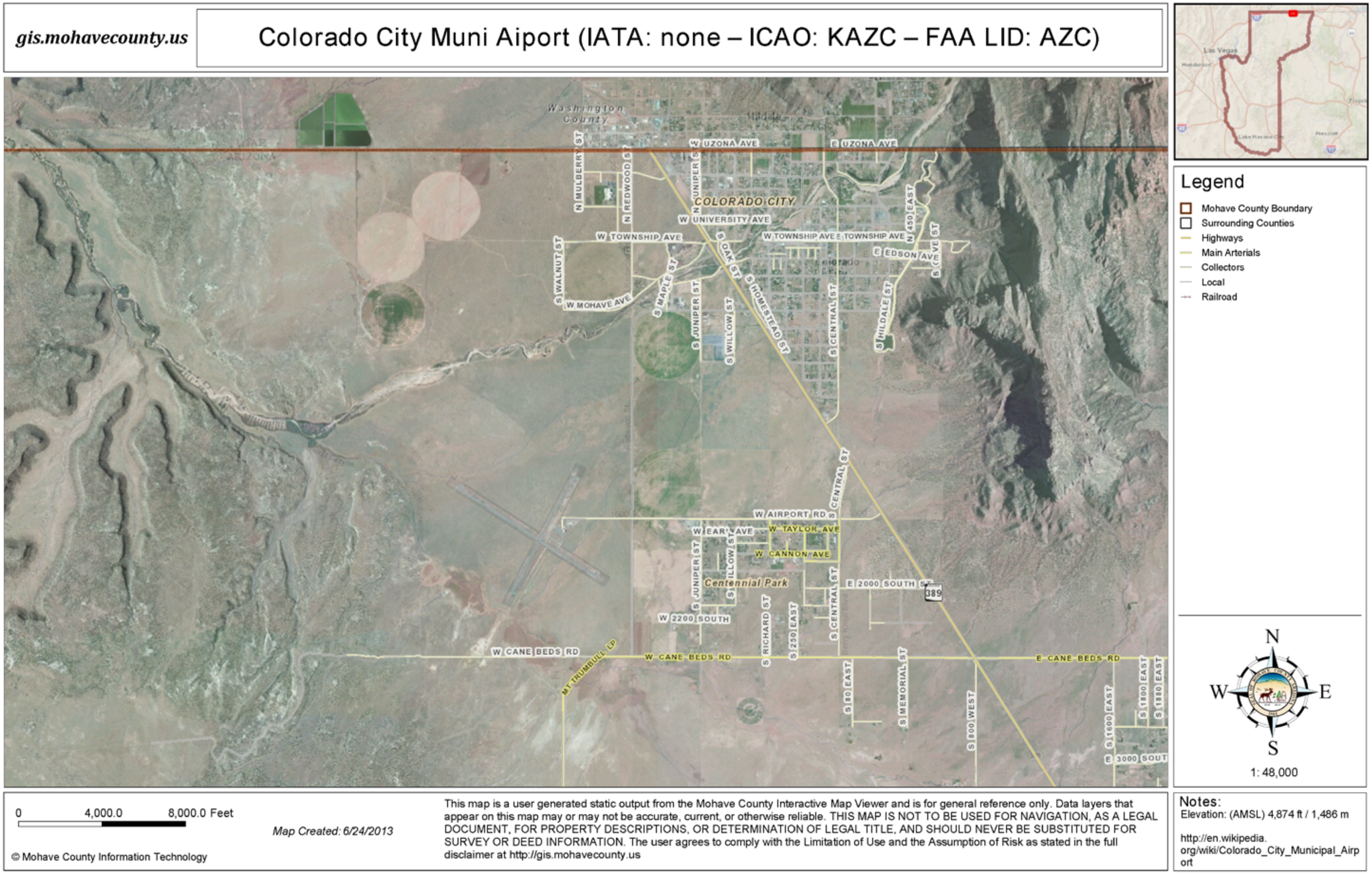
Map CD-21: Mohave County Land Ownership



Map CD-22: Mohave County/Bullhead City Airport



Map CD-23: Mohave County/Colorado City Airport



Map CD-24: Mohave County/Kingman Airport

Navajo County

History / Geography

According to the Arizona Department of Commerce, Navajo County was formed on March 21, 1895, as the final act of the Territorial Assembly before it adjourned at midnight. What is now Navajo County was first included in Yavapai County, but in 1879, the area was added to the newly formed Apache County. Today, Navajo County covers 9,959 square miles, 55% of which is Indian reservation land. The county seat is Holbrook. Navajo County is located in the northeastern portion of the State.

Navajo County is divided into two distinct parts by the Mogollon Rim. The high country in the northern part of the county is considered Colorado Plateau Shrublands and is characterized by arid, desert-like conditions with mesas and plateaus. The southern part is considered Arizona Mountain Forests and is characterized by rugged mountain area, heavily wooded with pinon, juniper and ponderosa pine.

The geographical characteristics of Navajo County have been mapped into two terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 6,000 to 7,100 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely heavily wooded with pinon, juniper and ponderosa pine forests, high altitude grasses, shrubs, and brush.
- **Colorado Plateau Shrublands** – this ecoregion covers the northern portion of the county and makes up the majority of the County with elevations that average around 5,000 to 7,500 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cold winters. The high country in the northern part of the County is arid and desert-like with mesas and plateaus.

Geology / Climate

The majority of Navajo County can be classified as Colorado Plateau Shrubland and Arizona Mountain Forest. The elevation range for these two ecoregions in Navajo County is from approximately 5,000 to 7,500 feet. Average temperatures within Navajo County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the county.

Precipitation throughout the County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

Navajo County is home to 123,172 residents, with the majority of the population living on the reservations and incorporated communities of Navajo County. The largest community is the City of Show Low. Geographically, the majority of the incorporated cities and towns are located in the southern portion of the county below the Navajo Reservation. Kayenta is also incorporated and in the northern section on the Navajo Reservation.

There are a total of 46 unincorporated communities scattered across the county, with many being comprised of only one structure or a prominent landmark. The majority of these unincorporated communities is also located on the Indian Reservations and will be addressed in the Reservation mitigation plans.

Population Estimates for Navajo County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Navajo County (total)	77,700	95,300	107,449	135,671	147,045
Holbrook	4,685	5,705	5,053	6,468	6,929
Pinetop-Lakeside	2,425	3,625	4,282	5,362	5,891
Show Low	5,030	8,575	10,660	14,380	16,370
Snowflake	3,680	4,850	5,590	5,910	6,342
Taylor	2,420	2,990	4,112	5,996	6,342
Winslow	8,205	11,395	9,655	10,482	10,768
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html, http://www.workforce.az.gov/census-data.aspx and http://www.azcommerce.com/econinfo/demographics/Population+Projections.html					

Economy

Navajo County was formed on March 21, 1895, as the final act of the Territorial Assembly before it adjourned at midnight, with the County Seat established in Holbrook. By the time it became Navajo County, the area was developed. The railroad had crossed the county for more than a decade, and North America's third largest ranch, the Aztec Land and Cattle Company near Holbrook, had been established. Backed by Easterners, Aztec bought 1 million acres of land from the railroad at 50 cents an acre. The company, known as the Hashknife Outfit because of its brand, brought 33,000 longhorn cattle and 2,200 horses into northern Arizona from Texas. Holbrook, the county seat, was founded in 1871.

Navajo County is unique in that there are three Native American Tribes. The Navajo and Hopi reservations comprise the northern half of Navajo County. Kayenta, founded in 1909 as a trading post, is now the gateway to the Navajo Tribal Park at Monument Valley and a thriving Navajo community. Members of the Hopi Indian Reservation, which is completely surrounded by the Navajo Reservation, depend upon cattle and sheep production and tourism. The Hopi pueblo of Oraibi is one of the oldest continuously inhabited settlements in the United States. The third tribe in Navajo County is the White Mountain Apache Tribe in the southern portion. The White Mountain Apache reservation is home to the Sunrise Ski Resort with year round outdoor activities.

The Interstate 40 corridor communities of Holbrook and Winslow in the county's center are areas of growth tied to the cross-country transportation route. In addition to transportation and ranching, tourism plays a key role with Holbrook as the gateway to the Petrified Forest National Park and Winslow's "Standin' on the corner" notoriety from the famous Eagles' song.

The county's southern portion is characterized by dynamic growth related to tourism and an increased demand for housing. Major communities in the south are Pinetop-Lakeside, Show Low, Snowflake, and Taylor. Both central and southern portions of the county have relatively low unemployment.

Land Use / Ownership

Within Navajo County, the US Forest Service, US Bureau of Land Management, and State Land combined, constitute nearly 15% of land ownership. Fifty-five percent of the County is comprised of Indian Reservation Land. The remaining 30% is individually or corporately owned.

Emergency Management

OEM - Navajo County Emergency Management works in conjunction with all of our partners throughout the county to mitigate, respond to and recover from all forms of disasters.

Law Enforcement - There are six law enforcement agencies within Navajo County not including state and federal resources. The local law enforcement includes: Winslow Police Department, Holbrook Police Department, Snowflake-Taylor Police Department, Show Low Police Department, Pinetop-Lakeside Police Department and Navajo County Sheriff's Office.

Fire/EMT - Fire departments include both volunteer and full time departments throughout the county. Many of the fire departments also cover the EMT services in their respective areas.

EMS - While there are a few independent Emergency Medical Service companies many departments have their own ambulance services.

Disaster Events

There have been several disasters in Navajo County through the years. Memorably, the Rodeo-Chedeski wildfire in 2002, which is now classified as the 2nd largest fire in Arizona State history. Additionally there have been several floods through the years from the Little Colorado River in Winslow and Silver Creek in Taylor.

Transportation

Roadways: Major roadway transportation routes through the county include Interstate 40, U.S. Highways 60, 160, and 163, State Routes 73, 77, 87, 99, 260, 264, 277, 377, and 564, and Indian Routes 6 and 15.

Railways: Railways include the Burlington Northern Santa Fe Railway, Apache Railway and AMTRAK.

Airports/Air Service: There are several small airports throughout Navajo County in Holbrook, Taylor, and Show Low as well as private airfields in the Heber-Overgaard (Aripine) areas.

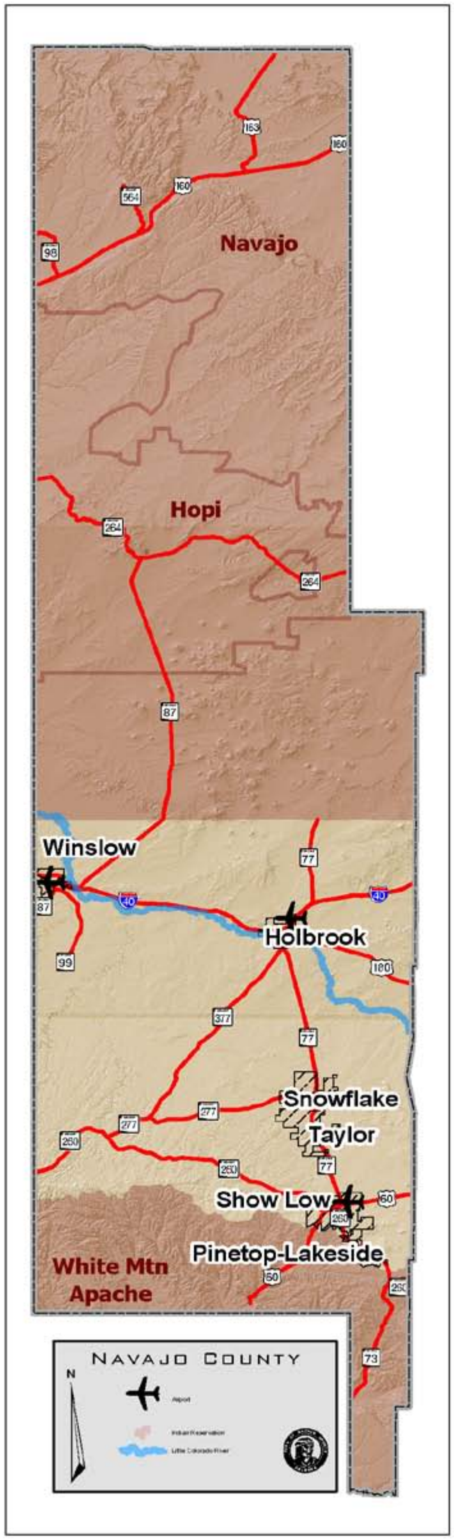
Utilities

Electric: Arizona Public Service and Navopache Electric Coop

Gas: UniSource and El Paso Natural Gas

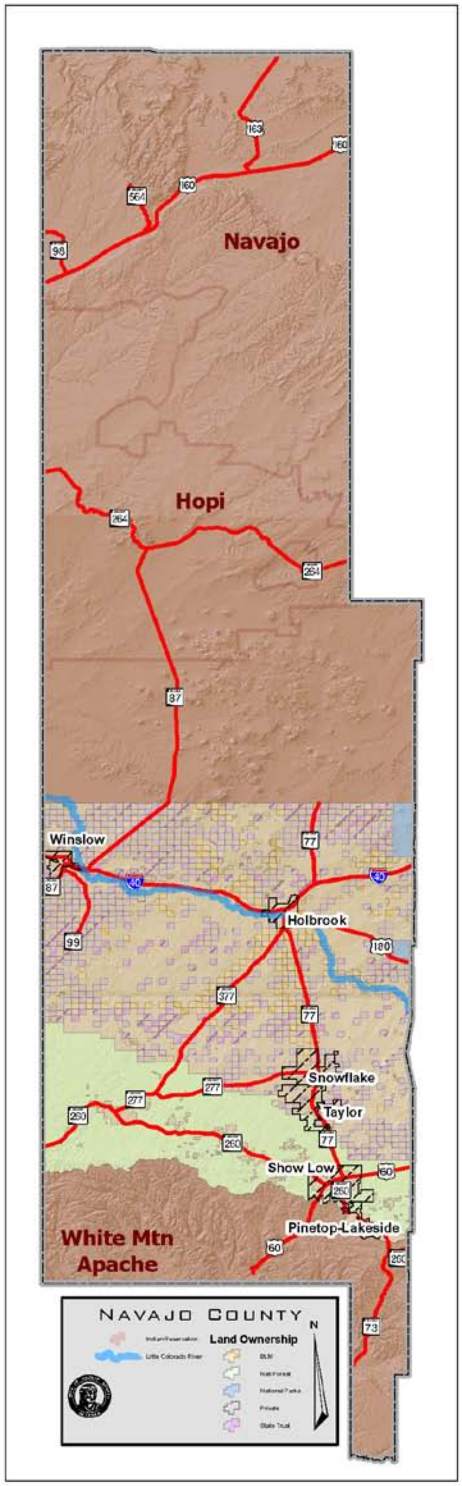
Water/Sewer: City or wells

Map CD-25: Navajo County



Map CD-26: Navajo County Over 65 Population

Map CD-27: Navajo County Land Ownership



Pima County

Geography

Pima County is located in southern Arizona and encompasses 9,184 square miles which is roughly the geographical equivalent of Rhode Island and Connecticut combined. Pima County shares approximately 120 miles of international border with Mexico. A large portion of the border is in central Pima County on the Tohono O'odham Nation.

Geology / Climate

Pima County is located in the south-central portion of the State of Arizona. Varying in elevation from desert valleys at roughly 1,200 feet to the 9,185-foot peak of Mount Lemmon, the county is home to diverse plant and animal communities. Numerous mountain ranges ring the Tucson basin, including the Santa Catalina, Rincon, Empire, Santa Rita, Sierrita, and Tucson mountains.

For the majority of Pima County, the climate is typical to the Sonoran Desert areas of the state and is characterized by abundant sunshine, a long summer, mild winter, low average annual precipitation, relatively low humidity, and generally light winds. In the relatively small areas of the county above 4,000 feet mean sea level, the climate tends to be more moderate.

Average temperatures within Pima County range from near freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the county.

Precipitation throughout Pima County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Average wind speeds are similar across Arizona, averaging approximately 6 to 9 mph annually. Pima County generally experiences average wind speeds at approximately 8 mph. However, significant variations can exist throughout the year, as evidenced by Tucson's statewide record of 71 mph maximum-recorded wind gust. The surrounding mountains and topography of the region influence wind velocities and directions in the Tucson basin.

Population

According to the 2010 Census, 980,263 residents now call Pima County home, which reflects a growth of 16% since the 2000 Census. The majority of the citizens still live in the incorporated communities or reservation portion of Pima County. The largest community is Tucson. The two incorporated cities and three towns are geographically located in eastern portion of Pima County. The other unincorporated communities and places located throughout the county are usually situated along a major highway and are mostly comprised of only one structure or landmark. Davis-Monthan Air Force Base currently has approximately 6,000 military personnel stationed on base and employs 1,700 civilian persons.

Population Estimates for Pima County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Pima County	666,880	843,746	980,263	1,175,967	1,271,912
Marana	2,187	13,566	34,961	60,809	72,915
Oro Valley	6,670	29,700	41,011	50,222	54,134
Pascua Yaqui Tribe	2,412	3,315	3,745	-	-
Sahuarita	1,629	3,242	25,259	57,367	71,479
South Tucson	5,093	5,490	5,652	5,761	5,743
Tohono O'odham Nation	2,750	2,799	9,051	-	-
Tucson	405,390	486,699	520,116	597,568	624,671
Unincorporated County	247,540	305,049	340,468	404,240	442,969
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html http://www.workforce.az.gov/?PAGEID=67&SUBID=255 & http://www.workforce.az.gov/?PAGEID=67&SUBID=257					

Economy

The metropolitan Tucson area, located in the eastern portion of Pima County, is the center of economic activity for the County. As of August 2011, the county-wide labor force was estimated at 484,311 with an unemployment rate of 8.4%.

Government

The governmental and administrative affairs of the unincorporated areas of Pima County are directed by a five-member Board of Supervisors with each member elected from a designated district to serve a four-year term. The chairperson is selected by the Board from among its members. Other elected officials, often referred to as constitutional officers, are the Assessor, Clerk of the Superior Court, the Constables, County Attorney, Recorder, School Superintendent, Sheriff and Treasurer. Presiding judges are appointed from elected members of the judicial bench.

Because of Arizona's constitutional provisions and the requirements promulgated by Arizona Revised Statutes, the government of Pima County is organized to have a direct and indirect relationship with the Board of Supervisors. These broad functions include the County's internal governmental administrative/management activities; maintenance and construction of the County's sewerage and sanitation infrastructures; County streets, roads, and bridges which comprise the County's transportation infrastructure; natural resources, parks, community centers, recreational facilities and libraries (in cooperation with the city of Tucson); and numerous clinics. Indirect relationships are maintained with the elected officials. The Board of Supervisors appoints a County Administrator to be responsible for the general direction, supervision, administration, and coordination of all affairs of the county.

Each of the five municipalities in the county (Marana, Oro Valley, Sahuarita, South Tucson, and Tucson) are governed by council-manager form of government, with an elected Council consisting of seven members, including a mayor and vice mayor and an appointed town or city manager. The Tohono O'odham Tribe and Pascua-Yaqui Tribe are governed by elected tribal councils.

Emergency Management

PCOEMHS

The Pima County Office of Emergency Management and Homeland Security (PCOEMHS) is responsible for the planning, coordination, and implementation of emergency management related activities for Pima County. The Mission of the PCOEMHS is to lessen the loss of life and reduce injuries and property damage during natural or man-made incidents through prevention, protection, mitigation, response, and recovery actions taken in accordance with the National Preparedness Goal and the Pima County Emergency Operations Plan.

PCOEMHS also coordinates the activities for the County's Emergency Operations Center (EOC). The EOC, when activated is a central location where representatives of local government and private sector agencies convene during disaster situations to make decisions, set priorities and coordinate resources for response and recovery.

EAS

Emergency Alert System (EAS) advisories for Pima County are prepared and released through the National Weather Service (NWS) or PCOEMHS. Emergency public advisories and messaging are coordinated through Joint Information Systems and Joint Information Centers to cover major broadcast and print media. Other means of informing the public of emergencies include: Commercial Mobile Alert System (CMAS), Integrated Public Alert and Warning System (IPAWS), and Social media, such as, Twitter and Facebook. In order to reach people with Functional Needs, the use of closed captioning and sign-language is encouraged during news broadcasts and during any official media briefings

Law Enforcement

Pima County law enforcement services are provided by jurisdictional law enforcement agencies at the municipal, tribal, county, state and federal levels. There are also private-sector law enforcement agencies protecting the airport and railroads. Law enforcement provides routine patrol, traffic enforcement/control, response to emergencies and search and rescue. Special law enforcement responses to hostage situations, unusual acts of violence, civil unrest, riot, demonstrations and other unusual situations are handled by Special Weapons and Tactics (SWAT) Teams and K-9 Units. LE air assets are used to provide video downlinks and aerial surveillance of disaster conditions.

Fire

Fire suppression and prevention agencies in Pima County include governmental fire departments and fire districts, as well as, a private-sector fire department for those areas of Pima County not covered by another fire agency. Fire suppression capabilities include both structural and wildland fires. Fire departments/districts are supported by a regional Pima County Fire Chiefs Association which increases collaboration, cooperation and communication between involved agencies. There are several Volunteer Fire Agencies which are composed of a mixture of paid and volunteer fire fighter positions.

EMS

Emergency Medical Services (EMS)are provided by several jurisdictional fire departments, fire districts and private-sector providers. Local fire agencies and ambulance companies provide Emergency Medical Technicians (EMTs) on their response teams.

Disaster Events

Within the past 10 years, Pima County has experienced flooding, forest fire, wildland fire, severe thunderstorms, blowing dust, high winds, and winter freezes. There have been several releases and spills of hazardous materials due to improper handling and transportation accidents involving motor vehicles and rail cars. In January 2011, a high profile, mass shooting incident took place in

Pima County where a US Congresswoman was critically injured and 6 others died, including a Federal Judge; many others were wounded and injured.

Transportation

Roadways: Several major roadways support both local and interstate transportation needs. Interstate 10 provides connectivity between the Phoenix metropolitan area and Tucson. On a larger scale, I-10 also connects California and Florida bringing transnational traffic through Pima County. Interstate 19 connects Tucson with Mexico to the south bringing in international traffic into Pima County. Several other State and US highways, provide local and regional access throughout southern Arizona.

Airports/Air Service: Pima County is host to four municipal airports and a military air force base providing commercial, military, and general aviation service to the region.

Utilities

Electric: Electric utility services in Pima County are provided by private-sector companies:

Tucson Electric Power and TRICO Electric Cooperative

Natural Gas: The primary natural gas supplier in Pima County is Southwest Gas Corporation which is supplied by a Kinder Morgan pipeline.

Propane: Propane is supplied by a number of private-sector companies providing refill and delivery services.

Fuel: Kinder Morgan supplies gasoline, diesel and aviation fuel to Pima County through a cross-country fuel pipeline which is stored at a tank farm on the south-central side of Tucson.

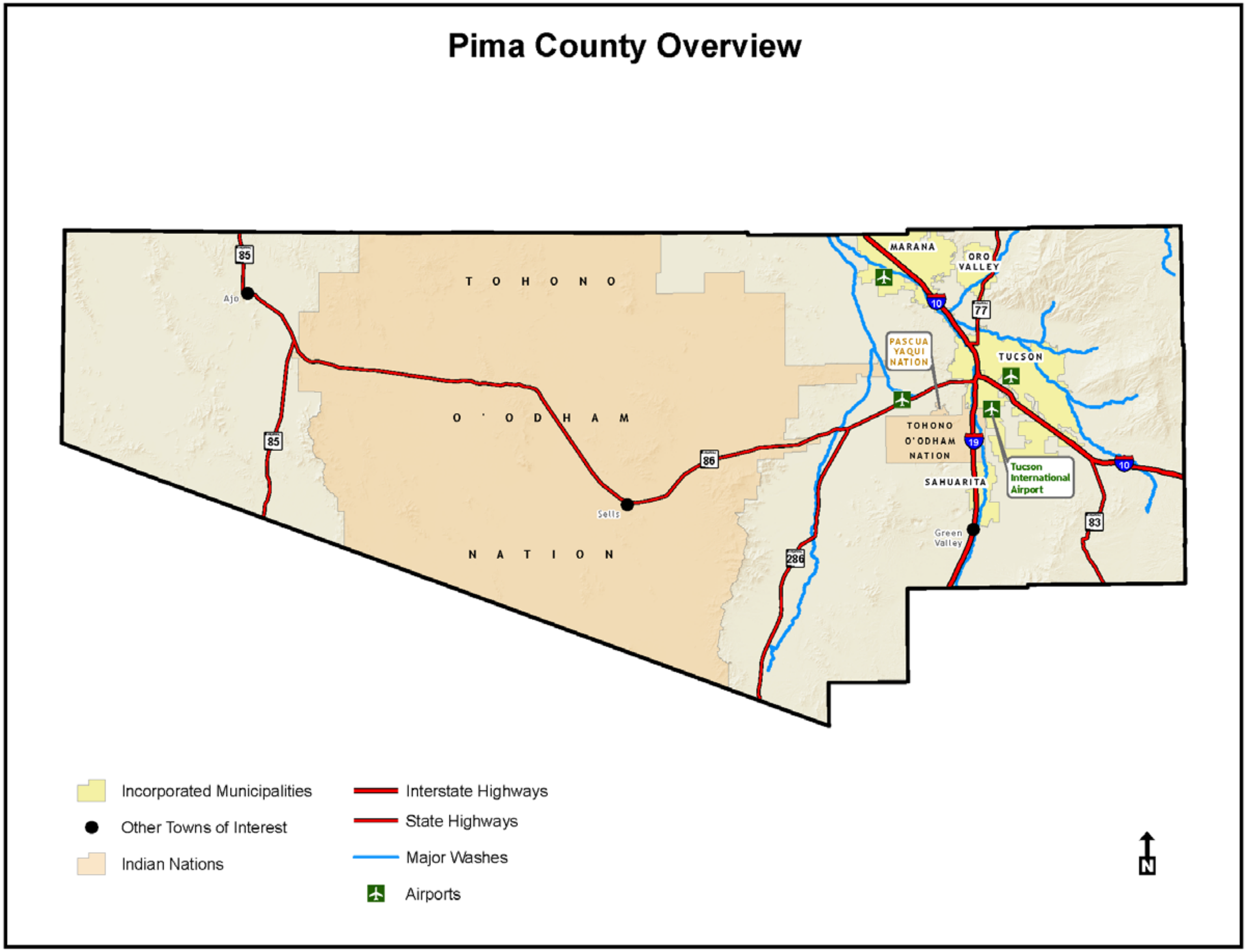
Water: Water utility companies and cooperatives of varying size serve the drinking water needs of Pima County.

Waste Water/Sewer: Pima County Wastewater Reclamation Department (RWRD) provides design, management, and maintenance of the sanitary sewer system, including the conveyance and treatment systems (3,400+ miles of sewer, two metropolitan wastewater treatment plants and eight sub-regional facilities).

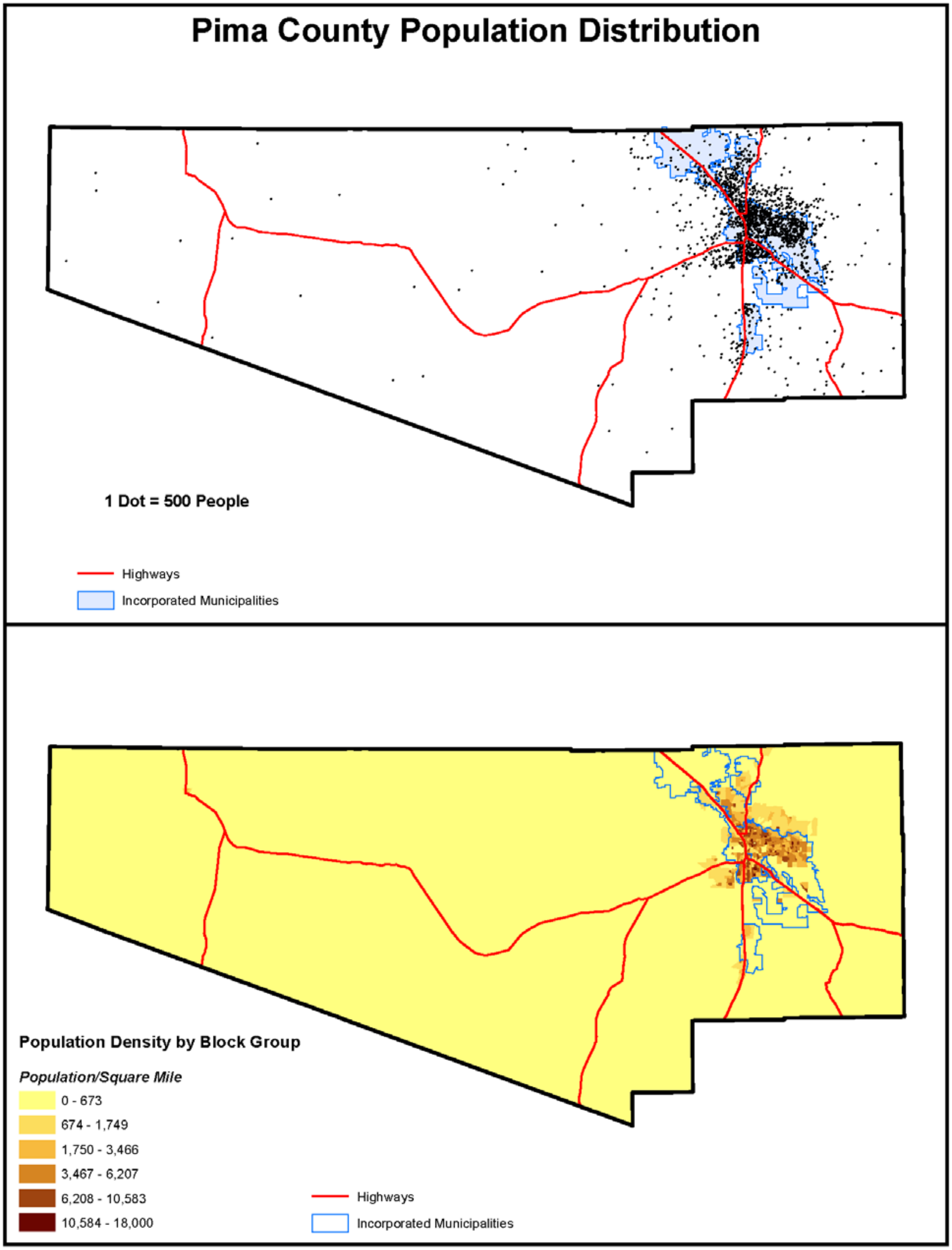
Arizona Water/Wastewater Agency Response Network (AZWARN):

AzWARN is a statewide mutual assistance program between water and wastewater utilities. This network allows utilities in Pima County to help one another in times of emergency when the resources of a utility are overwhelmed. The foundation of the network is a signed mutual aid agreement between all participating utilities. The network provides member utility contact information and resource listings for use in emergencies.

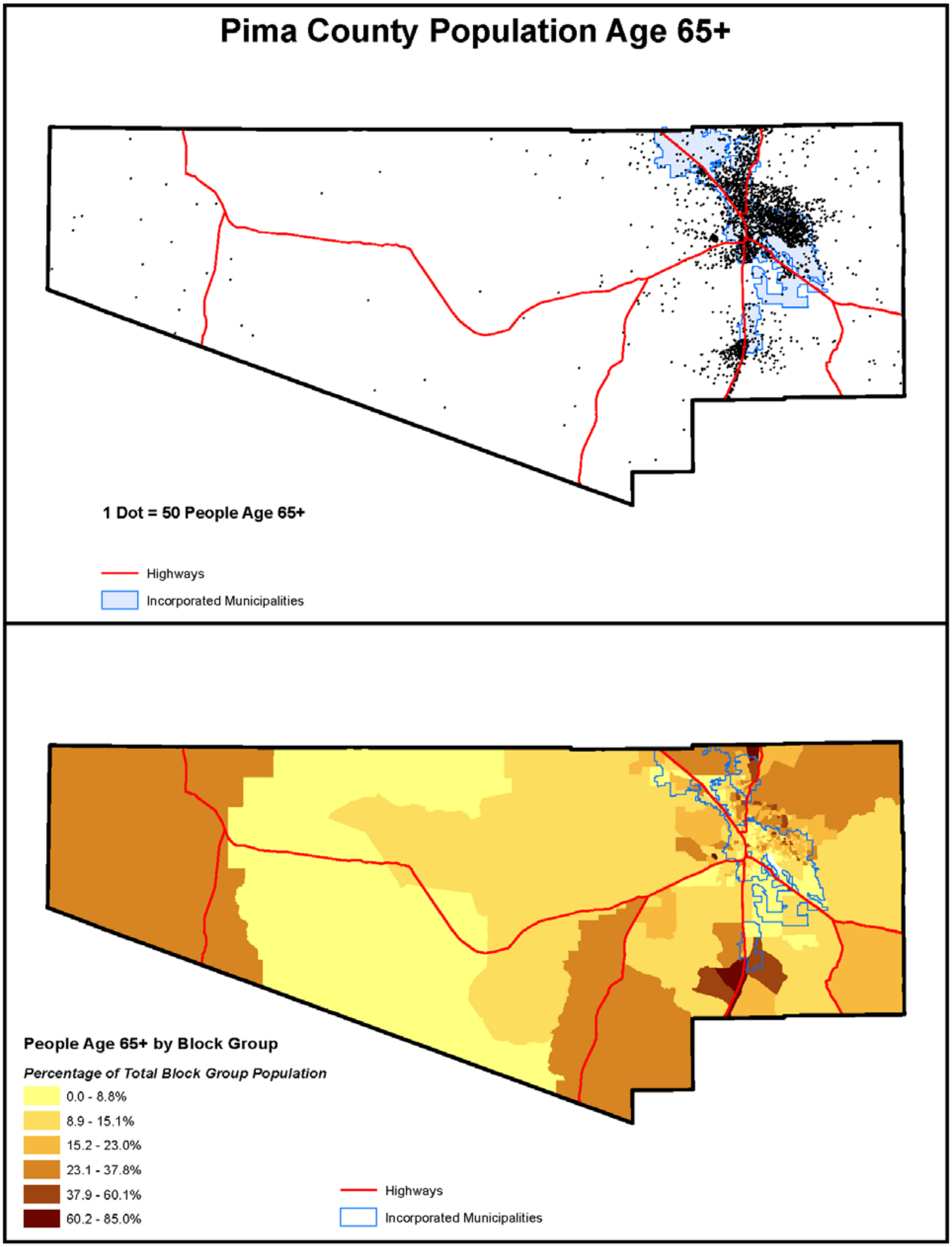
Map CD-28: Pima County



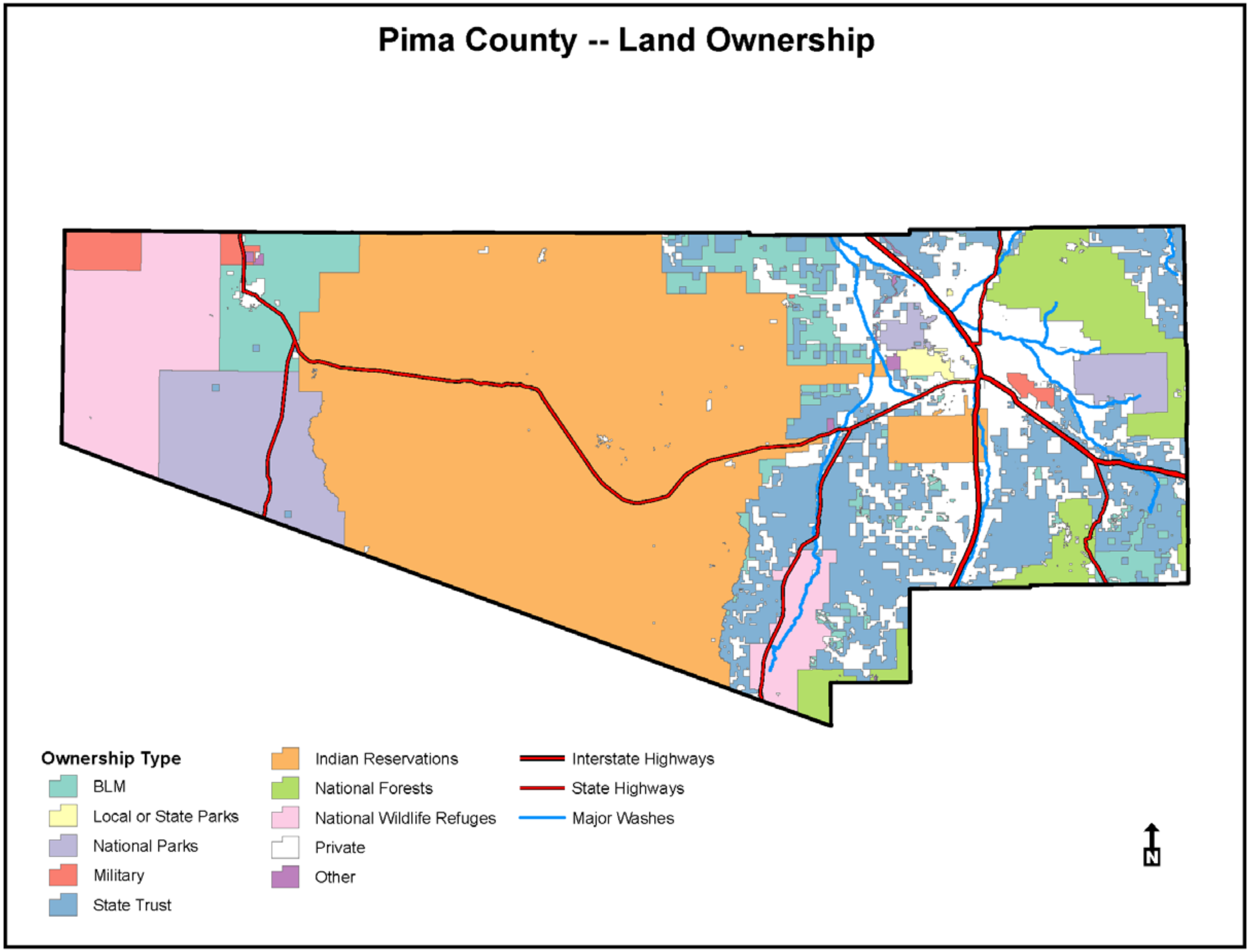
Map CD-29: Pima County Population



Map CD-30: Pima County Over 65 Population



Map CD-31: Pima County Land Ownership



Pinal County

History / Geography

According to the Arizona Department of Commerce, Pinal County was formed in 1875 from parts of Maricopa and Pima Counties by the Eighth Territorial Legislation. Florence, established in 1866, was designated and has remained the county seat to this day. The County's present area of 3,441,920 acres includes part of the Gila River Indian Community, Tohono O'Odham Nation, and San Carlos Apache Tribe, as well as all of the Ak-Chin Indian Community.

Pinal County is located in the south-central portion of the State of Arizona. The County has two distinct regions. The eastern portion is characterized by mountains with elevations to 6,000 feet and copper mining. The western portion is primarily low desert valleys and irrigated agriculture. The terrestrial and environmental uniqueness of Pinal County is due in large measure to the three major and sometimes riparian watercourses associated with the San Pedro, Gila, and Santa Cruz Rivers. These three major waterways help to define the native ecosystem and their association of plant and animal species within the Upper Sonoran Desert Region. These same topographical features have also had a great influence on the settlement of the county. Mountains in the County break up the relatively flat valley floors and include the San Tans, Superstitions, Sierra Estrella, Santa Catalina, Table Top, Palo Verde, Casa Grande, Sacaton, Picacho Peak, Sawtooth, Tortolita, Black, and Samaniego Hills.

The geographical characteristics of Pinal County have been mapped into four terrestrial ecoregions which are described as follows:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely high altitude grasses, shrubs, brush, and conifer forests.
- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevations in this zone vary between 3,000 to 4,500 feet. The average temperatures for the Chihuahuan Desert tend to be cooler than the Sonoran Desert (see below) due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.
- **Sierra Madre Occidental Pine-Oak Forest** – this ecoregion is predominant to mountainous regions in southeast Arizona with elevations generally above 5,000 feet. The average temperatures tend to be cool during the summer and cold in winter.
- **Sonoran Desert** – this ecoregion is an arid environment that covers much of southwestern Arizona. The elevation varies in this zone from approximately sea level to 3,000 feet. Vegetation in this zone is comprised mainly of Sonoran Desert Scrub and is one of the few locations in the world where saguaro cactus can be found. The climate is typically hot and dry during the summer and mild during the winter.

Geology / Climate

For the majority of Pinal County, the climate is typical to the Sonoran Desert areas of the state. In the relatively small areas of the county above 4,000 feet mean sea level, the climate tends to be more moderate. Average temperatures within Pinal County range from near freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the county. For instance, temperature extremes in the foothill communities will generally be about 10°F less than those in the valley communities.

Precipitation throughout Pinal County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

As of July 2012, the total population for Pinal County is estimated at 387,365 residents. The majority of the citizens still live in the incorporated communities or reservation portion of Pinal County. The largest community is Casa Grande. Pinal County encompasses the following communities:

- **Incorporated Pinal County**:
  - City of Apache Junction, City of Coolidge, City of Casa Grande, City of Eloy, City of Maricopa, Town of Florence, Town of Hayden, Town of Kearny, Town of Mammoth, Town of Queen Creek, Town of Superior, Town of Winkleman
- **Unincorporated Pinal County**:
  - Arizona City, Dudleyville, Gold Canyon, Oracle, Queen Valley, San Manuel, San Tan Valley, Sacaton

All incorporated cities and towns are geographically dispersed throughout the County from each other. Some communities and places located throughout the county are usually situated along a major highway and are mostly comprised of only one structure or landmark.

Geography	April 1, 2010		Population Estimate (as of July 1)		
	Census	Estimates Base	2010	2011	2012
Pinal County, Arizona	375,770	375,770	385,812	383,553	387,365

Economy

Several communities throughout Pinal County have been traditionally involved with copper mining, smelting, milling and refining, while others have developed agricultural based-economies. Larger communities such as Apache Junction, Coolidge, Eloy, and especially Casa Grande have developed manufacturing, trade, and services to diversify their economic base.

The growth experienced in Pinal County has been through the expansion of the Phoenix and Tucson corridor near I-10 and I-8, except for the Apache Junction community. Most of the southern ¾ of the County and an area of Apache Junction are designated as Enterprise Zones. The major industries are public administration, retail trade, accommodation and food services.

Over the past nine years, and especially during 2004-2008, citizens have flocked into Pinal County primarily due to the affordability of larger homes-at a lower price-and the rural living. Growth factors such as economic opportunity, a beneficial climate, and an active lifestyle are transforming the region from a primarily agricultural center to a vibrant commercial, industrial, and recreational hub. Growth in the northern areas of Pinal County commonly bordering Maricopa County is based upon the steady expansion of the Phoenix metropolitan areas. This is especially true in the areas around Apache Junction, Maricopa and Queen Creek. Other areas surrounding Coolidge, Casa Grande, and Eloy are also significantly outpacing previously estimated population projections. This rapid growth presents a significant challenge to Pinal County in order to maintain sustained economic prosperity, enhancing the quality of life and safety of county residents.

The current estimated civilian workforce population in Pinal County exceeds 130,000 persons, based on estimations from the Arizona Department of Commerce. The Pinal County workforce is highly diverse with several ethnic groups represented, motivated with a great work ethic. Professionals are highly trained with a variety of working and technical skills necessary for companies in the 21st century. Sixty-three percent (63%) of the County's available workforce is in the 18-65 year old age category and many also have earned post-high school degrees or advanced work certificates.

The availability of customized training has significantly impacted the County's workforce. Post high school training courses are available thru our varied workforce development agencies including: the Arizona Department of Economic Security, Pinal County Workforce Connection, and Central Arizona College (CAC). In addition, all three major state universities; the University of Arizona, Arizona State University, and Northern Arizona University maintain a consistent educational presence in Pinal County. Courses, certificates and degrees include: information technology, plastics, optics, electronics, aerospace, engineering (electrical, civil, manufacturing, etc.), business management, solar panel installation, various agricultural courses, ISO certification, and various soft-skills programs including team building and leadership skills training.

The continued focus on university, vocational, and continuing education programs in Pinal County will help contribute to the goal of providing a qualified, highly skilled and available workforce and also offer workforce training opportunities both now and in the future.

Government

Pinal County is one of the largest counties in Arizona at 5,386 square miles, which is larger than the state of Connecticut (4,845 square miles). Like most of Arizona, the County continues to experience tremendous growth. The rapid growth over the past two decades has been attributed to abundant, low-cost developable land and relatively inexpensive commutes into employment centers in the Phoenix and Tucson metropolitan areas. Pinal County has experienced a reduction of agricultural activities due to increasing costs, federal regulations, development encroachment, and the changing global market. At the same time, Native American communities are diversifying their economies and increasing the number of acres in agricultural production.

The County's land use patterns have been shaped by physical factors such as mountains and foothills, the San Pedro, Santa Cruz, and Gila Rivers, National Monuments such as the Sonoran Desert and Ironwood Forest, sensitive land areas such as Aravaipa Canyon Wilderness and Superstition Mountains, and state parks such as the Picacho Peak State Park. Ownership patterns have also shaped and will continue to shape land use within Pinal County.

Pinal County is a mosaic of public and private land ownership, with the County having planning authority over privately-owned land. Arizona state trust lands represent 2/3 of available developable land in Pinal County. Arizona State Land Department (ASLD) manages state trust land on behalf of the 14 beneficiaries of the trust. These lands may eventually transfer to private interests, through sale or lease, for residential, commercial, or employment development, or for agricultural or natural resource extraction uses. State land parcels with high scenic or habitat attributes may be designated or otherwise preserved for conservation pursuant to applicable State laws. Federal lands, such as those managed by the Bureau of Land Management (BLM), Bureau of Reclamation (BOR), and U.S. Forest Service (USFS) may also be transferred to private ownership.

Many of the dwelling units built over the past decade in Pinal County have been in unincorporated areas of the County. This is a very different land use pattern than in neighboring Maricopa and Pima Counties. Typically, the majority of suburban or urban development occurs in municipalities. Large master planned developments, such as Johnson Ranch and Saddle Brooke, have changed development patterns in parts of the County. Eleven municipalities in Pinal County have planning authority within their incorporated areas: the Town of Florence, Town of Kearny, Town of Mammoth, Town of Queen Creek, Town of Superior, Town of Winkelman, City of Apache Junction, City of Casa Grande, City of Coolidge, City of Eloy, and City of Maricopa. All municipalities within Pinal County have municipal planning areas (MPA). The majority of urban development in Pinal

County will likely occur in or near these MPA's. Pinal County has planning and zoning authority over all unincorporated areas, including the communities of Arizona City, Dudleyville, Gold Canyon, Picacho, Oracle, Red Rock, Stanfield and San Manuel.

In addition to the municipalities and unincorporated areas, all or parts of four Native American communities are located in Pinal County: Ak-Chin Indian Community, Gila River Indian Community, San Carlos Apache Indian Reservation, and Tohono O'odham Nation. Native American communities are considered sovereign nations and operate under their own tribal governmental system. Development can occur on these lands with tribal approval.

Employment Growth

While an increasing number of citizens have been drawn to Pinal County, today Pinal County's jobs per capita ratio is slightly lower in comparison to surrounding regions raising concerns. In 2000, Pinal County had 200 jobs per 1,000 residents but this figure dropped below 200 jobs per 1,000 residents in 2007 (Central Arizona Association of Governments, 2008); this figure compares to the jobs to population ratio of over 500 jobs per 1,000 residents in Maricopa and Pima Counties, (Morrison Institute for Public Policy, Arizona State University, *The Future at Pinal*, 2007). However, with an increase in academic programs, these trend figures will dramatically change in the future.

Historically, certain types of businesses (mostly retail and services) will develop when population thresholds are surpassed or income levels are achieved within a market. To achieve economic sustainability, a diverse mix of jobs is being developed within the County. Most employment opportunities will occur within municipalities, due to the jurisdictions' ability to provide the much needed public services and incentives for economic development. Pinal County is working to anticipate employment and job centers so they are sustainable, viable components with resources and transportation management systems that are consistent with the city general plans.

Land Use / Ownership

Land Category Percent Total	
State Trust Lands	36%
Private Lands	27%
Indian Communities	21%
U.S. Bureau of Land Management	8%
U.S. Forest Service	7%
U.S. Bureau of Reclamation	1%
National Park Service	<1%
Military	<1%
Total	100%
Source: Arizona Land Resource Information System (ALRIS), 2006	

Emergency Management

The Pinal County Office of Emergency Managements (PCOEM) provides services in all phases of an emergency or disaster cycle.

Preparedness/Planning

The PCOEM ensures adequate plans are in place to respond to both natural and man-made emergencies. These plans include:

- Emergency Operation Plans (EOP)
- Continuity of Operation (COOP) Plans
- Continuity of Government (COG) Plans
- Short and Long Term Recovery Plans
- Multi-Hazard Multi-Jurisdiction Mitigation Plans

Preparedness/Training

The PCOEM provides training in all phases of the emergency or disaster cycle for first responders, emergency management officials, private and non-governmental organizations, and other personnel with the knowledge, skills, and abilities needed to perform key tasks during emergencies or disasters. This training is critical for both response and the pursuit of alternative funding opportunities.

Preparedness / Training - Exercises

Pinal County received federal recognition for its participation in the full scale Weapons of Mass Destruction (WMD) terrorism exercise held by the U.S. Department of Homeland Security in 2007. The Top Officials 4 (TOPOFF4) exercise was a terrorism preparedness, response and recovery exercise. This exercise included international representation by the United Kingdom, Canada, and Australia. The U.S. Territory of Guam was a participant, as was Arizona, one of only two states included in the exercise; Oregon was the other.

Response

The PCOEM may be most visible during the Response phase when dealing with an emergency or disaster. It is the responsibility of Pinal County to coordinate resources to respond to those emergencies and disasters. Depending on the situation, a local jurisdiction, non-profit agency or faith-based volunteer resource may be included in resource management. While most emergencies are handled at the local and county level, some large disasters may require the assistance of the state. The Pinal County Office of Emergency Management will make requests for assistance as necessary. If the disaster goes beyond the state capacity, a Presidential Declaration for assistance can be made through FEMA.

The PCOEM can provide additional response assistance in support of county departments and local jurisdictions, throughout the County, via the Emergency Management Command and Communications Vehicle. This vehicle was purchased with Federal grant monies and is equipped with state of the art communications equipment capable of performing as a fully operational dispatch center. The Command and Communications Vehicle can be used to respond anywhere within the county!

Recovery

It is the responsibility of the PCOEM to coordinate with the State and FEMA representatives to help maximize the amount of the County’s recovered disaster dollars on behalf of the residents.

Mitigation

Pinal County is dedicated toward reducing the risk to citizens. The Pinal County Multi-Hazard Multi-Jurisdictional plan provides an outline of the various hazards posed to Pinal County, and promotes strategies designed to reduce the impacts of both natural and man-made disasters.

Disaster Events

Thunderstorms, flooding, wildland fires, droughts and snow storms are typical of the natural disasters that occur in Pinal County on annual basis. The earliest documented natural event was introduced by James H. Strobridge, Southern Pacific Railroad construction superintendent, in January 1880. Mr. Strobridge recorded that eight inches of snow fell upon the town of Maricopa (California State Railroad Museum). This unusual winter event resulted in delaying train transportation and railroad construction between Red Rock and Tucson within the county.

Unlike the winter storm of 1880, Pinal County has experienced several major natural disasters. Since 1966, twenty of Pinal County’s natural emergencies were declared gubernatorial and/or Presidential disasters. Eleven of the twenty declared disasters were flood related; at a damage cost over $30,000,000 dollars. Some of these major natural disaster events include the 1983 and 1993 Flooding Events, and the 2003 Aspen Fire.

1983 Flooding Event

In September 1983, Pinal County and the State of Arizona experienced an unusual amount of precipitation. As a result, in October 1983 Tropical Storm Octavo unleashed an average of 6 inches of rain over a period of two days within the central and southern portions of Arizona, which included Pinal County (Fieldnotes, Arizona Bureau of Geology and Mineral Technology, 1983). Due to the combination of pre-saturated soil, and the additional precipitation from Tropical Storm Octavo, the waterways in the county swelled beyond their capacity. Pinal County experienced major damage to public infrastructure and private property caused by the collapse and erosion of several river banks. Throughout the impacted storm area approximately 10,000 people were displaced from their residences; 1300 homes were destroyed; twenty main highways were closed isolating dozens of city and towns; Interstate 10 was washed out from the Santa Cruz River north of Tucson and the Gila River south of Phoenix; nine fatalities resulted from individuals trying to cross flooded washes; four fatalities resulted when two aircraft crashed after being caught in a downburst. Damage to agriculture was significant in all categories: crops, land, irrigation canals, ditches, wells, livestock and machinery. Approximately one-seventh of the state's cotton crop was severely damaged or destroyed. The following precipitation levels were recorded for the following areas: 4.51" in Eloy; 6.76" in Oracle; 9.72" in Nogales; 6.36" in Safford; and 6.40" in Tucson. Peak flows recorded were: 25,400 cubic feet per second (cfs) - San Pedro River near Reddington; 70,800 cfs - Aravaipa Creek north of Mammoth; 135,000 cfs – San Pedro River at Winkleman; 100,000 cfs – Gila River near Kelvin; and 65,000 cfs – Santa Cruz River north of Tucson.

1993 Flood Event

In December 1992, a series of four storms passed through Arizona. In each of these storms a southern extension of the Pacific storm track that typically affects the Pacific Northwest was encountered. The storms resulted in snow accumulation in areas above 6,000 feet, and heavy levels of precipitation below 6,000 feet respectively. The increased amount of snow within the mountain areas and the precipitation in the desert regions set the stage for later flooding. Atmospheric conditions charged during the last week of December 1992. The interactions experienced between the Pacific storms and the subtropical jet stream provided a continuous supply of rain and snow into Arizona during January 1993. As a result of three storm cycles, major flooding occurred along the Santa Cruz, San Pedro and Gila Rivers. The Santa Cruz River north of Tucson reached a peak discharge flow rate of 37,400 cubic feet per second (cfs); Gila River at Kelvin peaked at 74,900 cfs; San Pedro at Reddington peaked at 19,100 cfs; and Aravaipa Creek north of Mammoth peaked at 13,000 cfs. Bridges over the San Cruz, San Pedro and Gila Rivers were either washed out or damaged, leaving Pinal County residents isolated. The damages encountered during this event resulted in expenditures of $30,072,157 dollars for the state and $104,069,362 dollars for the Federal government.

2003 Aspen Fire

The Aspen Fire was the largest wildland fire experienced in Pinal County. The fire initiated within Pima County near Mount Lemmon on June 17, 2003 and burned for approximately a month. It consumed 84,750 acres of land in both Pima and Pinal Counties, destroyed 340 homes and businesses in the town of Summerhaven, and threatened the communities of Oracle, San Manual, Saddlebrooke, and Catalina. The wildfire required water tender support, road closures, evacuation of hundreds in the Oracle area, and security for the areas evacuated. The Pinal County Air Quality Department performed 90% of requested air quality meter readings for both Pinal and Pima Counties. On three separate occasions, meter readings raised to levels that almost required evacuating residents along the west side of the mountain range (Catalina and Saddlebrooke communities). While the Pinal County Public Works Department provided resources and support during the fire, sustained fire operations caused a strain on county personnel during fire suppression. Several road maintenance and construction projects were delayed during the month long incident due to limited resources. The damages encountered during this event resulted in expenditures of $684,103 dollars for the state and $5,907,407 dollars for the Federal government.

Transportation

Roadways: Major roadway transportation routes through the county, include Interstates 8 and 10, US Highway 60, State Highways 77, 79, 84, 87, 88, 177, 187, 237, 287, 347, and 387, as well as Indian Route 15.
Railways: Railroads include the Union Pacific, Magma Arizona, San Manuel Arizona Railroads, and the Copper Basin Railway.
Airports/Air Service:

Casa Grande Municipal	**Pinal Airpark**
Functional Class: Business Service	Location: Marana
Elevation: 1,462'	Functional Class: Business Service
Ownership: Public	Elevation: 1,891'
Use: Public	Ownership: Public
Navigation-Aids: ILS	Use: Public/Military
Runway: 05/23 Length: 5,200' Width: 100'	Nav-Aids: None
Surface: Asphalt	Runway: 12/30 Length: 6,860' Width: 150'
	Surface: Asphalt
Coolidge Municipal	
Functional Class: Business Service	**San Manuel Airport**
Elevation: 1,587'	Functional Class: B/II
Ownership: Public	Elevation: 3,275'
Use: Public	Ownership: Public
Nav-Aids: None	Use: Public
Runway: 05/23 Length: 5,550' Width: 150'	Nav-Aids: None
Surface: Asphalt	Runway: 11/29 Length: 4,215' Width: 55'
Runway: 17/35 Length: 3,740' Width: 75'	Surface: Asphalt Runway: 06/24 Length: 5,504'
	Width: 75'
Eloy Municipal	Surface: Asphalt
Functional Class: Basic Service	Runway: 15/33 Length: 4,000' Width: 75'
Elevation: 1,513'	Surface: Asphalt
Ownership: Public	
Use: Public	**Superior Municipal Airport**
Nav-Aids: None	Functional Class: Basic Service
Runway: 02/20 Length: 3,900' Width: 60'	Elevation: 2,646'
Surface: Asphalt	Ownership: Public
	Use: Public
Estrella Sailport	Nav-Aids: None
Location: Maricopa	Runway: 04/22 Length: 3,500' Width: 75'
Functional Class: Basic Service	Surface: Dirt
Elevation: 1,273'	
Ownership: Private	
Use: Public	
Nav-Aids: None	
Runway: 6R/24L Length: 2,520' Width: 30'	
Surface: Asphalt	
Runway: 6C/24C Length: 1,995' Width: 20'	
Surface: Dirt	
Runway: 6L/24R Length: 1,910' Width: 50'	
Surface: Asphalt	

Utilities

Electric:

- Ak-Chin Electric Utility Authority
- Arizona Public Service (APS)
- Bureau of Indian Affairs (Coolidge)
- Bureau of Indian Affairs (Mammoth/Oracle)
- Coolidge
- Copper Basin Railway
- Electrical Dist. #2 (Maricopa)
- Electrical Dist. #4 (Rural areas near Eloy)
- Salt River Project (SRP)
- San Carlos Irrigation Project
- Santa Cruz Water & Power

Gas:

- El Paso Natural Gas
- Southwest Gas Corporation

Agriculture and Equestrian Heritage

Farming and horses have historically been a valued part of Pinal County's heritage. Thousands of acres are still in agricultural production today. However, Pinal County is experiencing a transition from tractors to tricycles at a rapid rate as farmland is sold for residential development. This transition is occurring for a variety of reasons that include desirability of living in Pinal County and the relatively few housing choices that have existed in this area, the cost of water, global competition, and increasing land values. However, many still choose to live in Pinal County because of the agricultural and equestrian heritage.

Additionally, the amount of open space and trails identified for preservation will encourage the continuation and enhancement of the rural and equestrian lifestyles. Because the amount of land identified for open space is expansive, creative solutions and strong leadership will be required to achieve open space development.

The Native American communities within Pinal County have a long history of agricultural activities that is intended to continue. With new water settlements, Native American community farming operations will continue to expand and diversify. Discussions during comprehensive planning recognized the role agriculture will continue to play in Central Arizona. Part of the ambiance of the wide, open spaces between Phoenix and Tucson are due to the Native American communities' large agricultural operations.

Accomplishing compatibility and an appropriate transition between farming operations on Native lands and development elsewhere is critical. Native American communities are critical partners in determining appropriate guidelines for buffering and transitions between land uses to minimize future impact.

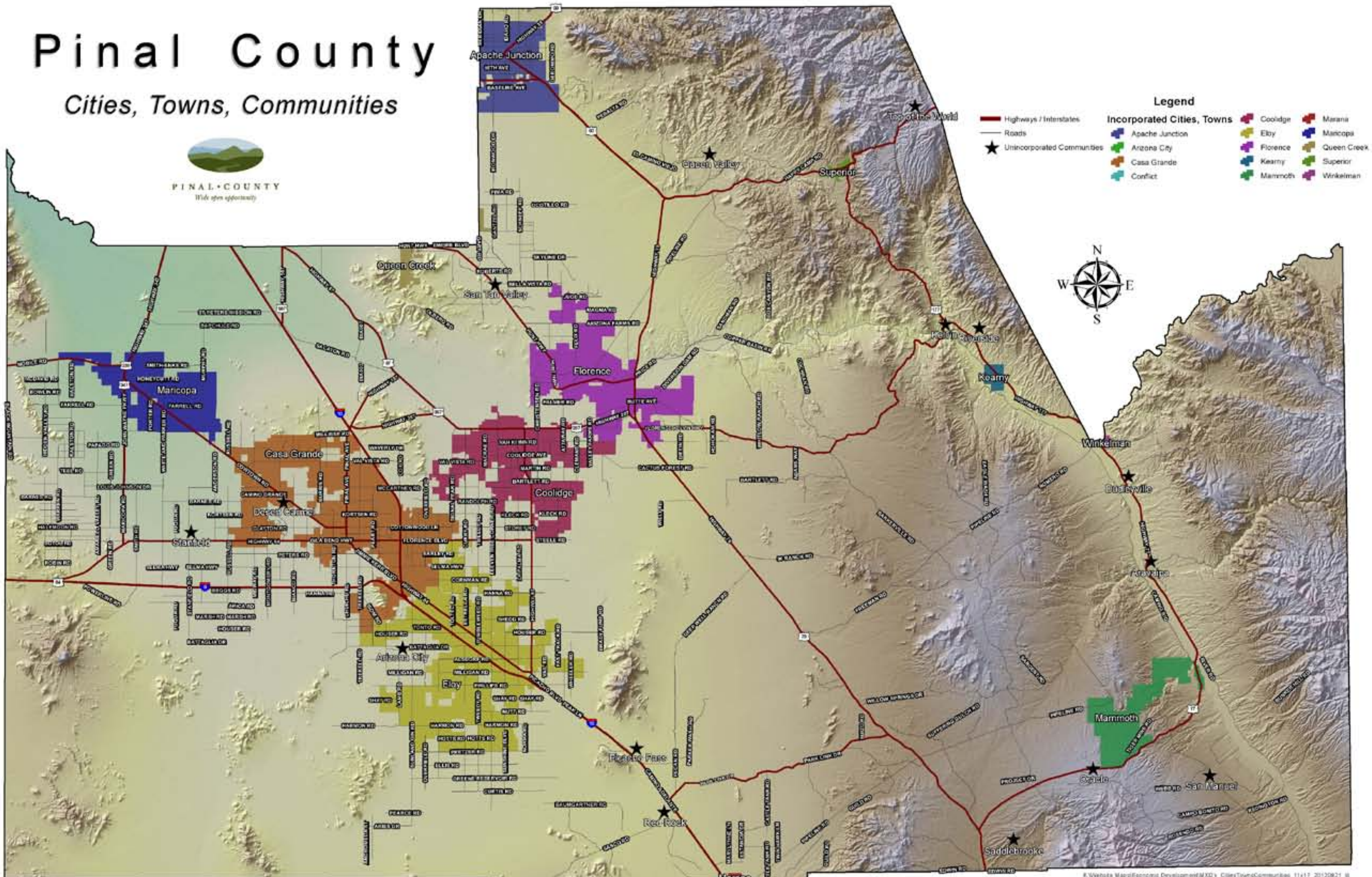
Native American Indian Communities

Pinal County is home to four sovereign nations: Gila River Indian Community; Tohono O'odham Nation; San Carlos Apache Indian Reservation; and the Ak-Chin Indian Community. These Native American communities play a major role in the economy of Pinal County and have a significant presence. Gila River Indian Community has several industrial parks and many very successful Tribal enterprises that provide jobs and revenue to the Community. Additionally, the other Native American communities are expanding employment and commercial development.

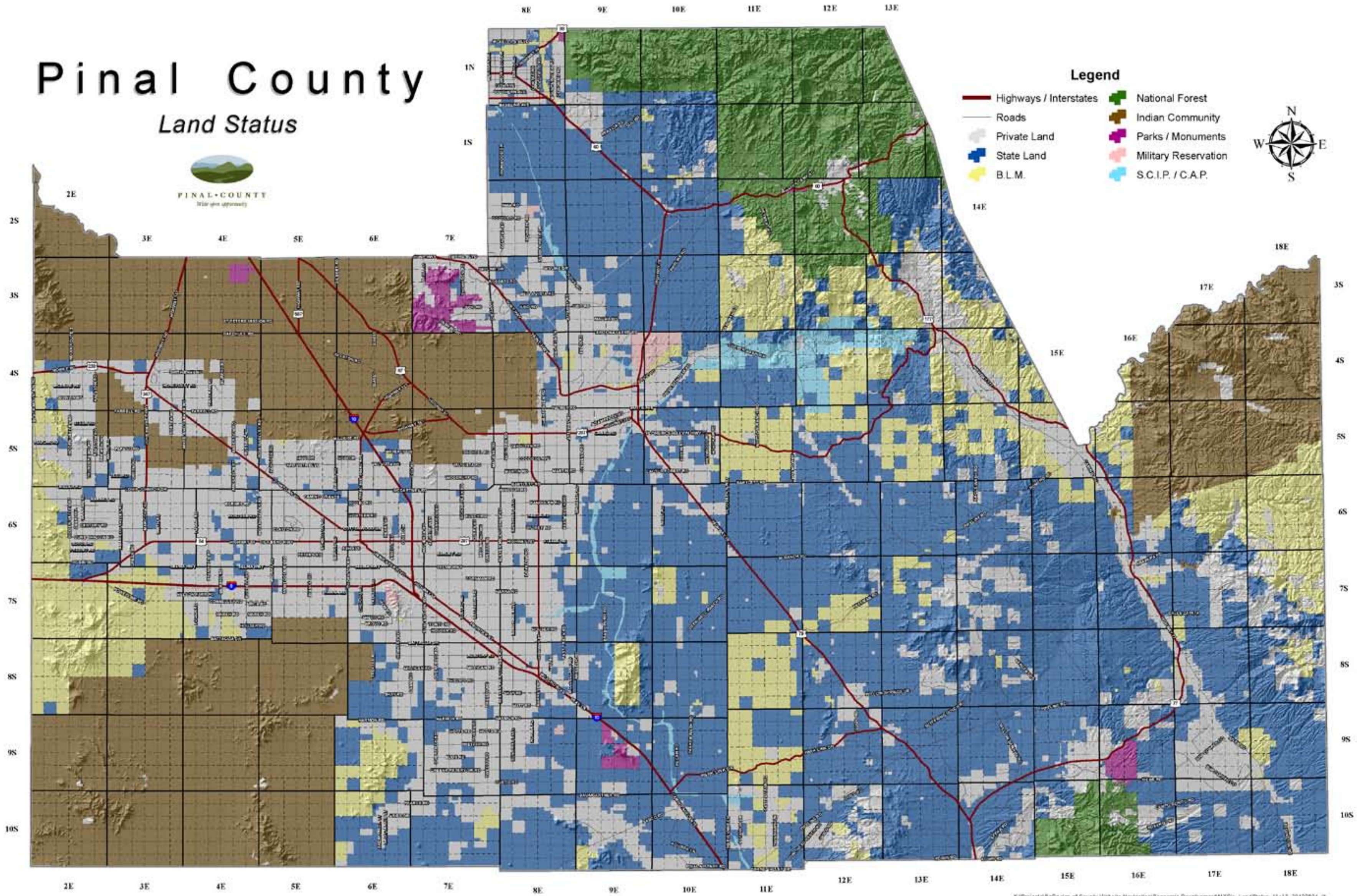
Three out of the four Native American communities have major casino operations within Pinal County. All of these communities are working diligently to diversify their economies. The Gila River Indian Community and Ak-Chin Indian Community also conduct major agricultural operations.

The County and municipalities are in the process of approving development adjacent to “tribal borderlands”. Compatibility is important so that tribal lands are not negatively impacted by expansive growth.

Map CD-32: Pinal County



Map CD-33: Pinal County Land Ownership



Santa Cruz County

History / Geography

Santa Cruz County is located in south central Arizona. It is bordered by Pima County on the north and west, Cochise County on the east and the State of Sonora, Mexico on the south. Two incorporated communities, Nogales and Patagonia, and 15 unincorporated communities are located within the County. The City of Nogales serves as the county seat.

The topographic characteristics of the County range from the gradually sloping riparian corridor of the Santa Cruz River Valley with its adjoining agricultural areas, to the steeply inclined pine-oak forests located on Mt Wrightson and other parts of the Santa Rita, Tumacácori, and Patagonia mountains, plus numerous other mountain ranges throughout the county. The highest point in the county is Mt Wrightson in the Santa Rita Mountains at 9,453 feet above sea level. The lowest point is Santa Cruz River channel at the Pima County/Santa Cruz County boundary at 3,022. The majority of the County is comprised of high desert plains and foothills that are typical to the Chihuahuan desert.

The primary watercourse within Santa Cruz County is the Santa Cruz River. Other major watercourses within the County include, but are not limited to, the Nogales Wash/Potrero Creek, Peck Canyon, Josephine Canyon and Sonoita Creek. There are also numerous other ephemeral washes and watercourses that primarily convey flood waters. Groundwater extraction is the primary source for both domestic and commercial water consumption.

The geographical characteristics of Santa Cruz County have been mapped into two terrestrial ecoregions, which are described below:

- **Chihuahuan Desert** – this ecoregion is typical of the high altitude deserts and foothills and is found in much of the southeastern portion of Arizona. Elevations in this zone vary between 3,000 to 4,500 feet. The average temperatures for the Chihuahuan Desert tend to be cooler than the Sonoran Desert (see below) due to the elevation differences. However, like its lower elevation cousin, the summers are hot and dry with mild to cool winters.
- **Sierra Madre Occidental Pine-Oak Forest** – this ecoregion is predominant to mountainous regions in southeast Arizona with elevations generally above 5,000 feet. The average temperatures tend to be cool during the summer and cold in winter.

Geology / Climate

For the majority of Santa Cruz County, the climate, when compared to other regions in the State of Arizona is relatively moderate. The region is considered to have mild winters and wet summers, with variation within these regions due to the fluctuation in elevation associated with the forests. Average temperatures within Santa Cruz County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures is highly dependent upon the location, and more importantly the altitude, within the County. For instance, temperature extremes at the top of Mount Wrightson are significantly different from those for the Santa Cruz River Valley.

Precipitation throughout Santa Cruz County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

Santa Cruz County is home to 47,420 residents according to 2010 Census, with the international border City of Nogales being the largest community. All of the communities are located within the Santa Cruz River Valley and are located relatively close to each other. There are 13 other towns and communities located throughout the County, with most situated along Interstate 19 and Highway 82 and many being comprised of only one structure or landmark. The largest of these two communities is Tubac and Rio Rico.

Population Estimates for Santa Cruz County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Santa Cruz County (total)	29,900	40,075	47,420	56,144	61,658
Nogales	19,595	21,810	20,837	23,858	24,783
Patagonia	890	985	913	1,003	1,041
Unincorporated	n/a	n/a	25,670	31,283	35,834
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html, http://www.workforce.az.gov/census-data.aspx and http://www.azcommerce.com/econinfo/demographics/Population+Projections.html					

Economy

The Santa Cruz County labor force in 2010 was 18,792 with an unemployment rate of 15.8%. Major industries of the County include transportation, services (i.e., tourism), manufacturing and public administration, and retail and wholesale trade.

The County was formed in 1899 by the 20th Territorial Legislature. The County was named after the Santa Cruz River that flows into Mexico from Arizona before winding back north into Santa Cruz County. Santa Cruz in Spanish means “holy cross”, and was given by Father Kino in the 17th century. The primary areas of growth within Santa Cruz County have occurred along the Santa Cruz River and the major transportation corridors within the County. Most residential growth has occurred within or very near the incorporated City of Nogales and the unincorporated community of Rio Rico. Commercial growth has historically been focused along Interstate 19 or State Highway 82, and to a lesser extent State Highway 83. Agricultural growth has occurred mainly along the Santa Cruz River and Sonoita Creek and has remained relatively stable.

Future growth in the next five years will depend on the region’s ability to climb out of the recession, a reduction or cessation of violence along the border and the continued implementation of the North American Free Trade Agreement (NAFTA). The County has been hard-hit by the economic downturn and the stigma that violence across the border has created. When those factors are coupled with the response nationally to actions taken on the State level regarding immigration reform, the region’s economy is at an all-time low.

The County has identified seven growth areas in its latest comprehensive plan update. All of these areas are located west of the Santa Rita Mountains in recognition of the interest for limited growth in the east. The following is a brief description of each area:

- **Airport** – The Nogales International Airport is located along SR 82, northeast of the City of Nogales. The Airport itself, and the land surrounding it, are ideal locations for industrial and commercial land uses. Development occurring near the airport should be complementary to long-term expansion opportunities at the Airport, including restricting noise-sensitive developments. Industrial growth will continue to be limited by the lack of a major road linking SR 82 and I-19.

- **Amado** – Amado serves as a gateway to the County along the I-19 corridor. The current zoning intensity should remain in the area. Appropriate development activities are neighborhood retail and services and campus commercial.
- **I-19 Corridor (Rio Rico Drive to Nogales)** – The I-19 corridor is a significant residential and commercial area for the County. Warehousing and other industrial and commercial activities occur along both sides of the highway with residential development beyond that. This growth area recognizes the desire of many businesses to be located along a highway to improve their accessibility and visibility.
- **Kino Springs Village Center** – The Kino Springs Village Center is a 2,000 acre master planned development area. It will serve the growing residential and tourism activities there with commercial uses.
- **Rio Rico Drive East** – The growing residential and tourism market in the Rio Rico area will continue to support an increasing amount of commercial development. Grocery stores, large retail and other smaller development are envisioned to be located along Rio Rico Drive, east of I-19.
- **Ruby Road** – Ruby Road is relatively a mid-point between the populations of Nogales and Rio Rico. As growth continues to occur in Rio Rico at a faster rate than in Nogales, the geographic center of the population in the west County will continue to move northward. The area south of Ruby Road is situated to serve both of these population centers. Retail and other commercial activities, including a regional mall or large retail development, would be appropriate uses in this area.
- **Tubac** – The Tubac core area is a tourist destination and also provides services for local residents. This area, located along the east side of I-19, is home to a resort and various retail and commercial businesses. Maintaining the identity of this area is critical, so any new development should respect the current activities. There should be no intensification of existing zoning, and new development should support the tourism core that already exists.

Land Use / Ownership

Land ownership in Santa Cruz County is divided between the US Forest Service and the Bureau of Land Management (54.6%), Arizona State Trust Lands (7.8%), Local/State/National Parks (0.1%) and private ownership (37.5%).

Disaster Events

Santa Cruz County faces Flooding, Wildfire, and Hazardous Materials Events as our principal areas of risk.

Flooding is a frequent occurrence in the City of Nogales as the Nogales Wash runs along the length of the City from the border of Mexico. This open concrete channel also contains a large sewage line that carries untreated effluent from Mexico into the US to a wastewater treatment system. Due to the aging infrastructure of this system, there have been several sewage line breaks.

Wildfires have also been more frequent. The most recent large wildfire was the Murphy Complex fire where two separate fires joined into one complex fire. This fire threatened portions of Rio Rico and Tubac before being controlled.

Santa Cruz County has both an interstate highway and rail transecting the County. Several hazardous materials are transported via these transportation routes including: Anhydrous Ammonia, Propane, and Sulfuric Acid. In the fall of 2012, two rail cars from the Mexico rail yard became detached at the yard and rolled downslope toward Nogales. One of the cars placarded for Sulfuric Acid derailed at the Port of Entry near the US side of the Nogales Wash. This event caused significant damage to the Port of Entry gates, and cosmetic damage to a building containing a rail car inspection system that uses high specific activity radioisotopes. No breach of either material occurred.

As a result of this event, the Border 2020 Commission and EPA held a table top exercise in Santa Cruz County with US and Mexico officials to mitigate, and prepare for a similar event should it ever occur again.

Transportation

Roadways: Interstate 19, State Highways 82, 83 and 289.

Railways: A branch line of the Union Pacific Railroad runs parallel to Interstate 19 from Tucson into Mexico.

Airports/Air Service: The Nogales International Airport, operated by the County, is located approximately 7 miles northeast of Nogales along State Highway 82.

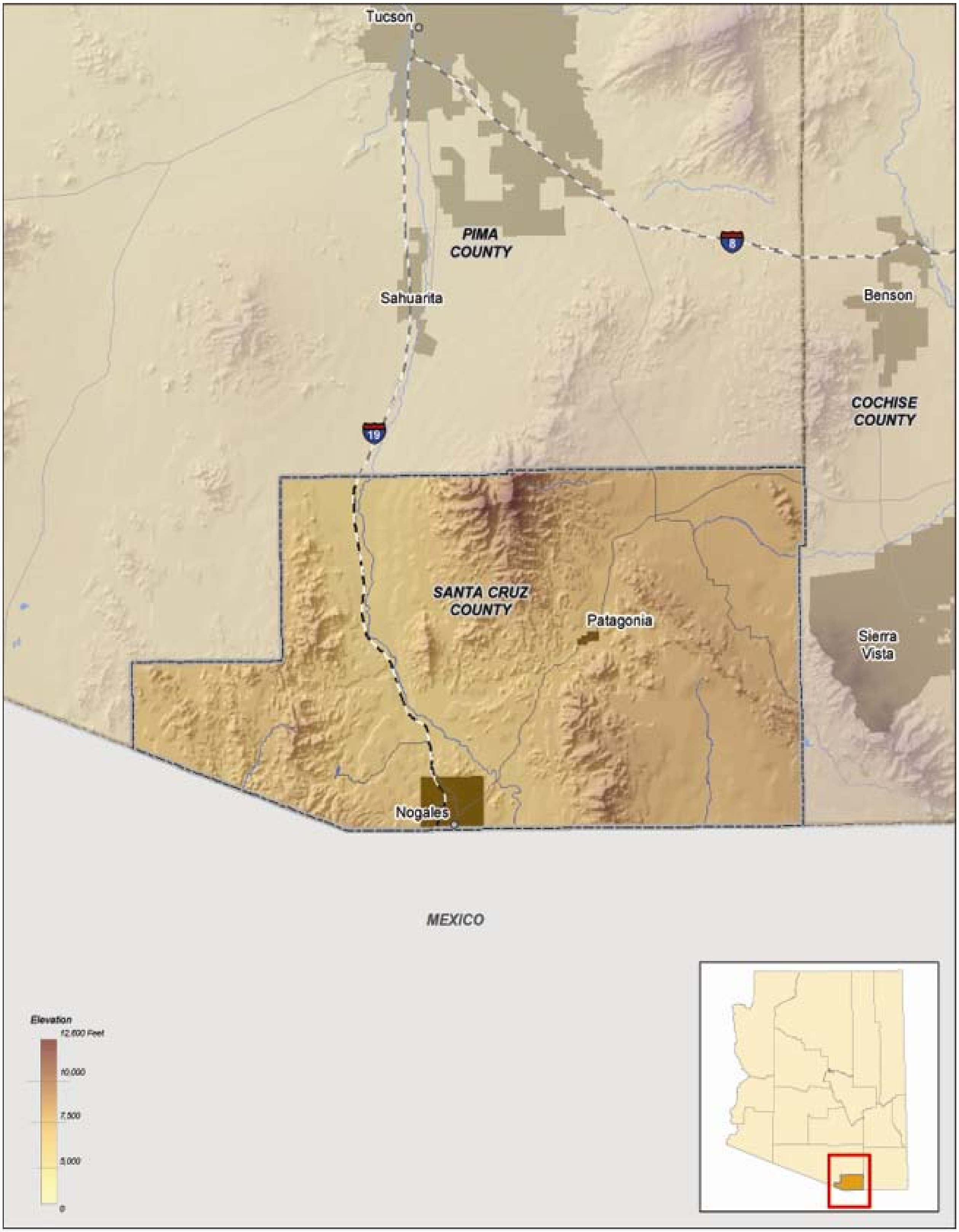
Utilities

Electric: Unisource

Gas: Unisource

Water/Sewer: Liberty Water and private companies

Map CD-34: Santa Cruz County



Yavapai County

History / Geography

According to the Arizona Department of Commerce, Yavapai County was formed along with the original four counties created when Arizona was still a territory. Known as the "Mother of Counties", Yavapai County was initially more than 65,000 square miles from which five other counties were later formed. Today, Yavapai County covers 8,125 square miles, with Prescott as its County seat. Yavapai County is located in the central portion of the State of Arizona.

Yavapai County is home to portions of five rivers and four mountain ranges. The Verde River is the longest stretch of riparian area which has year-long flows and is located along the eastern portion of the County. All the other rivers have intermittent flows and include the Santa Maria River, Aqua Fria River, Hassayampa River, and a small segment of New River. Except to the north, Prescott is nearly surrounded by the four mountain ranges, which are the Bradshaws, Black Hills, Weaver Mountains, and Sierra Prieta. This sort of geographical characteristics can be used to identify terrestrial ecoregions.

The geographical characteristics of Yavapai County have been mapped into three terrestrial ecoregions, which are described below:

- **Arizona Mountain Forests** – this ecoregion contains a mountainous landscape, with moderate to steep slopes. Elevations in this zone range from approximately 4,000 to 13,000 feet, resulting in comparatively cool summers and cold winters. Vegetation in these areas is largely high altitude grasses, shrubs, brush, and conifer forests.
- **Sonoran Desert** – this ecoregion is an arid environment that covers much of southwestern Arizona. The elevation varies in this zone from approximately sea level to 3,000 feet. Vegetation in this zone is comprised mainly of Sonoran Desert Scrub and is one of the few locations in the world where saguaro cactus can be found. The climate is typically hot and dry during the summer and mild during the winter.
- **Colorado Plateau Shrublands** – this ecoregion covers a small portion of the North-West corner of the County with elevations that average around 4,000-5,000 feet. Vegetation in this ecoregion is comprised mainly of Plains Grassland and Great Basin Desert scrub. Temperatures can vary widely in this zone, with comparatively warm summers and cool winters.

Geology / Climate

The majority of Yavapai County can be classified as Sonoran Desert and Arizona Mountain Forest. The elevation range for these two ecoregions in the County is approximately 2,000-8,000 feet. Such a range in elevation results in differences in climate. Average temperatures within Yavapai County range from below freezing during the winter months to over 100°F during the hot summer months. The severity of temperatures in either extreme is highly dependent upon the location, and more importantly the altitude, within the County.

Precipitation throughout Yavapai County is governed to a great extent by elevation and season of the year. From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms producing mild precipitation events and snowstorms at the higher elevations. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and aloft from the southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms are usually found in the mountainous regions of the central southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds, blowing dust, and infrequent hail storms.

Population

Yavapai County is home to 211,033 residents, with a large portion of the population living in Prescott and Prescott Valley.

Population Estimates for Yavapai County					
Jurisdiction	**1990**	**2000**	**2010**	**2015**	**2020**
Yavapai County (total)	108,500	160,075	211,033	275,056	305,343
Camp Verde	6,375	8,955	10,873	14,990	16,550
Chino Valley	4,835	7,860	10,817	20,681	24,299
Clarkdale	2,170	3,135	4,097	4,160	4,368
Cottonwood	5,930	9,405	11,265	13,988	15,343
Dewey-Humboldt	n/a	3,421	3,894	4,967	5,377
Jerome	405	580	444	331	332
Prescott	26,625	36,975	39,843	53,484	58,989
Prescott Valley	9,040	23,285	38,822	50,372	58,044
Sedona(Yavapai part only)	n/a	7,229	8,424	8,963	9,451
Yavapai-Apache Indian Tribe	n/a	743	899	969	1,032
Yavapai-Prescott Indian Tribe	n/a	182	189	193	196
Sources: http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html, http://www.workforce.az.gov/?PAGEID=67&SUBID=255 and http://www.workforce.az.gov/?PAGEID=67&SUBID=257					

Economy

Yavapai County was established by the Arizona Territorial Government in 1864, with the first Territorial Capital established in Prescott. Miners migrated to south and western Yavapai County with the building of Fort Whipple and Fort Verde. In the 1870s, large deposits of copper were discovered in Jerome spawning smelters in Clarkdale and Cottonwood (formerly Clemenceau). The railroad through northern Arizona was constructed in the 1880s and attracted farmers and ranchers in combination with the vast grasslands of the Verde, Chino and Peeples Valleys. Mining operations continued well into the 20th century and businesses diversified maintaining growth even after the mines started shutting down in the 1940s and 50s.

As with most of the state and nation, the Yavapai County economy has slowed over the last few years. According to the Arizona Department of Commerce, the major industries within the county include retail trade, public and private services, and public administration. Tourism also continues to serve a significant role in the economic health of the county and communities. As of June 2011, the civilian workforce was estimated at 97,600 with an unemployment rate of 10.4%.

Land Use / Ownership

In addition to the nine incorporated cities and towns, there are a total of 41 unincorporated communities scattered across the County, with many being comprised of only one structure or a prominent landmark. Within Yavapai County, the US Forest Service, US Bureau of Land Management, and State Land combined, constitute nearly 75% of land ownership. The majority of which is owned by the US Forest Service at 38%. Twenty-five (25%) is individually or corporately owned, and less than a half of a percent belongs to Yavapai-Prescott Indian Community and the

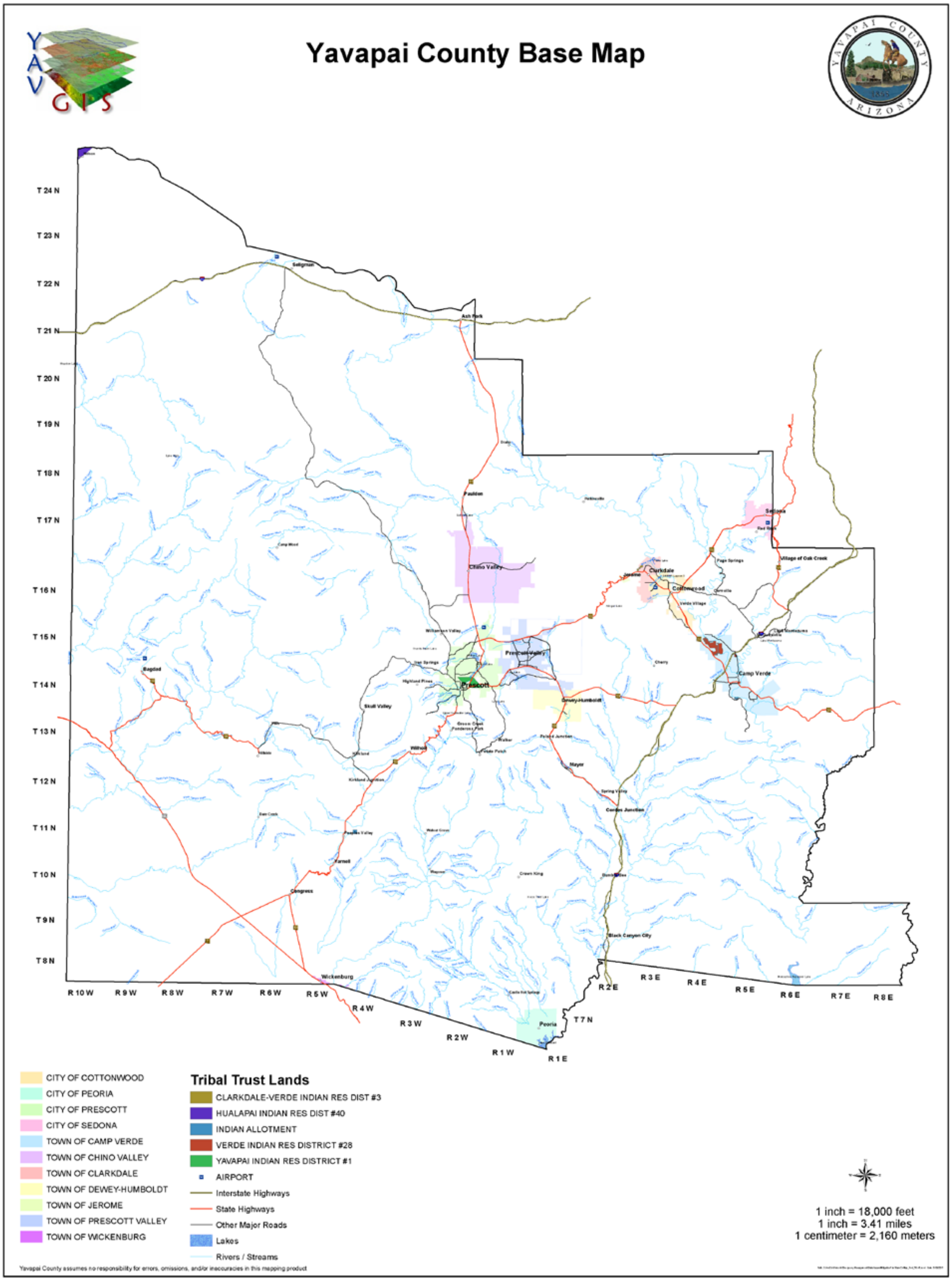
Yavapai Apache Nation combined. The City of Peoria has annexed land surrounding Lake Pleasant in Yavapai County.

Transportation

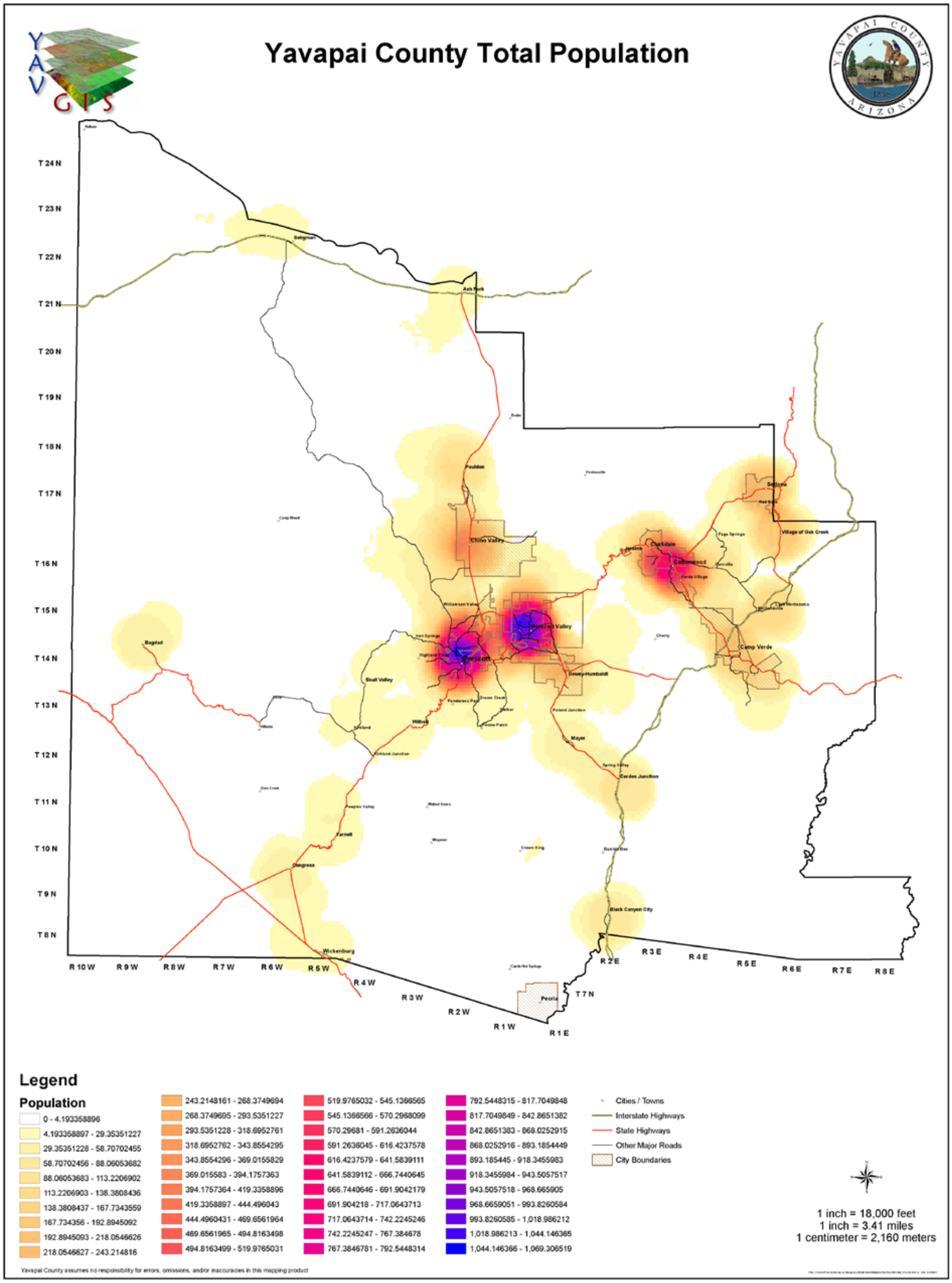
Roadways: Major roadway transportation routes through the County include Interstates 17 and 40, US Highway 93, State Routes 69, 71, 89, 89A, 96, 97, 169, 179, and 260.

Railways: Railways include the Burlington Northern Santa Fe Railway and Arizona Central Railway.

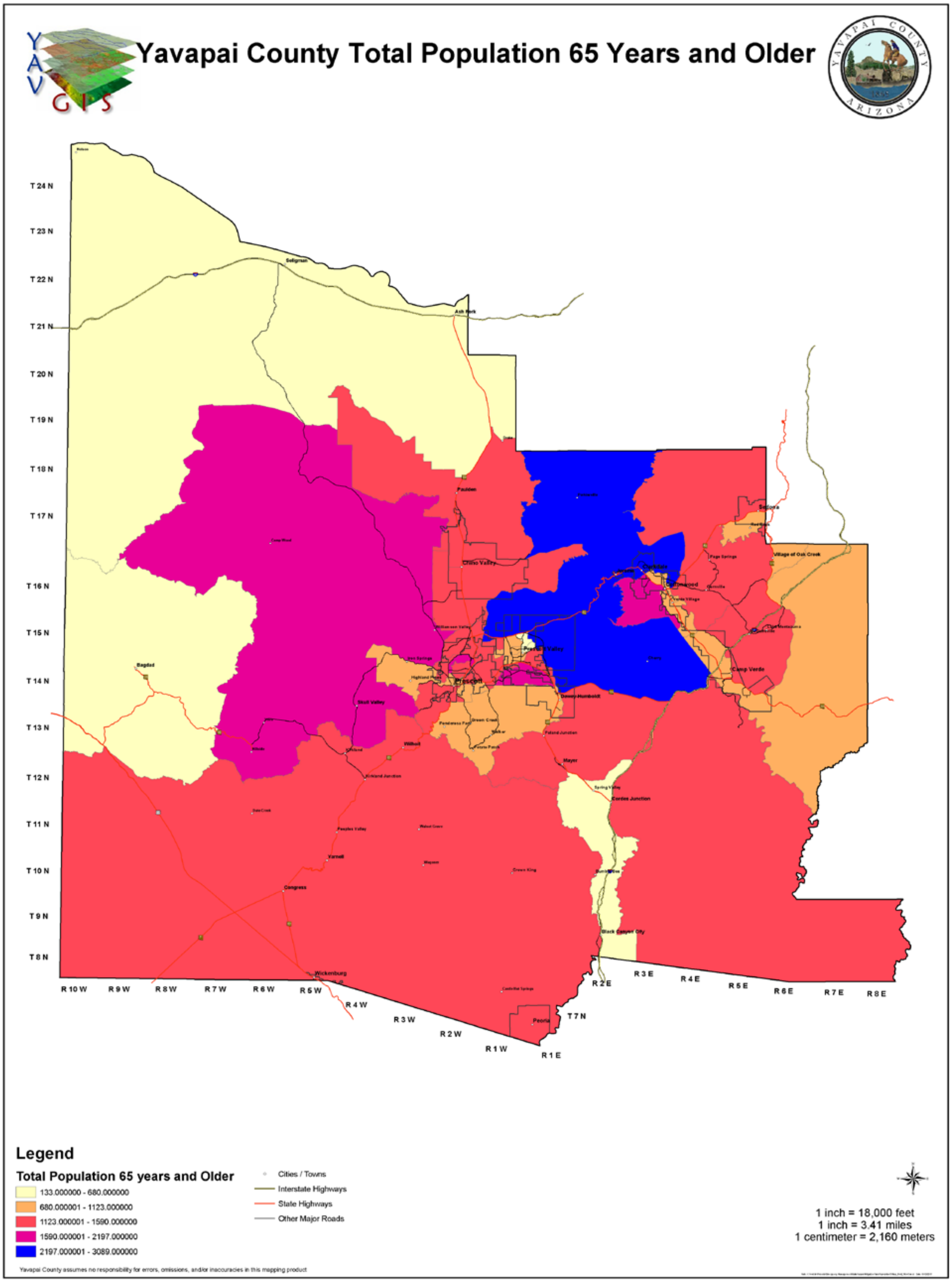
Map CD-35: Yavapai County



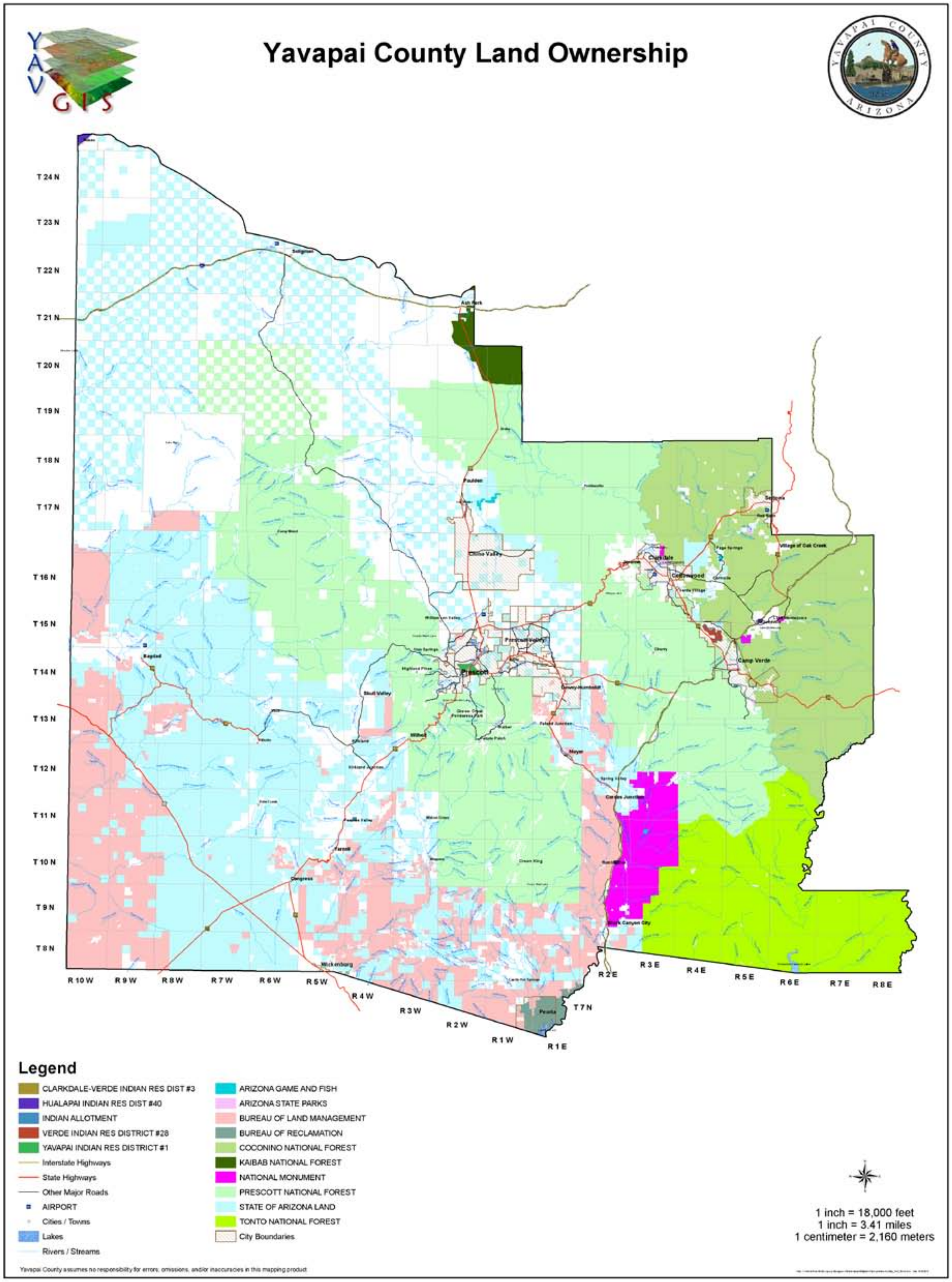
Map CD-36: Yavapai County Population



Map CD-37: Yavapai County Over 65 Population



Map CD-38: Yavapai County Land Ownership



Yuma County

History / Geography

The history of Yuma County is quite colorful and continues to live on today in a fast-growing and vibrant community. In 1540, just 48 years after Columbus discovered the New World, 18 years after the conquest of Mexico by Cortez, and 67 years before the settlement of Jamestown, Hernando de Alarcon visited the site of what is now the current City of Yuma. He was the first European to visit the area and to recognize the best natural crossing of the Colorado River.

Much of Yuma County's later development occurred because of this strategic location. From the 1850's through the 1870's, steamboats on the Colorado River transported passengers and goods to various mines and military outposts in the area, and served the ports of Yuma, Laguna, Castle Dome, Norton's Landing, Ehrenberg, Aubry, Fort Mohave and Hardyville. During this time, stagecoaches also carried the mail and passengers on bone-jarring rides through the area.

Yuma County is located in the extreme southwestern corner of Arizona. The County is larger than the state of Connecticut, and much of Yuma County's 5,522 square miles is desert land accented by rugged mountains. According to the Arizona Department of Commerce, Yuma County is one of four original counties designated by the first Territorial Legislature. In 1864, Yuma was selected as the county seat and has remained so to this day. The County maintained its original boundaries until 1983, when voters decided to split Yuma County, forming La Paz County in the north and the new, present day Yuma County in the south.

Yuma County is characterized by two prominent river valley regions formed by the Gila and Colorado Rivers. Within these regions exists an abundance of arable land which is irrigated with water from the Colorado River and groundwater supplies. There are also over 200 miles of irrigation canals that extend at regular intervals through the County's agricultural belt. The Colorado and Gila River Valley areas have some of the most fertile soils in the world, having received silt and mineral deposits from flooding of the watercourses until the rivers were “tamed” by an intricate series of dams and canals.

For many years, Yuma served as the gateway to the new western territory of California, which brought thousands of people from around the world in search of gold or to provide services to those who had it. In 1870, the Southern Pacific Railroad bridged the Colorado River, and Yuma became a hub for the railroad. The Ocean-to-Ocean Bridge (or Old Highway 80 Bridge) was the first vehicle bridge across the Colorado River. Prior to the construction of the bridge, cars were ferried across.

Geology / Climate

The climate in Yuma County is typically hot and dry during the summer and mild during the winter. Average temperatures within the County are fairly uniform and range from near freezing during the winter months to over 110°F during the hot summer months. Average extreme temperatures have exceeded either end of the spectrum by 10 to 15°.

Annual precipitation across the County varies significantly with elevation. For example, the urbanized Yuma Valley area receives less than three inches of rainfall annually while the eastern portion of the County receives nearly five inches annually and the northern areas approach seven inches annually. From a rainfall perspective, the Yuma Valley area is one of the driest areas of the State.

From November through March, storm systems from the Pacific Ocean cross the state as broad winter storms produce mild precipitation events. Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds move into Arizona at the surface from the southwest and southeast. The shift in wind direction, termed the North American Monsoon, produces summer rains in the form of thunderstorms that result largely from excessive heating of the land surface and the subsequent lifting of moisture-laden air, especially along the primary mountain ranges. Thus, the strongest thunderstorms usually do not form in Yuma County area, but are found in the mountainous regions of the central southeastern portions of Arizona.

Thunderstorms that do materialize are often accompanied by strong winds, blowing dust, and infrequent hail storms. During the period of October through February, temperature inversions occur nightly and last about one hour after sunrise. Air pollution levels can rise significantly during this period, as does the potential for fog. Prevailing winds are basically northwesterly, except during the months of June, July, August and September when they become south to southwesterly. Average wind speed through the year is about 7.8 mph.

All of Yuma County is situated within the Sonoran Desert and is characterized by an arid environment typical of much of southwestern Arizona. The elevations vary across the County with mountain peaks that are less than 3,000 feet in elevation to a low elevation of 175 feet. Vegetation in this zone is comprised mainly of a mixture of palo verde, cacti, creosotebush, and bursage communities. The river bottoms are primarily comprised of saltbrush and arroweed scrub, with a few sparse stands of mesquite and riparian deciduous woodland.

Population

Yuma County is home to 196,160 residents according to 2010 US Census Bureau population figures with the majority of the citizens living in the incorporated communities or Indian Reservation portions of Yuma County. The largest community is the City of Yuma. All three incorporated cities and one town are geographically located in the southwest portion of the County. The other 13 towns and communities located throughout the county, with most situated along major highways, are mostly comprised of only a few structures or a landmark.

Population Estimates for Yuma County					
Jurisdiction	**1990$_A$**	**2000$_A$**	**2010$_B$**	**Estimated 2020$_B$**	**Estimated 2030$_B$**
Yuma County	106,895	160,026	196,160	236,262	283,094
Cocopah Indian Tribe	N/A	1,025	N/A	1,589	2,094
Fort Yuma Indian Tribe	N/A	36	N/A	60	81
City of San Luis	4,212	15,322	25,509	44,963	63,052
City of Somerton	5,282	7,266	14,513	19,032	26,832
Town of Wellton	1,066	1,829	2,884	3,284	3,758
City of Yuma	56,966	77,515	93,637	105,404	121,362
Unincorporated	39,369	57,033	59,617	63,579	68,090
Sources: $_{(A)}$ US Dep of Commerce: US Census Bureau and $_{(B)}$ AZ Dept of Administration Subcounty Projections April 5, 2013.					

Economy

The Yuma valley regions contain an abundance of arable land, which utilizes the close proximity of the Colorado River water through a network of canals. Agriculture, tourism, military and government and retail trade are the county's main industries.

Farming, cattle raising, tourism, retail trade, and the US Marine Corp Air Station Yuma and US Army Yuma Proving Ground military bases are Yuma County's principal industries. Some of the major tourist attractions in Yuma County include the historical Territorial Prison, Yuma Crossing Historic Park, Kofa Mountain Range and Wildlife Refuge, Martinez and Mittry Lakes, and hunting for a variety of game animals.

Arizona Western College (AWC) is located in Yuma County, and offers a two-year community college education to full-time and part-time on-campus and off-campus students. AWC shares its campus with a satellite campus of Northern Arizona University, which offers a variety of two year, four year and postgraduate programs. In addition, the University of Phoenix has established a branch in Yuma.

After a period of rapid growth from 2000-2007, Yuma County is currently experiencing a period of slowed, albeit steady, growth. As the region prepares for growth accompanying improved economic conditions, there is a specific focus on job creation, particularly in the aerospace, agricultural, and industrial sectors.

In order to plan more efficiently, each municipality in Yuma County develops in accordance with its voter-approved General Plan. Similarly, development in the unincorporated portions of Yuma County is accomplished in accordance with the adopted 2020 Comprehensive Plan. In addition, all of the municipalities and Yuma County have adopted the Yuma Regional Development Plan which addresses county-wide development goals and objectives related to preserving valley agriculture lands and military installations and promoting sustainable development.

Land Use / Ownership

The US Forest Service and Bureau of Land Management own 42% of Yuma County land; Indian Reservations, 0.5%; and the State of Arizona 5%; individual and corporations 13%; and other public lands 40%.

Emergency Management

OEM	Yuma County Office of Emergency Management 198 S. Main Street, Yuma AZ 85364
EAS	via social media, National Weather Service
EMT Services	See Fire EMS
Law Enforcement	Yuma County Sheriff's Office 141 S. 3rd Avenue, Yuma AZ 85364
Fire	Yuma Fire Department San Luis Fire Department Somerton Cocopah Fire Department Town of Wellton Fire Department
EMS	City of Yuma Fire Somerton Cocopah Fire Department Rural Metro Corporation (subscription based)

Disaster Events Minimal – power grid in 2009 and earthquake in 2010

Transportation

Roadways: Major highways through the County include Interstate 8 and U.S. Highways 95 and 80, and State Highway 195, the high speed truck route from Mexico to Yuma.

Airports/Air Service: The Marine Corps Air Station (MCAS) shares one of the longest runways in the country with the Yuma International Airport. Additionally, the US Air Force operates Laguna Air Force Base in the central-western portion of the County.

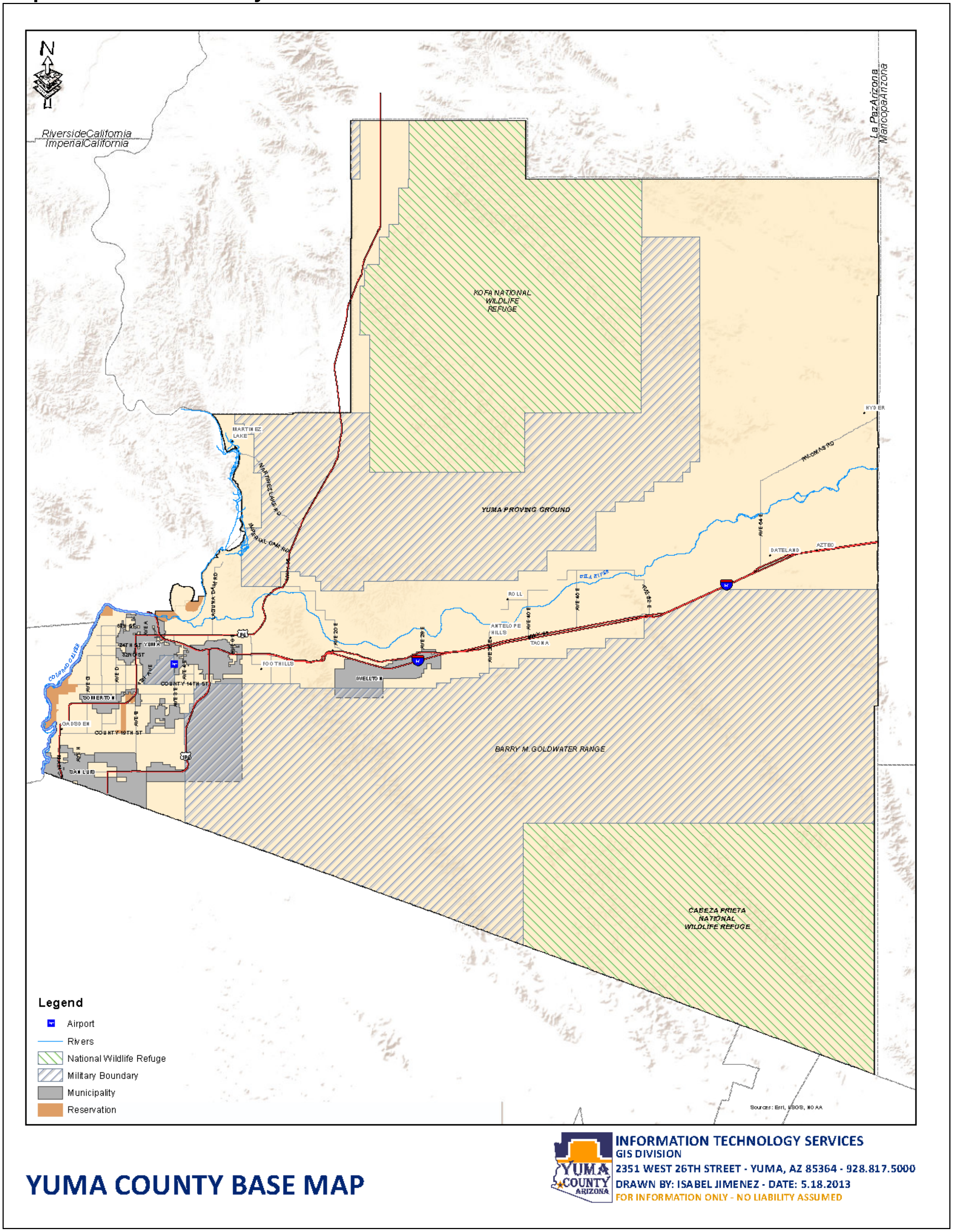
Utilities

Electric: Arizona Public Service Company (also Wellton Mohawk Irrigation District in the Dome Valley/Wellton area)

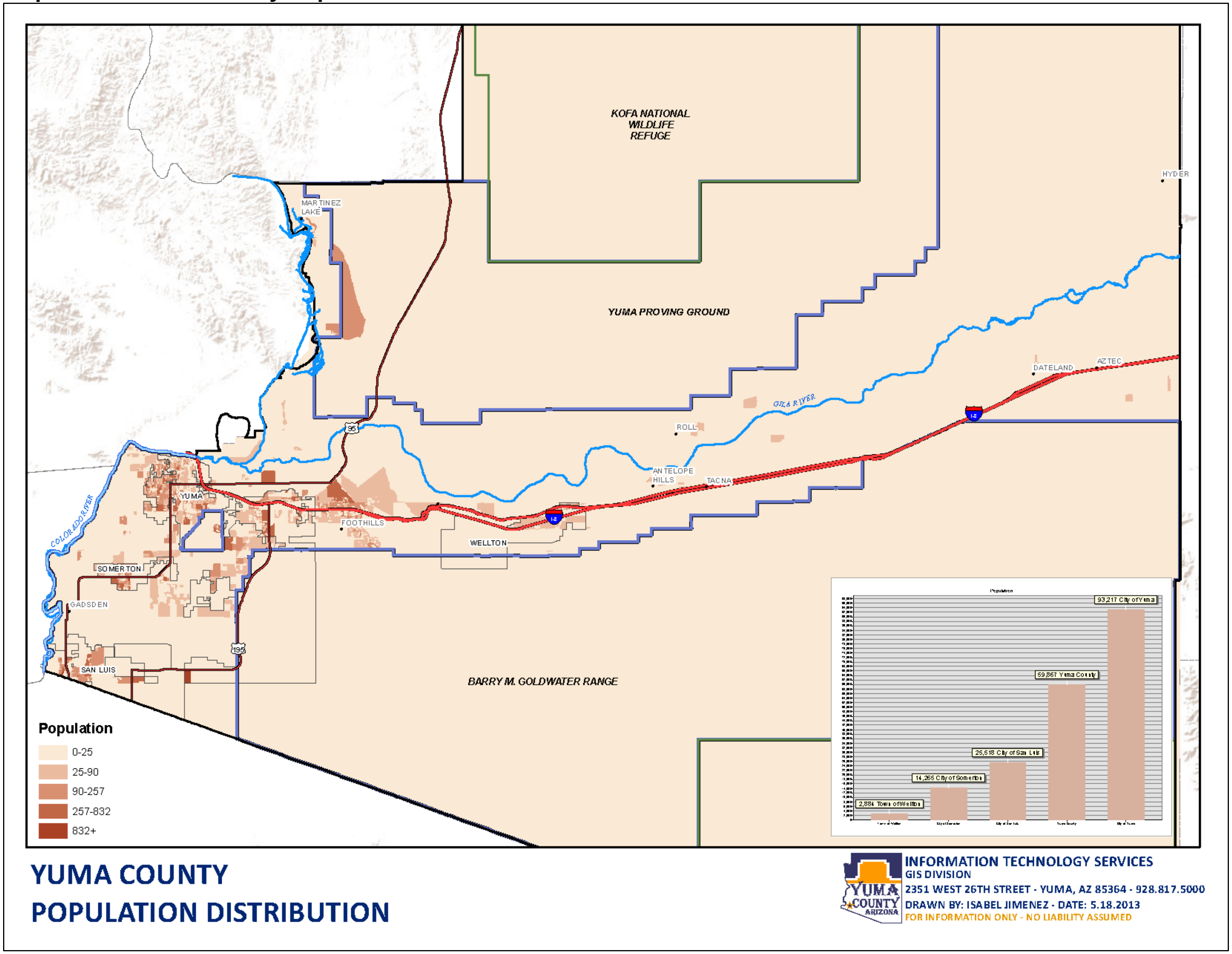
Gas: Southwest Gas Company, some mobile home parks on propane

Water/Sewer: Individual municipal systems (San Luis, Yuma, Somerton, Wellton) and an independent system of water/sewer known as the Far West Water Company, serving the foothills area of the Yuma community.

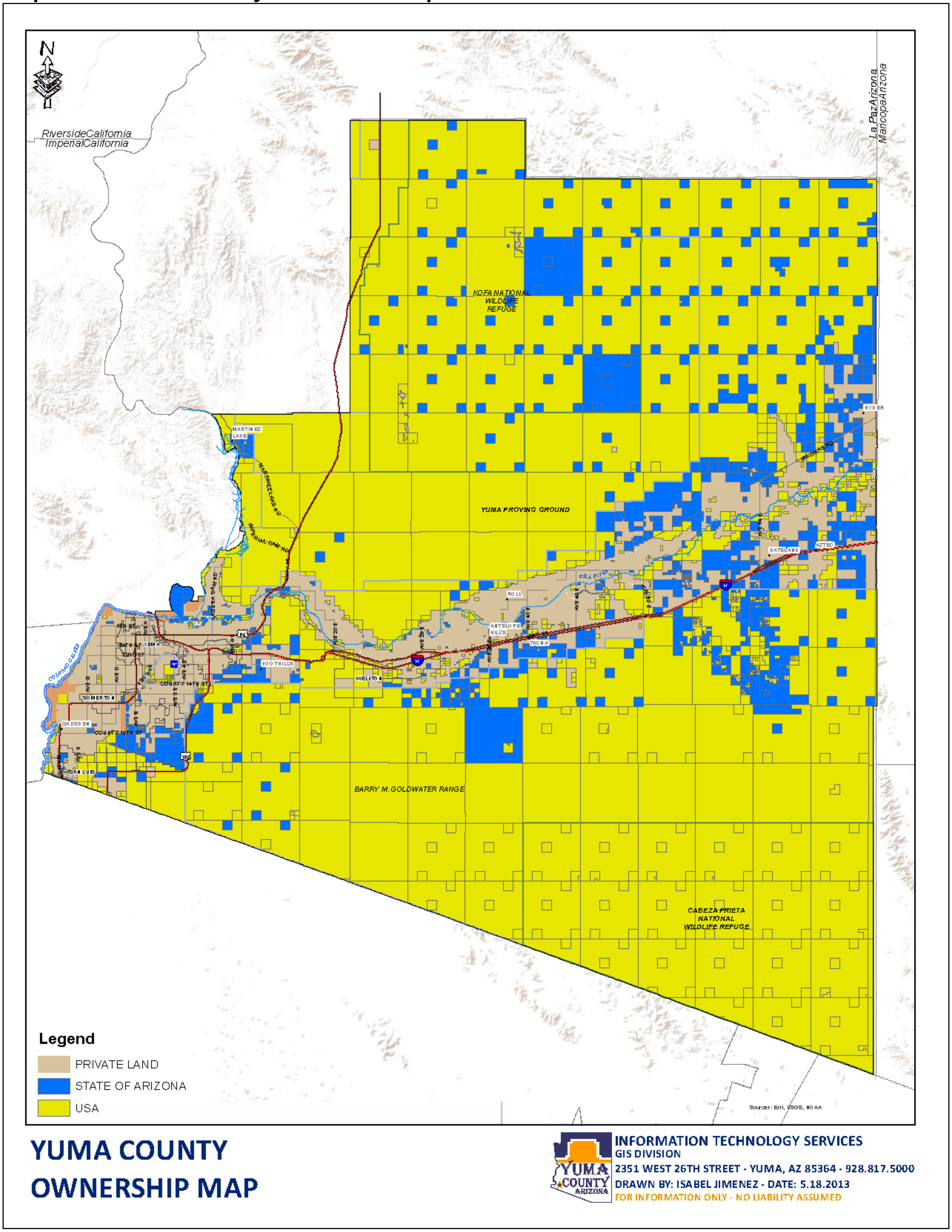
Map CD-39: Yuma County



Map CD-40: Yuma County Population



Map CD-41: Yuma County Land Ownership



4. Risk Assessment

Section Changes

Overview

Due to recent research on the subject and the focus on Climate Change, it is discussed in this section and more research on how it may affect Arizona and our disasters is anticipated. Information and data will be introduced into the Plan as it becomes available.

Hazard Profiles

During the current update process, it was determined the Plan shall now include Disease, Hazardous Materials Incidents and Terrorism. Including these hazards will make the Plan more consistent with other assessment and planning initiatives such as Homeland Security's Threat and Hazard Identification and Risk Assessment (THIRA) and the Emergency Management Accreditation Program (EMAP).

Local Jurisdiction Vulnerability

As does the State, local jurisdictions in Arizona use the Calculated Priority Risk Index (CPRI) methodology to weigh and prioritize their hazards. Local jurisdictional CPRI scores for each hazard have been "rolled-up" from county plans to provide a comparison between State and Local risk. Typically, for each hazard profile the CPRI scores from local plans are presented in table format, summarizing CPRI scores based on each county hazard mitigation plan (where available). The tables are provided to compare local vs. state perceived hazard risks. This comparison method utilizes the average county CPRI scores as a bench mark of perceived local risk.

Overview

Requirement: §201.4(c)(2): Risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments. The risk assessment shall include the following:

Identifying Hazards

As a part of the current update process, all of the hazards profiled in the 2010 Plan were closely examined and screened by the Planning Team. Certain considerations should be highlighted prior to reviewing risk assessment data in this section. These considerations include:

- Prior knowledge of the relative risk associated with each of the hazards;
- Information from the hazard event datasets including any recent events occurring within the most current plan update cycle;
- Comparison to risk assessment outcomes identified in local jurisdiction plans;
- The ability to effectively mitigate the hazard via the *DMA2000* process;
- The known or expected availability of information on the identified hazard;
- Duplication of the hazard's risk in other hazard definitions; and
- Whether or not the hazard is already being sufficiently addressed through other planning efforts of the State.

During past planning efforts there was a general consensus that several hazard categories should be consolidated or eliminated for clarity and brevity. For instance, hazards associated with a thunderstorm may include flooding, microburst winds, tornados, lightning and/or hail in a single event. Tropical storms/Hurricane is another storm event that may include damaging winds and heavy precipitation resulting in flooding. In both of these examples, the true resulting hazards are generally flooding and damaging or severe winds. Accordingly, the Planning Team chose to consolidate or eliminate several hazard categories during previous plan efforts. Changes to the hazard categories are:

Monsoon – this seasonal period typically begins in midsummer and can last for several months. In Arizona, the season is characterized by monsoon winds that bring humid subtropical air into the State. Solar heating then triggers afternoon thunderstorms that can produce devastating flash flood and wind related damages. The hazard category of Monsoon is eliminated as the damaging elements associated with the Monsoon season are primarily flood and severe wind related, which are covered elsewhere.

Thunderstorm/High Winds – the damaging elements associated with thunderstorms include very intense bursts of precipitation, micro- and macro-burst winds, hail, lightning, and occasionally tornados. Accordingly, the hazard category of “Thunderstorm/High Winds” is eliminated as the flooding and severe wind effects are addressed in other categories.

Tornado/Dust Devils –tornadoes and dust devils are usually associated with thunderstorm events. Additionally, mitigation of damages due to the typical type of tornado that impacts Arizona assets would be similar to those proposed for other severe wind events such as micro-bursts. Accordingly, this hazard is eliminated as a line item and will be incorporated into the Severe Wind category.

Tropical Storms/Hurricanes – the damaging elements associated with tropical cyclones are the heavy precipitation that results in flooding and sever winds. As with thunderstorm, these hazards are addressed elsewhere and this category is therefore redundant.

During the 2010 update process, the Planning Team added Extreme Heat and Levee Failure to the hazard list for Arizona. Extreme Heat was added based on the prominence of the hazard throughout much of State. Levee Failure was also added to address the State’s increased focus on evaluating and determining the flood risk associated with the potential failure of a levee system. There is also a historic precedent for the inclusion of both hazards.

Climate Change

Based on the growing body of research, it has become increasingly clear the world’s climate is changing. While the scope and severity of impacts resulting from climate change are still difficult to predict, emergency managers should consider the implications for hazards addressed during mitigation planning. The projected challenges posed by climate change, more intense storms, frequent heavy precipitation, rising temperatures and heat waves, increased drought and wildfire risk, and extreme flooding, could significantly increase the frequency and magnitude of emergencies and disasters faced by communities in Arizona (FEMA, 2011). The need to identify hazards and risks with the potential to cause future disasters, including those that may be intensified by climate changes, is an essential part of emergency management’s mission to reduce physical and economic loss and promote life saving measures. Proper acknowledgement and adequately accounting for climate change and resulting challenges will greatly assist emergency management in fulfilling this mission in the future (excerpt from *Climate Change, an Aggravating Factor for Arizona’s Natural Hazards*, Anthony Cox (ADEM) which can be viewed in this Plan’s Appendices.

Appreciating the difficulty in predicting the affects of climate change, we realize this is an issue that deserves more consideration. Discussion on how climate change could potentially affect Arizona’s identified hazards will be considered for inclusion in future updates of this Plan.

Profiled Hazards for This Plan

The profiles and historic hazard events summarized in each of the 15 county hazard mitigation plans provide “roll-up” information, which aids in identifying and screening hazards to determine statewide risk. The presumption is that the importance given to hazards by the local communities can inform the prioritization of hazards at the State level. According to the county plan’s roll-up, the top hazards predominately and consistently identified were:

- Drought
- Flooding/Flash Flooding (Thunderstorms, Tropical Storms, general storms, etc.)
- Severe Wind (Thunderstorms, Tropical Storms, Tornadoes, etc.)
- Wildfires

These top four hazards taken from the county plans are supportive of the hazards the Planning Team determined as the most important statewide. The following list of hazards represents the result of the screening/identification process undertaken by the Planning Team. Each of these hazards will be addressed in the profiling and vulnerability assessment phases of the overall risk assessment for this Plan:

- Dam Failure
- Disease
- Drought
- Earthquake
- Extreme Heat
- Fissure
- Flooding/Flash Flooding
- Hazardous Materials Incidents
- Landslide/Mudslide
- Levee Failure
- Severe Wind
- Subsidence
- Terrorism
- Wildfires
- Winter Storm

For the development of the 2013 Plan, the 2010 Plan’s historical hazard events information was updated by consolidating several of the original resources. Data from organizations such as ADEM, FEMA, the National Climate Data Center (NCDC), National Weather Service (NWS), Spatial Hazard Events and Losses Database for the U.S. (SHELDUS) and the US Forest Service, were used to develop the most complete inventory of historical events in tabular form, and in narrative form throughout the hazard profiles presented in this section.

The 2010 historic hazard database has been updated to include disaster declarations and events that have occurred during the current planning cycle. The previously established criteria and dataset for historical events were used without change. As such, hazard event data has been appended in the same consistent manner as previous update cycles. The time period for the historic events database is now 1966 to March 2013.

As part of the 2013 update process, original datasets such as the NCDC and SHELDUS were downloaded from current websites, purged of duplicate or erroneous records, and formatted to meet current dataset fields. The data consolidation effort was conducted to provide a more relevant and useful historic summary of disaster events for purposes of this plan.

The original hazard event dataset was populated in step-wise manner. The first step was to review records from ADEM, and FEMA, and the US Department of Agriculture (USDA) in order to identify and enter events that were declared a disaster or emergency by one or more of the following:

- Governor of Arizona;
- Secretary of the U.S. Department of Agriculture; or President of the United States.

Next, events were identified in the NCDC historic weather events dataset that, while not declared a disaster or emergency, caused sufficient one-time or repetitive damage to be considered a relevant hazard event in Arizona. To append new 2010 to 2013 records to the current Arizona State HMP dataset, added NCDC records met one or more of following criteria:

- 1 or more fatalities per hazard event;
- 1 or more injuries per hazard event;
- $50,000 or more in damages; or
- Significant events recorded under ADEM criteria.

Screening criterion is useful to eliminate small or minor events included in a wide array of datasets and allows us to focus attention on hazards that cause risk to human life or critical infrastructure. Data entries are typically from narrative descriptions cited in a wide range of sources which is identified in descriptive field as records in the database.

The table below provides a summary of records for declared disaster events within the State of Arizona for the period of 1966 to March of 2013. It should be noted that the hazard categories listed in the table below are formatted to match the hazards identified within this plan. As such, hazard categories from the NCDC, SHELDUS and FEMA databases have been changed to meet current planning requirements of the State. (e.g. – There have been three Presidential declarations for “Snow Storms” in Arizona. As part of a data consolidation effort “Snow Storm” hazard in FEMA’s databases has been converted to a “Winter Storm” category to allow hazard mitigation planners to consolidate hazard definitions and maintain consistency across data sources).

Table 1 - Declared Disasters in Arizona, 1966 – March 2013

Hazard Category	Total Events	Fatalities	Injuries	Total Property Damage
Dam Failure	3	0	0	$0
Drought	17	0	0	$303,000,000
Earthquake	1	0	0	$0
Fissure	0	0	0	$0
Flooding / Flash Flooding	127	70	154	$3,480,028,001
Landslide / Mudslide	1	0	0	$0
Levee Failure	0	0	0	$0
Subsidence	0	0	0	$0
Severe Wind	51	29	1,134	$933,811,000
Wildfire	64	6	28	$84,820,000
Winter Storm	11	12	0	$750,000
Total	**275**	**117**	**1,316**	**$4,802,409,001**

Notes: Declared disasters refer to Presidential, Gubernatorial and/or USDA.
Fatalities, Injuries and Total Expenditures data sources can vary or be unavailable for some records.
From 2010 to present, FEMA declared disasters and NCDC datasets have been updated.
Source: ADEM, FEMA, NCDC, and SHELDUS; 2013.

ASSESSING VULNERABILITY

Requirement: §201.4(c)(2)(ii): [The risk assessment shall include the following:] An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards and most vulnerable to damage and loss associated with hazard events. State owned critical or operated facilities located in the identified hazard areas shall also be addressed;

State Vulnerability

The vulnerability assessment provided in the 2007 Plan is updated in this 2013 Plan to reflect new and updated hazard profile and local multi-hazard mitigation plan data that have become available over the last three years. Specific changes will be summarized in each of the hazard profiles.

The vulnerability assessment for this Plan update is comprised of three key components:

- State Asset Inventory
- State Loss Estimation
- Local Vulnerability Summary

The procedures and methodology used by the Planning Team to accomplish each of the three components are discussed and summarized in the following subsections.

State Asset Inventory

A key component of the vulnerability analysis is the identification and location of state-owned assets. For the purpose of this Plan update, an asset is defined as:

> *Any natural or human-caused feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.*

The assets specifically considered in this Plan update are generally categorized as either human or structural. Human assets would include the general population and can be sub-grouped by age and many other socio-economic categories. Structural assets pertain more to the inanimate physical realm of constructed or planned infrastructure and facilities.

Structural Assets

In general, structural assets identified within the State are classified as critical or non-critical facilities and infrastructure. Critical facilities and infrastructure are those systems within the State whose incapacity or destruction would have a debilitating impact on the State's ability to recover following a major disaster, or to defend the people and structures of the State from further hazards. Following the criteria set forth by the Critical Infrastructure Assurance Office (CIAO – Executive Order 13010), the eight general categories that the State has adopted to define critical facilities and infrastructure are:

Table 2 - State Critical Facilities and Infrastructure Asset Categories

Asset Type	Summary
Communications Infrastructure	• Fiber Optic Lines • Radio, Cellular, and/or Microwave Towers • Large, trunk-line cables, Switch Offices
Electrical Power Systems	• High Voltage Transmission Lines • Transform Substations, Generation Stations
Gas and Oil Facilities	• Conveyance or Delivery Pipelines • Major Storage Locations (10,000 gallons or larger) • Production Facilities, Refineries • Natural Gas Pipelines (4-inch and larger) • Fuel and Oil Dispensing Locations Owned by the State
Banking and Finance Institutions	• Local Banks • Credit Unions
Transportation Networks	• Interstates, US or State Highways, Major Local Arterial Roadways • Railways, Rail Yards, Train Depots • Airports, Major Bridges, Culverts, and Storm Drains
Water Supply Systems	• Water Treatment Plants, Sewer Treatment Plants, Water Supply Wells/Reservoirs • Primary Delivery Pipelines (10-inch and larger) • Booster or Pump Stations • Storage Tanks, Water Towers
Government Services	• City, County, and/or State Administrative Buildings • Facility Yards • Military Bases, Correctional Facilities • Emergency Operation Centers, IT Support Centers
Emergency Services	• Fire, Police & Sheriff Stations • Hospitals, Trauma or Urgent Care Centers • Evacuation Centers, Ambulance Centers

Typically, other assets such as public libraries, educational institutions (universities, colleges, and other schools), museums, parks, recreational facilities, historic buildings or sites, churches, residential and/or commercial subdivisions, apartment complexes, and so forth, are classified as non-critical facilities and infrastructure, as they are not necessarily “critical” per the definition set forth in Executive Order 13010. Most State-owned facilities of these types, however, are very important to the State in that they often can function as emergency shelters and housing, and/or staging areas for fire-fighting and rescue operations. The table below displays the six additional categories used to further define State-owned assets. These facilities are classified as non-critical, but as previously noted, may serve as critical facilities during an emergency.

Table 3 - Non-Critical Facilities and Infrastructure Asset Categories

Asset Type	Summary
Educational	• Schools, Stadiums
Cultural	• Churches • Historic Buildings, Parks or Structures, Museums
Businesses	• Government owned buildings that operate as business centers • Buildings leased to commercial vendors
Residential	• Structures used primarily for living quarters or residential purposes: o Houses, Apartments, Mobile Homes, o Dining halls, Cafeterias, etc.
Recreation/Leisure	• Swimming Pools, Golf Courses, Parks • Gymnasiums, Recreation Halls

For this update, there was no comprehensive update to the 2010 Plan asset database and the Planning Team consensus decision was to use existing data as-is. A comprehensive spatial inventory of State Facilities could ultimately capture structures' footprints and vertical distribution of included assets and store the data in a geospatial database to better assess structural vulnerability to direct hazard impact (i.e. flooding or fire). In 2010, the Planning Team reviewed and re-classified several records in the data using a tiered approach that would capture the secondary use value of facilities that may not primarily qualify as a critical facility. For instance, the team assigned replacement costs to state-owned recreational facilities that could also function as emergency shelter locations. They may not be primarily classified as a critical facility but could be classified as critical on a secondary basis. The 2010 asset database includes information related to the facility's physical location, name, responsible agency, square footage, replacement cost, and latitude and longitude coordinates and identifies the facility category per the tables above and its status as either critical or non-critical. A summary of the state owned facilities tabulated by category, critical or non-critical status, and county is provided in Table 4. Other details of the database are not published with this plan, but are maintained on data servers at ADEM.

Risk Assessment Data Tables

The following are summaries of the data tables included and updated in the vulnerability analysis section of each hazard profile, as appropriate. A description is provided for each table that details the update process and the steps taken to develop the data in the table.

"Summary of State-Owned Asset Inventory Loss Estimates …" – These tables are developed using GIS algorithms that intersect spatially referenced state facilities with the particular hazard areas and jurisdictional boundaries to determine the total number of facilities that are exposed to the hazard and their location. A quantitative estimate of exposure for state facilities using GIS overlay tools and methods was performed for hazards with known risk zones such as flooding, wildfire, earthquake, fissure, subsidence and dam inundation zones where available. For other hazards with uncertain risks and extents, it was assumed that all state-owned facilities are equally exposed unless otherwise noted. Potential losses to state-owned facilities were estimated based on their assessed replacement value and loss-to-exposure ratios that were either: 1) obtained from published sources, 2) subjectively assigned based on trends noted in the historic record, or 3) assigned by some other rationale or logic. Potential loss estimates for exposed state facilities were calculated for dam failure, flooding and wildfire. The assignment and source of loss-to-exposure ratios are summarized in the vulnerability section of the hazard profiles where applicable. The tables presented throughout the hazard profiles are similar to those found in the 2010 Plan with minor adjustments. The table below provides a sample of a typical loss estimate table found in a hazard risk assessment profile along with definitions for fields found in each table.

Table 4 - Sample State-Owned Asset Inventory Loss Estimates Based

Jurisdiction	# of Facilities In Jurisdiction	Percentage of State-Wide Total	Est. Replacement Cost x $1,000)	Est. Structure Loss (x $1,000)
[Hazard Severity]				
*County 1**	*The total number of state-owned assets exposed to the subject hazard that are located within the respective jurisdiction*	*The percentage of the total statewide-owned assets exposed to the subject hazard attributable to this jurisdiction*	*The total estimated replacement cost for all exposed state-owned assets that are located within the respective jurisdiction*	*The total estimated structure loss for all exposed state-owned assets that are located within the respective jurisdiction*
Statewide	*The total number of state-owned assets exposed to the subject hazard*	*The percentage of statewide-owned assets exposed to the subject hazard (100%)*	*The total estimated replacement cost for all state-owned assets exposed to the subject hazard*	*The total estimated structure loss for all state-owned assets exposed to the subject hazard*

"State Facilities Located in the ---- Hazard Area by Jurisdiction" – These tables are developed using GIS algorithms that intersect spatially referenced state facilities with the particular hazard area to determine the total number of facilities that are exposed to the hazard. That data set is then intersected with incorporated jurisdictional boundaries for cities and towns within the state to determine the jurisdictional location for those exposed facilities. Facilities located within the unincorporated county areas are not summarized for these tables. The intersected facilities are tabulated by facility type. The table below provides a summary of critical and non-critical State Facilities located in each county.

Table 5 - State Facilities by Types and County

State Facility Type	Apache	Cochise	Coconino	Gila	Graham	Greenlee	La Paz	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma	Total
Critical Facilities																
Banking and Finance Institutions	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2
Communications Infrastructure	7	1	12	0	2	0	5	15	2	6	7	2	0	5	2	66
Electrical Power Systems	0	1	4	3	2	1	0	6	0	0	0	1	0	1	0	19
Emergency Services	0	3	2	0	4	0	0	26	0	1	36	14	0	0	3	89
Gas and Oil Facilities	9	6	11	13	4	3	6	16	9	12	9	13	2	10	4	127
Government Services	70	129	156	97	119	21	45	828	85	122	232	338	14	97	72	2,425
Transportation Networks	18	23	35	6	0	3	23	37	23	0	12	8	2	16	14	220
Water Supply Systems	6	5	25	12	14	5	12	29	11	5	19	31	0	10	7	191
Non-Critical Facilities																
Businesses	0	0	0	0	0	0	2	7	0	0	14	2	1	1	0	27
Cultural	0	3	16	0	7	0	5	4	2	0	12	8	12	24	7	100

Educational	0	10	61	5	13	0	0	185	0	2	464	39	1	1	38	819
Recreational/Leisure	13	19	11	12	18	0	36	60	26	5	35	21	21	30	6	313
Residential	19	33	68	29	80	2	17	149	15	19	108	117	3	33	22	714

Notes: Many of the Non-Critical facilities owned by the State can be used as shelters or staging areas during an emergency and may serve a "Critical" roll at that time.

"County Population Sectors Exposed to…" – These tables are developed using GIS algorithms that intersect US Census block level population data from census year 2010 and known hazard risk areas. Population count for partial block intersect with hazard areas is calculated based on the ratio of area intersected to total block size with the assumption that population density has a normal distribution. The results of total block intersects are then summarized by county. The table identifies total populations exposed to a particular hazard by county and the elderly over the age of 65. If zero population exposure is represented for a particular county, it is possible that hazard areas were either not identified, defined or not available at this time. According to the 2010 census data, the population for the State of Arizona is at about 6.4 million people. The total Arizona population represented by the 2000 Census block data was 5.2 million.

"Local Risk Assessment & Loss Estimates Based on…" – These tables were developed using data extracted from FEMA approved county and local plans. In several cases, data was not readily available and a "No Data Available" descriptor was used. Typically, missing data was attributed to either 1) the county not recognizing the particular hazard as a priority and did not evaluate losses for that hazard; or 2) the detailed information of the type reported in the table was not available from the county plan.

Local Jurisdiction Vulnerability

Multi-hazard mitigation planning has been conducted by all 15 counties within the State of Arizona. As such, each county has conducted vulnerability and risk analysis based on the *Index Values* and *Assigned Weighting Factors* determined using a tool developed by the State of Arizona called the Calculated Priority Risk Index (CPRI). The CPRI values are obtained by assigning varying degrees of risk to four (4) categories for each hazard, and then calculating an index value based on a weighting scheme. The weighting scheme for the CPRI is summarized below,

"CPRI Results for (each hazard)…" CPRI Scores for each hazard has been developed by the Planning Team and are included in each hazard profile of this section. Below is an example of how the weighting scheme from the CPRI table (described above) is applied. The values which help determine the CPRI for each hazard score are based upon the probability of an event occurring, the magnitude or severity of that event, how much warning time the state will have, and how long will the event impact the state for each hazard.

For an example, the CPRI for *"Hazard A"* was updated below. Hazard A's probability is ranked as highly likely, the magnitude/severity is typically critical, the warning time is less than 6 hours, and the duration is usually less than 24 hours. These factors resulted in a CPRI rating of 3.5 of a possible maximum of 4.0.

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score (Max: 4)
Hazard A	Highly Likely	Critical	< 6 hours	< 24 hours	**3.5**
	4	3	4	2	

CPRI Score = (Probability x .45) + (Magnitude/Severity x .30) + (Warning Time x .15) + (Duration x .10).

Local jurisdictions in Arizona use the same CPRI methodology to allow consistency among local and state planning efforts. Local jurisdictional CPRI scores for each hazard have been "rolled-up" from county plans to provide a comparison tool for planners at the State level. Typically, for each hazard profile the CPRI scores from local plans are presented in the roll-up table following the example table above. The roll-up table summarizes CPRI scores based on each Arizona county hazard mitigation plan (where available). The roll-up tables are provided to compare local vs. state perceived hazard risks. This comparison method utilizes the average county CPRI scores as a bench mark of perceived risk from local jurisdictions. Some CPRI scores are not available from county plans and comparisons are based upon best available data.

Table 6 – Sample Calculated Priority Risk Index (CPRI) Worksheet

<table>
<tr><th rowspan="2">CPRI Category</th><th colspan="3">Degree of Risk</th><th rowspan="2">Assigned Weighting Factor</th></tr>
<tr><th>Level ID</th><th>Description</th><th>Index Value</th></tr>
<tr><td rowspan="4">Probability</td><td>Unlikely</td><td>▪ Extremely rare with no documented history of occurrences or events.
▪ Annual probability of less than 0.001.</td><td>1</td><td rowspan="4">45%</td></tr>
<tr><td>Possibly</td><td>▪ Rare occurrences with at least 1 documented or anecdotal historic event.
▪ Annual probability that is between 0.01 and 0.001.</td><td>2</td></tr>
<tr><td>Likely</td><td>▪ Occasional occurrences with at least 2 documented historic events.
▪ Annual probability that is between 0.1 and 0.01.</td><td>3</td></tr>
<tr><td>Highly Likely</td><td>▪ Frequent events with a well documented history of occurrence.
▪ Annual probability that is greater than 0.1.</td><td>4</td></tr>
<tr><td rowspan="4">Magnitude/ Severity</td><td>Negligible</td><td>▪ Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure).
▪ Injuries or illnesses are treatable with first aid & no deaths.
▪ Negligible quality of life lost.
▪ Shut down of critical facilities for less than 24 hours.</td><td>1</td><td rowspan="4">30%</td></tr>
<tr><td>Limited</td><td>▪ Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure).
▪ Injuries or illnesses do not result in permanent disability & no deaths.
▪ Moderate quality of life lost.
▪ Shut down of critical facilities for more than 1 day and less than 1 week.</td><td>2</td></tr>
<tr><td>Critical</td><td>▪ Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure).
▪ Injuries or illnesses result in permanent disability and at least 1 death.
▪ Shut down of critical facilities for more than 1 week and less than 1 month.</td><td>3</td></tr>
<tr><td>Catastrophic</td><td>▪ Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure).
▪ Injuries or illnesses result in permanent disability & multiple deaths.
▪ Shut down of critical facilities for more than 1 month.</td><td>4</td></tr>
<tr><td rowspan="4">Warning Time</td><td>Less than 6 hrs</td><td>Self-explanatory.</td><td>4</td><td rowspan="4">15%</td></tr>
<tr><td>6 to 12 hrs</td><td>Self-explanatory.</td><td>3</td></tr>
<tr><td>12 to 24 hrs</td><td>Self-explanatory.</td><td>2</td></tr>
<tr><td>More than 24 hrs</td><td>Self-explanatory.</td><td>1</td></tr>
<tr><td rowspan="4">Duration</td><td>Less than 6 hrs</td><td>Self-explanatory.</td><td>1</td><td rowspan="4">10%</td></tr>
<tr><td>Less than 24 hrs</td><td>Self-explanatory.</td><td>2</td></tr>
<tr><td>Less than 1 wk</td><td>Self-explanatory.</td><td>3</td></tr>
<tr><td>More than 1 wk</td><td>Self-explanatory.</td><td>4</td></tr>
</table>

"CPRI Results for the Environment…" CPRI Scores for the Environment (Air, Water, Soil) has been developed by the Planning Team and are included in each hazard profile of this section. Below is an example of how the weighting scheme from the CPRI table is applied. The values which help determine the CPRI for each hazard score are based upon the probability of each component being impacted by event occurring, the magnitude/severity of the impact, and the duration of the impact/damage. This CPRI is much like the worksheet above for specific hazards, however some of the descriptions differ. It was also determined that warning time was not as critical as the worksheet is a measure of the impact to the components of the environment, not of a specific hazard event occurring.

This analysis has not yet been used by the local jurisdictions, therefore no data rolled up from local plans for comparison.

Table 7 – Sample Environmental Calculated Priority Risk Index (CPRI) Worksheet

CPRI Category	Degree of Risk to Arizona's AIR as a Result of Drought			Assigned Weighting Factor
	Level ID	**Description**	**Index Value**	
Probability of Impact	Unlikely	Extremely rare. No documented history of occurrences/events.	1	30%
	Possibly	Rare occurrences with at least one documented or anecdotal historic event.	2	
	Likely	Occasional occurrences with 2+ documented historic events.	3	
	Highly Likely	Frequent events with a well documented history of occurrence.	4	
Magnitude/ Severity	Negligible	Negligible impact.	1	30%
	Limited	Moderate impact. Special population groups may experience effects. Unlikely to impact general public.	2	
	Critical	Significant impact. General public likely to experience effects. Caution required.	3	
	Catastrophic	Severe impact. Unsafe for general public. Evacuation required.	4	
Duration of Impact	< 1 month	Self explanatory.	1	30%
	1 – 3 months	Self explanatory.	2	
	3 – 6 months	Self explanatory.	3	
	6 months +	Self explanatory.	4	
CPRI Category	**Degree of Risk to Arizona's WATER as a Result of Drought**			**Assigned Weighting Factor**
	Level ID	**Description**	**Index Value**	
Probability of Impact	Unlikely	Extremely rare. No documented history of occurrences/events.	1	30%
	Possibly	Rare occurrences with at least one documented or anecdotal historic event.	2	
	Likely	Occasional occurrences with 2+ documented historic events.	3	
	Highly Likely	Frequent events with a well documented history of occurrence.	4	
Magnitude/ Severity	Negligible	Negligible impact/disruption.	1	30%
	Limited	Minor impact/disruption. No threat to public, caution limited. Possible remediation required.	2	
	Critical	Moderate impact/disruption. Consumption may require special handling/preparation actions. Remediation likely.	3	
	Catastrophic	Severe impact/disruption. Not safe for consumption/agricultural uses. Remediation required.	4	
Duration of Impact	< 1 month	Self explanatory.	1	30%
	1 – 3 months	Self explanatory.	2	
	3 – 6 months	Self explanatory.	3	
	6 months +	Self explanatory.	4	
CPRI Category	**Degree of Risk to Arizona's SOIL as a Result of Drought**			**Assigned Weighting Factor**
	Level ID	**Description**	**Index Value**	
Probability of Impact	Unlikely	Extremely rare. No documented history of occurrences/events.	1	30%
	Possibly	Rare occurrences with at least one documented or anecdotal historic event.	2	
	Likely	Occasional occurrences with 2+ documented historic events.	3	
	Highly Likely	Frequent events with a well documented history of occurrence.	4	

Magnitude/ Severity	Negligible	Negligible impact/disruption.	1	30%
	Limited	Moderate impact/disruption. No remediation required.	2	
	Critical	Significant impact/disruption. Recovery likely with remediation.	3	
	Catastrophic	Severe impact/disruption, rendered non-productive/unusable for agriculture and/or development for extended period of time or indefinitely.	4	
Duration of Impact	< 1 month	Self explanatory.	1	30%
	1 – 3 months	Self explanatory.	2	
	3 – 6 months	Self explanatory.	3	
	6 months +	Self explanatory.	4	

Environmental Risk & Vulnerability Due to (Hazard) Calculated Priority Risk Index (CPRI)				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score** (max: 3.6)
Air	Unlikely	Negligible	< 1 month	**.85**
Water	Unlikely	Catastrophic	6 months+	**2.95**
Soil	Unlikely	Critical	6 months+	**2.65**
Average CPRI Environmental Risk Rating: 2 (max 3.6)				

Population

Historic and projected populations for the counties and selected local jurisdictions are provided in Section 4 and a table summarizing the total estimated population for the state and by county as of July 2009 is included below. As previously discussed, vulnerability of the state population to the Plan hazards are estimated for the following sectors using 2000 Census block level data:

- Total population
- Number of persons 65 years and older (potentially vulnerable population group)

Maricopa County (which includes Phoenix, Mesa, and numerous other local jurisdictions) has by far the largest population in the State, both in terms of total population and households, as well as in terms of potentially vulnerable population groups. Pima County (which includes Tucson) is the next largest county.

Arizona Population, July 2009	
State/County	**Population**
State of Arizona	6,683,129
Apache	76,668
Cochise	140,263
Coconino	136,735
Gila	57,204
Graham	39,792
Greenlee	8,688
La Paz	21,616
Maricopa	4,023,331
Mohave	206,763
Navajo	115,420
Pima	1,018,012
Pinal	356,303
Santa Cruz	47,900
Yavapai	228,494
Yuma	205,940
Source: Arizona Department of Commerce, April 2010	

Arizona has a relatively small number, but high proportion, of population that may be vulnerable to hazards. These populations have historically involved the following demographic types: those that are very young or very old and households earning very low incomes. According to latest statistics from the U.S. Census Bureau for the three year period of 2006-2008, approximately 26.4% of the State's resident base is comprised of inhabitants under the age of 18, while 13.0% are 65 and over. Together these groups comprise approximately 39.4% of the State's overall population. Furthermore, Arizona's income levels reflect 10.2% of the population living below poverty level.

Overall, Arizona has experienced growth in the past three years. According to the U.S. Census Bureau, July 2010 – July 2012 carried a population increase of 2.5%. However, many counties such as Graham, Navaho, Gila and La Paz have experienced a population decline in the past three years. Population growth directly correlates to growth in the sectors of housing, retail, infrastructure, etc. Growth in these sectors can inform the goals of hazard mitigation, especially in hazard prone areas, and will drive the need for more or enhanced planning mechanisms at the local level to ensure smart growth. Growth will also increase the need for mitigation activities to protect the existing and new development. Over the past three years, ADEM has worked closely with growing Arizona counties and communities by aiding in the review and update of their current hazard mitigation plans to ensure they reflect and address growth related challenges. Aid in the form of secured funding for the mitigation plan updates, provision of resources such as brochures and pamphlets, input to discussions during planning team meetings, and mitigation plan review, were provided by ADEM.

Table 10: County Population Growth from July 2010 to July 2012.

County	Growth %
Pinal	10.7%
Maricopa	3.6%
Yuma	3.2%
Apache	3.0%
Greenlee	2.0%
Coconino	1.9%

County	Growth %
Mohave	1.8%
Pima	1.7%
Cochise	1.5%
Yavapai	.7%
Santa Cruz	.6%
Graham	-0.3%
Navajo	-0.4%
Gila	-0.8%
La Paz	-1.1%

Source: US Census Bureau: State & County QuickFacts, June, 2013.

Table 11: Top 15 Growing Arizona Jurisdictions for July 2010 - July 2012

			Jurisdictional Hazard Exposure at High or Significant Risk Level														
Jurisdiction	**County**	**Growth**	**Dam Failure**	**Disease**	**Drought**	**Earthquake**	**Extreme Heat**	**Fissure**	**Flooding / Flash Flooding**	**HAZMAT**	**Landslides / Mudslides**	**Levee Failure**	**Severe Wind**	**Subsidence**	**Terrorism**	**Wildfires**	**Winter storm**
Duncan	Greenlee	7.87%		X	X				X			X				X	
Guadalupe	Maricopa	7.37%		X			X		X				X			X	
Buckeye	Maricopa	6.52%	X	X	X		X		X				X			X	
Thatcher	Graham	6.13%		X	X				X				X				
Goodyear	Maricopa	6.12%	X	X	X		X		X				X			X	
Marana	Pima	5.90%		X	X	X	X		X	X		X	X	X		X	X
Gilbert	Maricopa	5.62%	X	X	X		X	X	X			X	X	X		X	
Queen Creek	Maricopa	5.33%	X	X	X		X		X				X			X	
Clifton	Greenlee	4.58%		X	X				X			X				X	
Litchfield Park	Maricopa	4.36%		X			X		X				X			X	
Chandler	Maricopa	3.81%		X	X		X		X				X				
Peoria	Maricopa	3.51%	X	X	X		X	X	X			X	X			X	
Prescott	Yavapai	3.33%		X					X		X		X				X
Somerton	Yuma	3.25%		X	X	X			X				X				
Paradise Valley	Maricopa	3.03%	X	X	X		X		X			X	X			X	

Source: Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2012; U.S. Census Bureau, Population Division

Estimating Potential Losses

Requirement: §201.4(c)(2)(iii): [The risk assessment shall include the following:] An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure and critical facilities located in the identified hazard areas.
Update Requirement §201.4(d): Plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities…

The estimation of potential losses is expressed in terms of population exposure and dollar losses due to damage of State-owned facilities. Wherever possible, a quantitative approach was used. Where data was not available, a more qualitative approach was adopted. Estimates of losses and/or exposure are discussed and summarized by hazard in Section 5.4. The assessment for each hazard is typically based on a commonly accepted event type, such as the 100-year flood or a National Weather Service severe thunderstorm. Wherever possible, a quantitative and comparable assessment of vulnerability to the hazard was made. The vulnerability assessment builds upon the hazard profile information by geospatially identifying the State-owned assets and population estimates and intersecting them with the hazard profiles to generate a list of exposed assets. Exposure to loss ratios is then applied to estimate the potential amount of damage/loss that could be caused by each hazard event to State-owned facilities.

Note that the loss estimates provided herein use the best data currently available and the methodologies applied result in an approximation of risk. In some cases, the exposure to loss ratios is purely subjective. These estimates are solely intended to provide an understanding of relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment, as well as approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people and State-owned facilities, with loss estimations to State-owned facilities being made where appropriate. It was beyond the scope of this Plan update to analyze other types of hazard impacts (e.g., people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts are candidates for address with future updates of the plan as data become available to support such estimates.

Several of the hazards profiled in this Plan update will not include quantitative exposure and loss estimates. The vulnerability of people and State-owned facilities/infrastructure associated with some hazards are nearly impossible to evaluate given the uncertainty associated with where these hazards will occur, as well as the relatively limited focus and extent of damage. Instead, a qualitative review of vulnerability will be discussed to provide insight to the nature of losses that are associated with the hazard. For subsequent updates of this Plan, the data needed to evaluate these unpredictable hazards may become refined such that comprehensive vulnerability statements and thorough loss estimates can be made.

Hazard Profiles

Requirement: §201.4(c)(2)(i): [The risk assessment shall include the following:] An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future events, using maps where appropriate:

For this Plan, the hazard profile section was thoroughly reviewed and updated by the Planning Team as a whole and in specific by Planning Team members according to their area of expertise. For example, the Team Member from the Forestry Division of the State Land Department reviewed and provided recommended changes on the wildfire profile. The Team Members also provided updated profile information to also be used for the mapping included in this section. The following topics are discussed for each hazard in the following pages:

- **Introduction/History**: Background information about the hazard and previous occurrences in Arizona is provided. The information in this section is drawn mainly from the database of historical hazard events in Arizona.
- **Map XX**: A description of the hazard profile map or maps provided to better illustrate the risk posed by the hazard. These may appear at various locations throughout the profile.
- **Potential Secondary/Cascading Effects**: Cascading events, sometimes referred to as multi-hazard events, occur as a direct or indirect result of some initial event. For example, ground shaking from an earthquake precipitates a rock-fall that dams a stream that results in local flooding which swamps a nearby community ending in loss of life, mass evacuations, and property damage – a perfect example of how an initial event can multiply into a suite of discrete but related events. Taken together, cascading events can cripple a community. A description of the secondary or cascading effects attributable to the hazard and its occurrence is discussed in the section.
- **Probability and Magnitude**: The probability or frequency of the hazard and its magnitude. The information in this section is drawn from a combination of national sources, Arizona expertise, and the Arizona hazard event database.
- **Vulnerability**: This section summarizes the vulnerability analysis and loss estimations for the subject hazard. The first part of the vulnerability analysis is an assessment of the perceived overall risk for each of the plan hazards using a tool developed by the State of Arizona called the Calculated Priority Risk Index (CPRI). The CPRI value is obtained by assigning varying degrees of risk to four (4) categories for each hazard, and then calculating an index value based on a weighting scheme. The indices and weighting scheme for the CPRI are summarized in the table on the following page. Loss to exposure ratios comparisons to the 2007 Plan results are discussed and summarized, where appropriate.
- **Environmental Risk and Vulnerability**: The hazard risk is evaluated with respect to three environmental elements; air, water, and soil. An evaluation risk matrix tool was used to assess the risk posed by each hazard to environmental elements.
- **Consequences/Impacts**: This section provides an assessment of the consequence and impacts posed by an occurrence of the hazard, to the following sectors:
    - **Public** – the public in general
    - **Responders to the Incident** – a discussion of the hazard impacts/consequence posed to officials and individuals responding to or during the hazard.
    - **Continuity of Operations/Delivery of Services** – an assessment of the hazard impact/consequence to state agencies and delivery of state level services.

  - **Environment** – a general discussion of the impacts/consequences of the hazard on the environment. This will compliment the previous "Environmental Risk & Vulnerability" section.
  - **Economic / Financial Condition of Jurisdiction** – a general discussion of the impacts/consequences to the Arizona economy and financial condition.
  - **Public Confidence in Jurisdiction's Governance** – a general discussion of the impacts/consequences to the public's confidence in the ability of the state to effectively govern and maintain governance during and after the hazard event.
- **Resources**: This section provides a listing of resources available for information and help with the hazard per the following sub-categories:
  - **Definitions** – definitions peculiar to the hazard or hazard resources. These may be duplicated or in addition to the those found in the general Glossary of Terms
  - **Sources** – A listing of sources for further investigation and understanding regarding the hazard
  - **References** – A bibliography of literature, website, agency, and other published data sources used to develop the hazard profile.

Dam Failure

Introduction/History

Two dam failure disaster declarations (Presidential or Gubernatorial) and four (4) additional undeclared dam failure events were identified in Arizona. Collectively, these events resulted in an estimated 150 fatalities. A sampling of these events is listed below:

- April 19, 2004. A State Declaration of Emergency was declared at River Reservoir No. 3 Dam in Apache County due to concern based on observed seepage and internal erosion. The large volume of seepage and eroded embankment soil was first observed on March 30, 2004. Successively larger increases in seepage flow and eroded embankment soils reached a magnitude on April 13 that appeared to indicate an imminent failure was possible. The County Sheriff mobilized personnel to monitor the dam on a 24-hour basis to provide early warning of a dam failure and to facilitate evacuation of residents in the threatened downstream communities of South Fork, Eagar and Springerville. The reservoir was drained and the dam repaired the following year.
- September 1997. Centennial Narrows Dam in Maricopa County failed due to flooding from Hurricane Nora. This failure is significant because the single-purpose flood control dam most likely failed due to flow through transverse cracks through the dam. Major population areas in Maricopa and Pinal Counties are protected by earthen dams experiencing similar cracking.
- February 22, 1890. The most significant dam failure experienced in the State occurred in Walnut Grove. The dam failed due to overtopping and the ensuing flood caused an estimated 150 deaths and extensive destruction of property. The failure was blamed on inadequate capacity of the spillway and poor construction (ADEM, March 1998). Located 30 miles by river north of Wickenburg on the Hassayampa River, the dam was built to provide water for irrigation and gold placer mining. The rock fill structure was 110 feet high, 400 feet long, had a base width of 140 feet, a top width of 10 feet, and a spillway of 5 - 20 feet long. The lake was 2.5 miles long by one mile wide covering over 1,100 acres, and an average depth of 60 feet. Based upon various accounts of the Walnut Grove Dam failure, the weather at the time was rain and melting snow. The day before the breach, water in the lake rose rapidly at the rate of about one and one-half foot per hour. The spillway was enlarged to allow excess water to escape but the effort was insufficient to stop water from running over the top. A sheet of water three feet thick reportedly poured over the dam top for six hours. Between 1 – 2 am on February 22, 1890 the dam broke and the lake drained in one to two hours. The water rushed down Box Canyon, a narrow, steep canyon in a body 80 feet high. Floodwaters reached Wickenburg, 30 miles downstream in two hours and were reportedly still in a column 40 feet high.

Arizona's Dam Safety Program has existed since 1929, prior to 1971, funding for the program was minimal and sporadic. Legislative approval of a consistent budget since 1971 has authorized permanent staffing and the development of a comprehensive Dam Safety Program. Arizona dam safety law includes the major areas suggested by the National Dam Safety Program Act and the United States Committee on Large Dams. The Arizona Revised Statutes (A.R.S.) § 45-1201 assigns the responsibility for supervision of the safety of non-federal dams to the Director of the Arizona Department of Water Resources (ADWR). The mission of the ADWR Dam Safety Section is to maximize the protection of the public against loss of life and property by reducing the likelihood of catastrophic failure of dams within the state's jurisdiction.

A.R.S. § 45-1201 defines a jurisdictional dam as an artificial barrier for the impounding or diversion of water either 25 feet or more in height or having a storage capacity of more than 50 acre-feet, but does not include:

- Any barrier for the purpose of storing liquid-borne material (e.g. mine tailings dams),
- Any barrier that is a “release-contained barrier,”
- Any barrier that is federally owned and operated, and
- Sole use transportation structures
- Any barrier that is or will be less than six feet in height, regardless of storage capacity.
- Any barrier that has or will have a storage capacity of fifteen ac-feet or less, regardless of height.

The statutes further define “height” as the vertical distance from the lowest elevation of the outside limit of the barrier at its intersection with the natural ground surface to the spillway crest elevation. “Storage capacity" is defined as the maximum volume of water, sediment, or debris that can be impounded in the reservoir with no discharge of water, including the situation where an uncontrolled outlet becomes plugged.

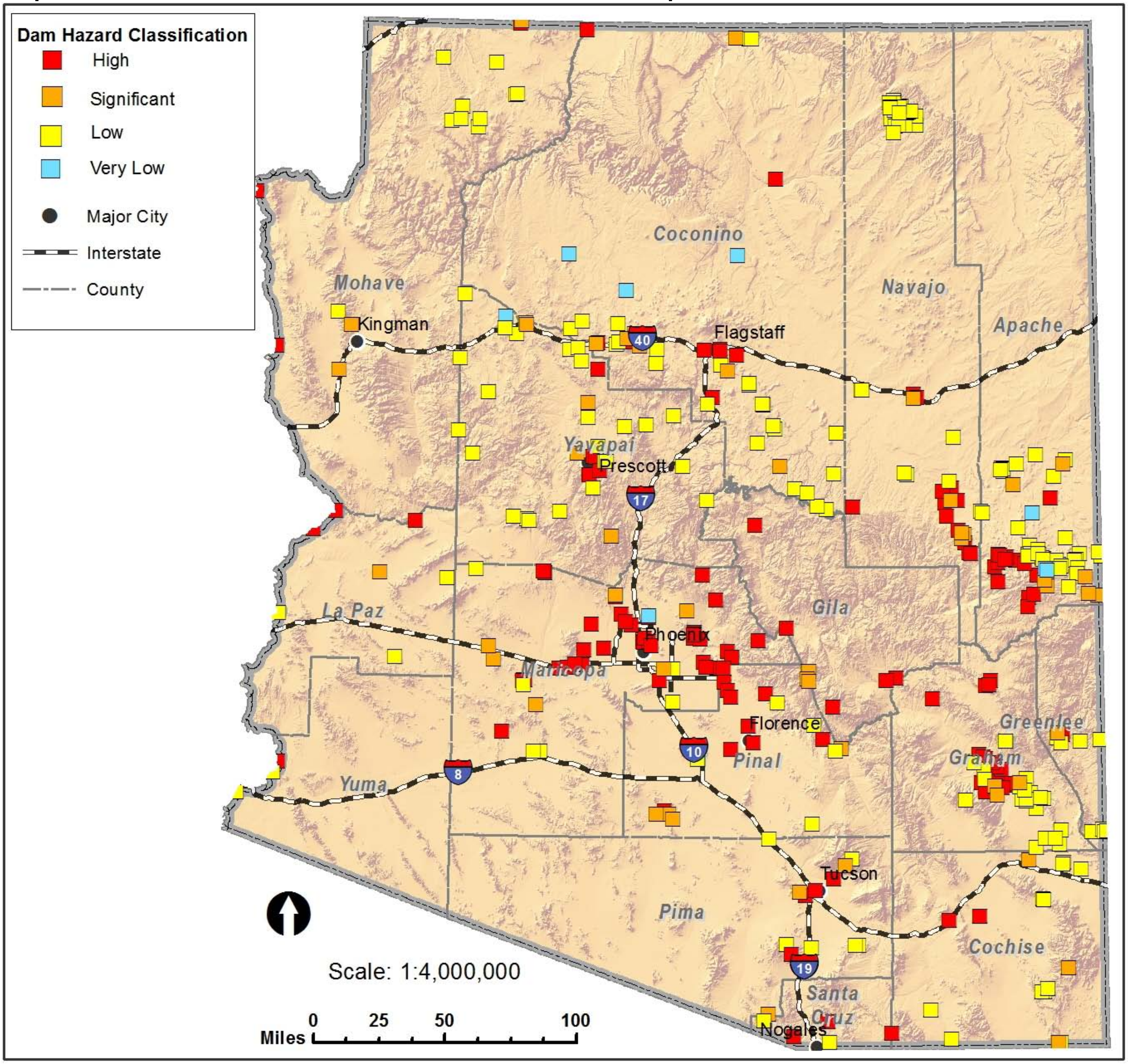
In order for an artificial barrier and/or appurtenant works structure to be considered a "release-contained barrier," both of the following criteria should comply:

a) Has storage capacity that in the event of failure would be contained within property that the release-contained barrier owner owns, controls, operates, maintains or manages.

b) The property on which the release would be contained is not open to the public.

The following map illustrates the locations of all state jurisdictional dams and federal dams. Data was obtained from ADWR and the National Inventory of Dams (NID). This map does not include the dams owned by the City of Phoenix Water Services Department. The City formally requested that the Department keep the locations confidential due to Homeland Security issues. However, the numbers within the narrative tables include those dams.

Map RA-1: State Jurisdictional and Federal Dam Location Map



Potential Secondary/Cascading Effects

The most obvious secondary effect of a dam failure is flooding and the associated damages due to erosion, debris, and hazmat contamination. Another secondary impact would be the loss of stored water and that impact during a season of drought. This would be especially true if the reservoir were relied upon as a source for irrigation or drinking water. Ground fissures located in the downstream flood path could also be enlarged with the flowing water. A dam failure could also trigger a mudslide in the right conditions depending on the geology of the area, and especially in the rapidly evacuated pool area.

Probability and Magnitude

A dam failure is an uncontrolled release of water impounded behind the dam. Dam failures may occur due to a variety of causes. As shown in below, the three most common causes, i.e. leakage and piping, overtopping, and spillway erosion have been responsible for 74% of historic failures.

Table RA-1: Dam Incidents Causes (Dam > 50 Feet High)

Fundamental Causes	Percentage
Foundation Leakage & Piping	35
Overtopping	25
Spillway Erosion	14
Excessive Deformation	11
Sliding	10
Gate Failure	2
Faulty Construction	2
Earthquake Instability	2

Source: "Safety of Existing Dams, 1983, National Research Council

Jurisdictional dams in Arizona, as illustrated in below, can generally be divided into two groups: (1) storage reservoirs designed to permanently impound water, and (2) normally dry single-purpose flood control structures designed to impound water for short duration of times during flood events. In Arizona, storage reservoirs are common in the higher elevations of the state while single-purpose flood control dams are prevalent in the lower elevations.

Table RA-2: Primary Dam Failure Risks on "Sunny Days" and During Flood Events

Dam Type	"Sunny Day"	Flood Event
Storage Reservoir Dams	Leakage and Piping	Leakage & Piping, Overtopping, Spillway Erosion
Single-Purpose Flood Control Dams	Not Applicable	Leakage & Piping, Overtopping, Spillway Erosion

Typically, the dam-break inundation zone is more extensive than the regulatory floodplains used for land use development purposes and few communities consider upstream dams when permitting development. The potential severity of a full or partial dam failure is influenced by several factors: the amount of impounded water, the rate of failure; and the density, type, and value of development and infrastructure downstream.

The following two information sources provide an indication of the risk posed by specific dams in Arizona and the potential for their failure:

- ADWR's Dam Safety Program: ADWR has jurisdiction of 251 dams in Arizona. The numbers of dams under different structure types are summarized in Table RA-3.
- The average height and storage capacity are approximately 32 feet and 2,000 acre-feet. Major program areas include: applications to construct, modify or remove; construction monitoring; inspection and oversight of existing dams; EAP planning and response; unsafe dam rehabilitation; and unregistered (violation) dams. A Dam Safety Database was created to store information on the physical attributes of the dam as well as ownership, location, hazard rating, safety types and deficiencies, and EAPs.
- National Inventory of Dams (NID): The NID contains information on approximately 79,000 dams throughout the United States that meet the following criteria: it is a high or significant hazard potential class dam or, it is a low hard potential class dam that exceeds 25 feet in height and 15 acre-feet storage, or it is a low hazard potential class dam that exceeds 50 acre-feet storage and six (6) feet in height. The NID is maintained, updated, and published by the U.S. Army Corps of Engineers with information from all 50 states, Puerto Rico, and 16 Federal agencies. The inventory consists of 54 data fields that describe the physical and regulatory aspects of the dam, including name, owner, river, nearest city, length, height, average storage, hazard rating, EAP, and location. In 2006, the NID database listed 328 dams that were located in the State of Arizona.

Table RA-3: Dam Type Counts

Type	Number
Arch/Multiple Arch	5
Gravity	5
Masonry	5
Other	4
RCC	1
Earthen	231
Total Number of Dams	**251**

Source: ADWR Dam Safety Database (May 2013)

The NID and ADWR databases provide useful information on the potential hazard posed by dams. Each dam in the NID is assigned one of the following three hazard potential classes based on the potential for loss of life and damage to property should the dam fail. The above table provides a listing of dams in increasing hazard severity: low, significant, or high. The hazard potential classification is based on an evaluation of the probable present and future incremental adverse consequences that would result from the release of water or stored contents due to failure or improper operation of the dam or appurtenances, regardless of the condition of the dam. The ADWR evaluation includes land-use zoning and development projected for the affected area over the 10-year period following the classification of the dam. It is important to note that the hazard potential classification is an assessment of the consequences of failure, but not an evaluation of the probability of failure or improper operation.

Table RA-4: Downstream Hazard Potential Classes for State Regulated Dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Very Low	None Expected	Limited to Owner or 100-year floodplain
Low	Not Likely	Low and generally limited to owner
Significant	Not Likely	Yes
High	Probable. One or more expected.	Yes (but not necessary for this classification)

Note: The hazard potential classification is an assessment of the consequences of failure, but not an evaluation of the probability of failure. Sources: NID, ADWR

Table RA-5: Identified Federal and State Regulated Dams in Arizona, 2009

County	High Hazard Potential	Significant Hazard Potential	Low Hazard Potential	Total
Apache	15	8	39	62
Cochise	3	3	10	16
Coconino	10	5	30	45
Gila	3	3	1	7
Graham	21	3	21	45
Greenlee	1	1	14	16
La Paz	1	1	2	4
Maricopa	44	6	7	57
Mohave	3	3	11	17
Navajo	12	5	38	55
Pima	4	3	5	12
Pinal	10	5	6	21
Santa Cruz	2	0	2	4
Yavapai	7	4	28	39
Yuma	3	1	3	7
Total	**139**	**51**	**217**	**407**

Source: NID, ADWR Dam Safety Database (October 2009)

Federal Dams on the Salt/Verde River, the Aqua Fria River, the Gila River, and the Colorado River pose a potential threat to population centers and agricultural lands within the State (refer to the following table). For example, failure of any U.S. Bureau of Reclamation dams on the Salt/Verde River or the Aqua Fria River would cause massive flooding in Phoenix and Maricopa County. Failure of Coolidge Dam, a Bureau of Indian Affairs Dam, on the Gila River could cause massive flooding in the Winkelman and Hayden areas of Gila County; Kearny, Florence and the Gila River Indian Reservation in Pinal County; and possibly portions of Maricopa County. Failure of Painted Rock Dam, an Army Corps of Engineers dam, also on the Gila River system, could result in massive flooding of portions of Maricopa and Yuma Counties, including the City of Yuma. Failure of any or all the Bureau of Reclamation dams on the Colorado River would cause massive flooding in Mohave, La Paz and Yuma Counties. Table RA-6 provides a listing of high and significant hazard potential federal dams located on major Arizona rivers.

Table RA-6: High & Significant Hazard Potential Federal Dams on Major Arizona Rivers

River	NID	Dam Name	Hazard Class	Height (ft.)	Storage (ac-ft.)	Purpose	Nearest Downstream Development
Salt	AZ10311	Horse Mesa	High	305	261,335	Irrigation, Hydroelectric, Water Supply	Mesa
	AZ10313	Mormon Flat	High	224	57,852	Irrigation, Hydroelectric, Water Supply	Mesa
	AZ10318	Stewart Mountain	High	207	70,070	Irrigation, Water Supply, Hydroelectric	Mesa
Verde	AZ10308	Bartlett	High	309	249,693	Water Supply	Mesa
	AZ10310	Horseshoe	High	202	214,372	Water Supply, Irrigation	Fort McDowell
Agua Fria	AZ82929	New Waddell	High	438	1,063,163	Recreation	Peoria
Gila	AZ10436	Coolidge	High	252	1,073,000	Irrigation, Hydroelectric, Recreation	Winkelman
	AZ10002	Painted Rock	High	181	4,831,500	Flood Control & Storm Mgmt	Agua Caliente
Colorado	AZ10307	Glen Canyon	High	710	29,875,000	Hydroelectric, Irrigation, Recreation, Other	Lees Ferry
	NV10122	Hoover	High	730	29,755,000	Hydroelectric	Bullhead City
	AZ10312	Parker	High	320	180,000	Water Supply, Irrigation, Hydroelectric	Parker
	AZ10309	Davis	High	200	1,592,300	Hydroelectric	Bullhead City
	CA10159	Imperial	No Data	No Data	No Data	Irrigation	Yuma
	AZ10437	Headgate Rock	Significant	34	20,000	Irrigation, Hydroelectric	Parker
Bill Williams	AZ82203	Alamo	High	283	1,409,000	Flood Control	Parker

Sources: NID, ADWR

State regulated single-purpose flood control dams operated and maintained by the Flood Control District of Maricopa County provide flood protection to large populations in the Phoenix Metropolitan Area. Failure of any of these dams would cause serious flooding.

State regulated dams are inspected regularly by ADWR according to downstream hazard potential classification. High hazard dams are inspected annually; significant hazard dams, every three years; and low hazard dams every five years. During inspections, "safety deficiencies" are sometimes identified and the owners are required to implement corrective actions. A "safety deficiency" refers to a condition at a dam that impairs or adversely affects the safe operation of the dam, per the A.A.C. R12-15-1202. Such conditions may include embankment cracks, erosion, breaching, unusual/uncontrolled seepage, slope instability and/or inadequate spillway capacity. Following each safety inspection, a written report is returned to the owner identifying the safety deficiencies and making recommendations for needed maintenance work. ADWR tracks the safety deficiencies and works to assist dam owners in their resolution. Safety deficiencies which left uncorrected could result in dam failure with subsequent loss of human life or significant property damage will classify the dam as "Unsafe," per A.A.C. R12-15-1202. The following table provides the safety rating definitions and the number of state regulated dams classified as having a safety deficiency or considered unsafe.

Table RA-7: State Regulated Dam Safety Ratings

Safety Rating	Definition
No Deficiency	Not Applicable
Safety Deficiency	One or more conditions at the dam that impair or adversely affects the safe operation of the dam.
Unsafe Categories	
Category 1: Unsafe Dams with Elevated Risk of Failure	These dams have confirmed safety deficiencies for which there is concern they could fail during a 100-year or smaller flood event. There is an urgent need to repair or remove these dams.
Category 2: Unsafe Dams Requiring Rehabilitation or Removal	These dams have confirmed safety deficiencies and require either repair or removal. These dams are prioritized for repair or removal behind the Category 1 dams.
Category 3: Unsafe Dams with Uncertain Stability during Extreme Events (Requiring Study)	Concrete or masonry dams that have been reclassified to high hazard potential because of downstream development (i.e. hazard creep"). The necessary documentation demonstrating that the non-earthen dams meet or exceed standard stability criteria for high hazard dams during extreme overtopping and seismic events is lacking. The dams are classified as unsafe pending the results of required studies. Upon completion of these studies, the dams are either removed from the list of unsafe dams or moved to Category 2 and prioritized for repair or removal.

Safety Rating	Definition
Category 4: Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	In 1979, the U.S. Army Corps of Engineers established Federal Guidelines for assessing the safe-flood passing capacity of high hazard potential dams (CFR 44 No. 188). These guidelines established one-half of the "probable maximum flood" (PMF) as the minimum storm which must be safely passed without overtopping and subsequent failure of the dam. Dams unable to safely pass a storm of this size were classified as being in an "unsafe, non-emergency" condition. Prior studies for these earthen dams (mostly performed in the 1980's) predicted they could not safely pass one-half of the PMF. They were predicted to overtop and fail for flood events ranging from 30-46% of the PMF. Recent studies both statewide and nationwide have indicated that the science of PMF hydrology as practiced in the 1990's commonly overestimates the PMF for a given watershed. The ADWR is leading efforts on a statewide update of probably maximum precipitation (PMP) study scheduled for completion in 2011. These dams should be re-evaluated using updated methods to confirm their safety status. Upon completion of these evaluations, they are either removed from the list of unsafe dams or moved to Category 2 and prioritized for repair or removal.

The following map shows locations of state regulated dams that are classified as unsafe or have safety deficiencies associated with them. Data was obtained from ADWR and the National Inventory of Dams (NID). This map does not include the dams owned by the City of Phoenix Water Services Department. The City formally requested that the Department keep the locations confidential due to Homeland Security issues. However, the data provided in Table RA-8, includes county owned dams and counts under each safety deficiency class.

Map RA-2: State Regulated Dams with Unsafe/Safety Deficient Classifications

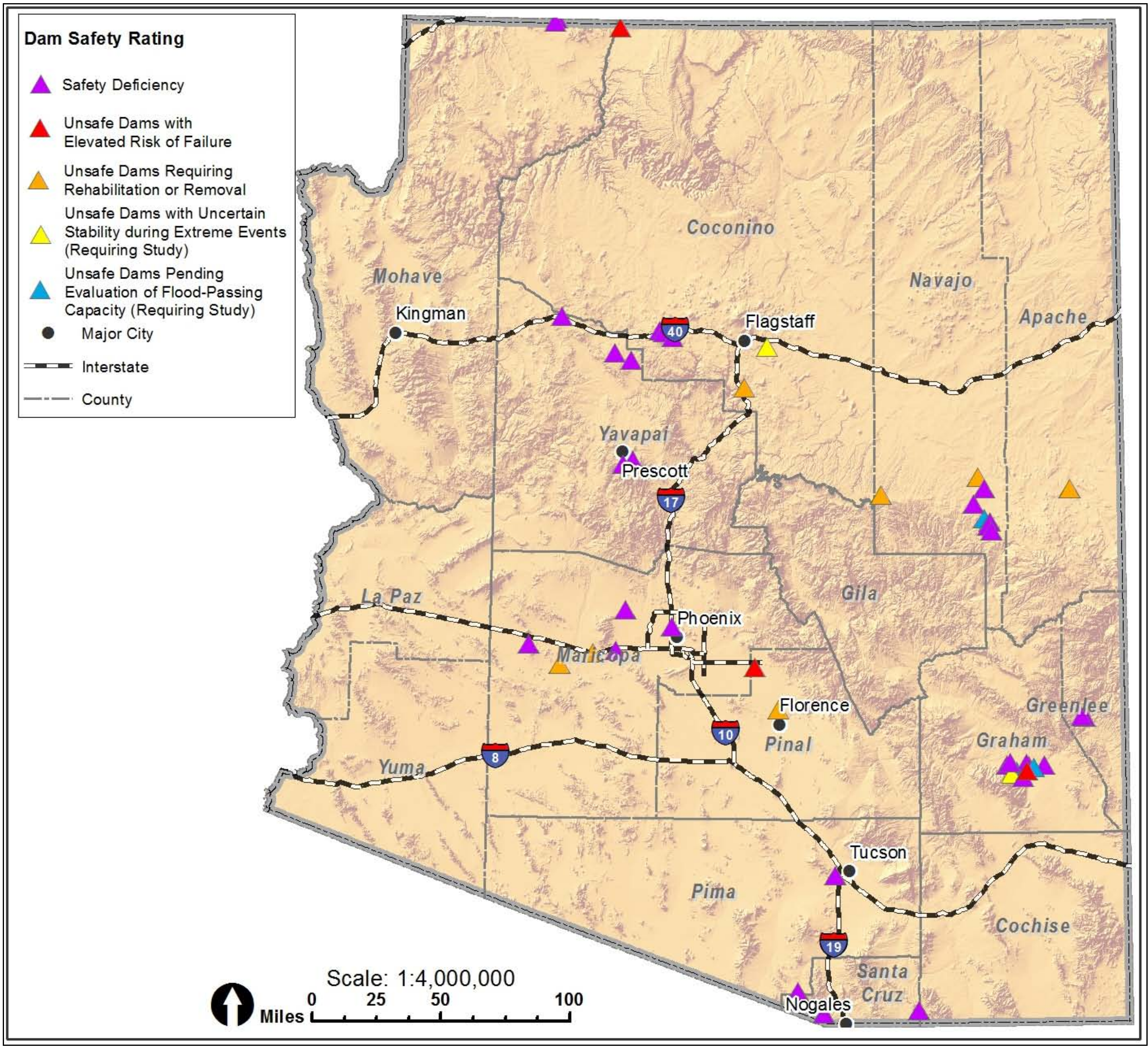


Table RA-8: State Regulated Dams with Identified Safety Deficiencies, 2009

County	Safety Deficiency	Unsafe Dams with Elevated Risk of Failure	Unsafe Dams Requiring Rehabilitation or Removal	Unsafe Dams with Uncertain Stability during Extreme Events (requiring study)	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (requiring study)
Apache	1	0	1	0	0
Cochise	1	0	0	0	0
Coconino	3	1	1	1	0
Gila	0	0	0	0	0
Graham	6	1	0	1	2
Greenlee	1	0	0	0	0
La Paz	0	0	0	0	0
Maricopa	4	0	2	0	0
Mohave	2	0	0	0	0
Navajo	5	0	2	0	1
Pima	2	0	0	0	0
Pinal	0	1	1	0	0
Santa Cruz	1	0	0	0	0
Yavapai	6	0	0	0	0
Yuma	0	0	0	0	0
Total	32	3	7	2	3

Source: ADWR Dam Safety Database (May 2013)

ADWR requires each owner of a high and significant hazard potential state regulated dam to prepare, maintain, and exercise a written emergency action plan (EAP) for immediate defensive action to prevent failure of the dam and to minimize any threat to downstream development, per A.A.C. R12-15-1221. The EAP defines the dam owner's requirements to observe his dam for emergency conditions, the responsibilities for notifying a pre-determined list of emergency responders, and a description of the downstream areas potentially affected. The EAP is required to contain the following items:

- Notification Chart
- Reservoir & Dam Description
- Delineation of Unsafe Conditions, Procedures, & Triggering Events
- Delineation of Responsibilities
- Discussion of Emergency Supplies/Equipment
- Identification of Potentially At-Risk Areas Downstream

Each owner of a state regulated dam is required to review and update the emergency action plan annually or more frequently to incorporate changes such as new personnel, changing roles of emergency agencies, emergency response resources, conditions of the dam, and information learned from mock exercises.

Table RA-9: Emergency Action Plan Status for State Regulated Dams, 2009

County	Hazard Potential Class	Dams within hazard Potential Classification	Dams with EAPs	Dams with a Draft EAP	Dams with Outdated EAPs	Dams without EAPs	Dams w/ Inundation Mapping	Dams w/o Inundation Mapping	Dams w/ Draft Inundation Mapping
Apache	High	3	1	0	2	0	3	0	0
	Significant	6	6	0	0	0	4	2	0
Cochise	High	2	2	0	0	0	2	0	0
	Significant	0	-	-	-	-	-	-	-
Coconino	High	8	5	2	0	1	6	2	0
	Significant	3	1	2	0	0	1	2	0
Gila	High	1	1	0	0	0	1	0	0
	Significant	3	3	0	0	0	3	0	0
Graham	High	18	14	2	1	1	17	0	1
	Significant	3	2	0	1	0	2	1	0
Greenlee	High	1	1	0	0	0	1	0	0
	Significant	1	1	0	0	0	1	0	0
La Paz	High	0	-	-	-	-	-	-	-
	Significant	0	-	-	-	-	-	-	-
Maricopa	High	41	35	0	0	0	34	7	0
	Significant	2	2	0	0	0	2	0	0
Mohave	High	1	1	0	0	0	1	0	0
	Significant	2	1	0	0	1	1	1	0
Navajo	High	9	6	1	2	0	7	2	0
	Significant	5	3	0	0	2	3	2	0
Pima	High	5	3	1	0	1	4	1	0
	Significant	1	1	0	0	0	1	0	0
Pinal	High	7	7	0	0	0	7	0	0
	Significant	2	2	0	0	0	2	0	0
Santa Cruz	High	2	2	0	0	0	2	0	0
	Significant	0	-	-	-	-	-	-	-
Yavapai	High	6	6	0	0	0	5	1	0

County	Hazard Potential Class	Dams within hazard Potential Classification	Dams with EAPs	Dams with a Draft EAP	Dams with Outdated EAPs	Dams without EAPs	Dams w/ Inundation Mapping	Dams w/o Inundation Mapping	Dams w/ Draft Inundation Mapping
	Significant	1	0	0	0	1	1	1	0
Yuma	High	0	-	-	-	-	-	-	-
	Significant	0	-	-	-	-	-	-	-

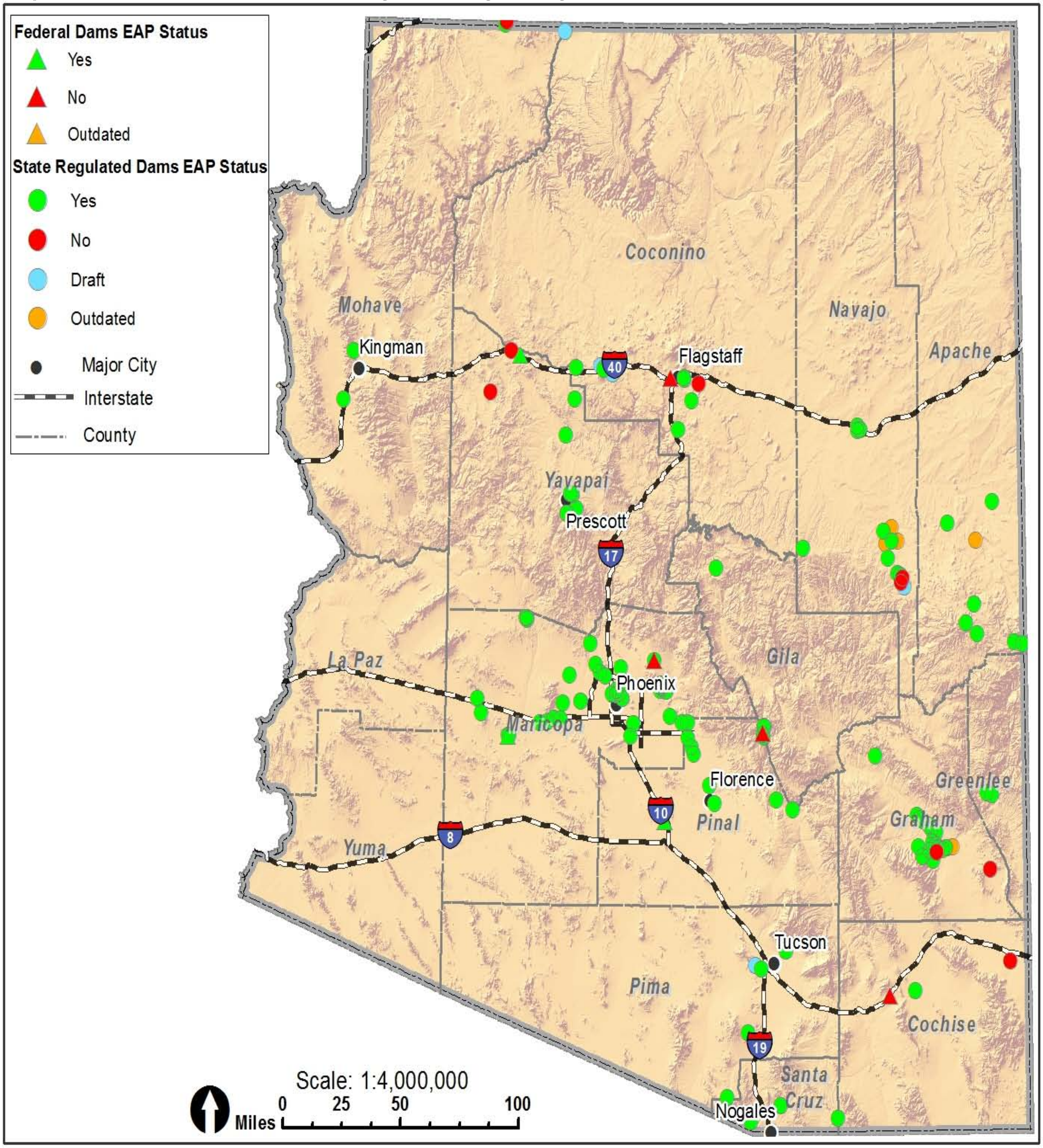
Source: ADWR Dam Safety Database (May 2013)

Map RA-3 shows the EAP status of all of the federal and state regulated high and significant hazard potential dams. Data was obtained from ADWR and the National Inventory of Dams (NID). This map does not include the dams owned by the City of Phoenix Water Services Department. The City formally requested that the Department keep the locations confidential due to Homeland Security issues. However, the numbers within the narrative tables include those dams. The tables located in this Plan's Appendices provide the dam name, associated EAP information, and nearest downstream development for both federal and state regulated dams located in Arizona. Data sources used to develop the tables are from the NID and ADWR Dam Safety Databases. Federal dams do not have State Inventory Database (SID) numbers and ADWR Safety Types and therefore are denoted as not applicable (N/A).

Vulnerability

The estimation of potential exposure due to a dam failure was accomplished by intersecting the human and facility assets with the inundation limits of a perceived dam failure scenario. Where available, dam failure inundation limits were obtained for dams within the state and digitized into a GIS shapefile. Sources for the inundation limits included ADWR, various county flood control districts, Bureau of Indian Affairs, US Army Corps of Engineers, and the US Bureau of Reclamation. It is noted that there are many dams within the ADWR and NID database that do not have readily available dam failure inundation mapping and none were estimated for these structures with this vulnerability analysis.

Map RA-3: Status of Federal/State Regulated High & Significant Hazard Potential Dams



Since no common methodology is available for estimating losses from the exposure values, estimates of the loss-to-exposure ratios were assumed based on the perceived potential for damage and comparative damages to regular flooding events. Any storm event or series of storm events of sufficient magnitude to cause an emergency spillway to operate or cause a daybreak scenario would have catastrophic consequences in the downstream inundation area. Floodwaves from these types of events generally travel very fast and possess tremendous destructive energy. Accordingly, an average loss-to-exposure ratio for the dam failure inundation areas is estimated at 25%.

In summary, $630.1 million in asset related losses to potentially impacted state-owned critical and non-critical facilities are estimated for a dam failure/inundation event. Regarding human vulnerability, a total population of 1.26 million people, or 19.7% of the total 2010 state population, is potentially exposed to a dam failure or emergency spillway inundation event. The potential for deaths and injuries are directly related to the warning time and type of event. Dam failures are usually very sudden and very destructive. Given the proximities of the dams to the impacted populations, it is anticipated that moderate warning times of 2 to 3 hours are expected. However, the magnitude of such an event may realistically result in at least one death and/or several injuries. There is also a high probability of population displacement for most of the inhabitants within the inundation limits downstream of a dam.
The compilation of risk assessment data from local plans indicates that approximately $17.9 billion in locally identified critical and non-critical facilities are exposed to a “high” dam failure inundation hazard, with approximately $5 billion in potential losses estimated.

Tables RA-10 thru 13 provide risk assessment data tables for dam failure hazards.

Table RA-10: State-Owned Asset Inventory Loss Estimates Based on Dam Failure

Location	Total No. of Facilities In Jurisdiction	Percentage of State-Wide Total	Estimated Replacement Cost (x $1,000)	Estimated Structure Loss (x $1,000)
Apache	0	0.00%	$0	$0
Cochise	0	0.00%	$0	$0
Coconino	1	0.09%	$26	$7
Gila	0	0.00%	$0	$0
Graham	34	3.09%	$4,223	$1,056
Greenlee	0	0.00%	$0	$0
La Paz	3	0.27%	$180	$45
Maricopa	698	63.45%	$2,362,328	$590,582
Mohave	2	0.18%	$212	$53
Navajo	0	0.00%	$0	$0
Pima	0	0.00%	$0	$0
Pinal	293	26.64%	$142,054	$35,513
Santa Cruz	0	0.00%	$0	$0
Yavapai	0	0.00%	$0	$0
Yuma	69	6.27%	$11,561	$2,890
Statewide	**1,100**	**100.00%**	**$2,520,583**	**$630,146**

Table RA-11: State Facilities Located in the Dam Failure "High" Hazard Area by Jurisdiction

Jurisdiction	Critical Facilities								Non-Critical Facilities				
	Banking and Finance Institutions	Communications Infrastructure	Electrical Power Systems	Emergency Services	Gas and Oil Facilities	Government Services	Transportation Networks	Water Supply Systems	Businesses	Cultural	Educational	Recreational / Leisure	Residential
Phoenix	0	3	3	7	7	323	4	3	0	2	12	3	8
Florence	0	1	1	9	2	187	0	5	0	2	4	1	48
Tempe	0	1	0	3	0	20	6	0	2	2	126	7	62
Mesa	1	0	0	6	1	47	0	1	5	0	6	4	11
Yuma	0	0	0	0	0	6	5	1	0	18	0	0	0
Chandler	0	0	0	0	0	9	0	0	0	0	0	0	0
Safford	0	0	0	0	0	0	0	0	0	0	8	0	0
Buckeye	0	0	0	0	0	4	0	0	0	0	0	0	1
Coolidge	0	0	0	0	0	3	0	0	0	0	0	0	0
Parker	0	0	0	0	0	0	3	0	0	0	0	0	0
Lake Havasu City	0	0	0	0	0	2	0	0	0	0	0	0	0

Table RA-12: County Population Sectors Exposed to Dam Failure

County	Total	Exposed	Percent Exposed	Over 65	Over 65 Exposed	Percent Over 65 Exposed
Apache	71,518	0	0.00%	8,268	0	0.00%
Cochise	131,346	0	0.00%	22,688	0	0.00%
Coconino	134,421	3,732	2.78%	11,924	464	3.89%
Gila	53,597	795	1.48%	12,450	182	1.46%
Graham	37,220	17,838	47.93%	4,261	2,419	56.77%
Greenlee	8,437	0	0.00%	1016	0	0.00%
La Paz	20,489	6,674	32.57%	6,683	1,456	21.79%
Maricopa	3,817,117	963,989	25.25%	462,641	77,843	16.83%
Mohave	200,186	40,934	20.45%	46,658	8,260	17.70%
Navajo	107,449	7210	6.71%	14,241	1029	7.23%
Pima	980,263	6271	0.64%	151,293	821	0.54%
Pinal	375,770	121,090	32.22%	52,071	8,396	16.12%

County	Total	Exposed	Percent	Over 65	Over 65	Percent
Santa Cruz	47,420	2469	5.21%	6,224	250	4.02%
Yavapai	211,033	0	0.00%	50,767	0	0.00%
Yuma	195,751	88,367	45.14%	30,646	8,410	27.44%
Statewide	**6,392,017**	**1,259,369**	**19.70%**	**881,831**	**109,530**	**12.42%**

Table RA-13: Local Risk Assessment & Loss Estimates Based on Dam Failure

Location	Total Estimated Asset Value (x $1,000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $,1000)
Apache	$11,101,665	No Data	No Data
Cochise	$10,615,770	No Data	No Data
Coconino	$22,517,439	$225,711	$56,428
Gila	$6,811,526	No Data	No Data
Graham	$2,999,628	$1,610,788	$520,497
Greenlee	$6,747,353	$36,314	$15,293
La Paz	$2,359,292	$515,342	$128,835
Maricopa	$189,975,238	$8,735,833	$2,183,958
Mohave	$15,521,558	$2,564,781	$641,195
Navajo	$11,908,834	$1,881,548	$860,558
Pima	$50,584,821	No Data	No Data
Pinal	$14,610,551	$2,282,664	$570,666
Santa Cruz	$3,044,947	No Data	No Data
Yavapai	$18,491,858	No Data	No Data
Yuma	$14,750,955	No Data	No Data
Statewide Totals	**$382,041,435**	**$17,852,981**	**$4,977,430**

NOTE: *"No Data"* denotes lack of available information for assessment.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Dam Failure are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-14: State CPRI Results for Dam Failure

Risk Due to Dam Failure					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max 4)**
Dam Failure	Possible	Critical	< 6 hours	< 24 hours	**2.60**
	2	3	4	2	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-15: County CPRI Results for Dam Failure

County	CPRI
Apache	No Data
Cochise	No Data
Coconino	2.19
Gila	No Data
Graham	2.09
Greenlee	No Data
La Paz	2.3
Maricopa	2.04
Mohave	2.48
Navajo	2.26
Pima	No Data
Pinal	2.02
Santa Cruz	2.98
Yavapai	No Data
Yuma	No Data
Average	**2.00**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Dam Failure are shown below.

Table RA-16: State Environmental CPRI Results for Dam Failure

Environmental Risk Due to Dam Failure				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.85**
Water	Unlikely	Catastrophic	6 months+	**2.95**
Soil	Unlikely	Critical	6 months+	**2.65**
Average CPRI Environmental Risk Rating: 2 (max 3.6)				

Consequences / Impacts

- **Public**
  See the "County Population Sectors Exposed to Dam Failure" in this section.
  Because dam failures can happen very suddenly, the typical impact to the general public is injuries and loss of life. Fatalities as a result of dam failure are usually due to drowning.

Another very disruptive effect is when this hazard leads to isolation or evacuation. The evacuation alone can cause great trauma and stress for those affected, not to mention those who must find shelter for their pets and livestock.

- **Responders to the Incident**
  Much like the dangers of flooding, dam failure incident responders may experience injury due to debris, drowning, electrocution, cold stress and exposure to hazardous materials. Because flooded disaster sites are unstable, clean-up workers might also encounter sharp jagged debris, biological hazards in the flood water, exposed electrical lines, blood or other body fluids, and animal and human remains. Responders are prone to basically the same dangers the general public is, only on a higher level as they may be putting themselves in harm's way by performing rescue activities.

- **Continuity of Operations / Delivery of Services**
  As the table in this section titled "Ranking of Most Vulnerable Communities – Dam Inundation" illustrates, the majority of the most vulnerable communities are in Maricopa County. Maricopa County is home to the State Capitol and the main state agency buildings. The agencies housed in these buildings will be critical to the continuation of operations and services during a dam failure event in Arizona.
  Again, because dam failure leads to flooding and flash flooding, refer to the Flooding/Flash Flooding profile in this section.

- **Environment**
  Dam failure leads to flooding/flash flooding, refer to the Flooding/Flash Flooding profile in this section.

- **Economic / Financial Condition of Jurisdiction**
  Dam failure leads to flooding/flash flooding, refer to the Flooding/Flash Flooding profile in this section.

- **Public Confidence in Jurisdiction's Governance**
  Dam failure leads to flooding/flash flooding, refer to the Flooding/Flash Flooding profile in this section.

Resources

Definitions
ADWR – Arizona Department of Water Resources
EAP – Emergency Action Plan
NID – National Inventory of Dams

Sources
AZ Dept of Water Resources:
National Inventory of Dams

References
ADWR, March 2001. *Arizona's Program for Safety of Dams.* http://www.water.az.gov/adwr/Content/Publications/files/AZDamSafetyProgram0401.PDF

ADWR, July 2005. *Arizona's Dam Safety Program*. http://www.azwater.gov/dwr/Content/Find_by_Program/Dam_Safety_and_Flood_Mitigation/Dam_Safety_Docs/Arizona_Dam_Safety_Program.pdf

Graham, Wayne. *Dam Failure Inundations – Are They Accurate?*

Klochko, Kateryna. *Chronology of major tailings dam failures (1970-2000),* http://www.personal.ceu.hu/students/99/Kateryna_Klochko/Chrono.htm

Disease

Introduction & History

An outbreak is defined as an increase in cases of disease in time or place that is greater than expected. If a condition is rare (e.g. measles) or has serious public health implications (e.g. bioterrorism agent), an outbreak may involve only one (1) case. When two (2) or more cases in the same outbreak have a laboratory result involving the same etiologic agent, the outbreak is considered to be laboratory confirmed.

Local and state epidemiologists are responsible for outbreak investigations involving Arizona residents regardless of where they were exposed. Outbreaks involving residents from multiple states are usually coordinated by the Center for Disease Control and Prevention (CDC). Investigations into the source of an outbreak can depend on the etiology involved (viral, bacterial, parasitic or chemical), the mode of transmission (foodborne, waterborne, environmental, person-to-person), or the outbreak setting (restaurant, hospital or assisted living facility, school or community) (Arizona Department of Health Services (ADHS)). Most infectious disease outbreaks can be classified into the following categories. These are:

- Foodborne or Waterborne Outbreaks
- Vectorborne or Zoonotic Disease Outbreaks
- Respiratory or Influenza-Like Illness Outbreaks
- Vaccine Preventable Disease Outbreaks
- Healthcare-associated Infection Outbreaks

In Arizona, historical records indicate that the State has had numerous food born, waterborne, environmental and person-to-person outbreaks harming and killing people and animals. The following are a generalized list of previous disease out breaks in Arizona:

- June 19, 2013. After consuming frozen berries, 110 people were confirmed to have become ill from Hepatitis A. Illness reportings are as follows: Arizona (15), California (55), Colorado (21), Hawaii (6), New Mexico (5), Nevada (5), and Utah (3).
- 2009 – Present. The H1N1 virus epidemic begins. ADHS registered over 8,000 confirmed cases, and 149 deaths.
- 2002. Arizona experienced two major outbreaks of the Norwalk-like virus (ADHS, March/April 2003).
- May 18, 2002. Arizona Game and Fish Dept placed an emergency ban on the importation of live hoofed animals (e.g., deer and elk) into Arizona due to a fear of Chronic Wasting Disease (CWD). CWD is a disease closely related to “mad cow disease” in cattle and scrapie in domestic sheep and goats but affects deer and elk (Arizona Game and Fish).
- 1993 – Present. There have been 22 confirmed Hantavirus cases in Arizona since 2006, 11 of which have resulted in death.
    - Hantavirus killed 11 people on the Navajo Nation (CNN, October 15, 1995).
    - June 7, 2013 - Coconino County Public Health Services District officials confirmed that a Flagstaff-area woman died from complications of Hantavirus
- May 1998. A horse near Kingman, Arizona was diagnosed with Vesicular Stomatitis (Arizona Dept of Agriculture, May 21, 1998).

The probability and magnitude of disease, particularly an epidemic, is difficult to evaluate due to the wide variation in disease characteristics, such as rate of spread, morbidity and mortality, detection and response time, and the availability of vaccines and other forms of prevention.

Disease related disasters do occur in humans, animals, and plants with some regularity and severity within Arizona. There is growing concern, however, about emerging infectious diseases due to new and more resistant strains of viral infections and so called, “Super Bugs”, that the probability of a serious outbreak goes up as new resilient viruses are identified.

Historically, events have occurred in the farming and agricultural communities that cause great concern amongst responding Governmental agencies. Due to these events, and the fact that Arizona shares an international trade border with Mexico, the probability of an infectious disease impacting livestock is high.

Pandemic is defined as a disease affecting or attacking the population of an extensive region, including several countries, and/or continent(s). It is further described as extensively epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale. Infectious diseases are also highly virulent, but are not spread person-to-person.

Pandemic and infectious disease events cover a wide geographical area and can affect large populations, potentially including the entire population of the State of Arizona. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in denser areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness.

Pandemic influenza planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. H5N1 did not reach pandemic proportions in the United States, but Arizona began actively planning for an occurrence of an influenza pandemic. As stated in the Arizona Pandemic Influenza Response Plan, “it is likely that another influenze pandemic will occur sometime in the future” (ADHS, 2011). Influenza, also known as “the flu”, is a contagious disease that is caused by the influenza virus and most commonly attacks the respiratory tract in humans.

The 2009 H1N1 virus, colloquially known as swine flu, is of particular concern. This virus was first detected in people in the United States in April 2009. On June 11, 2009, the world health organization signaled that a pandemic of 2009 H1N1 flu was underway (CDC, 2009).

The magnitude of a pandemic or infectious disease threat in Arizona will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is easily transmitted from person-to-person, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined (see table below). The severity of illness from the 2009 H1N1 influenza flu virus has varied, with the gravest cases occurring mainly among those considered at high risk. High risk populations considered more vulnerable include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 have recovered without needing medical treatment. However, the virus has resulted in many deaths, including 149 in Arizona as of February 2010. According to the CDC, about 70% of those who have been hospitalized with the 2009 H1N1 flu virus in the United States have belonged to a high risk group (CDC, 2009).

Table RA-17: Significant Outbreaks of Influenza over the Past Century

Date	Pandemic Name/Subtype	Worldwide Deaths (Approximate)
1918-1920	Spanish Flu / H1N1	50 million
1957-1958	Asian Flu / H2N2	1.5-2 million
1968-1969	Hong Kong Flu / H3N2	1 million
2009-2010	Swine Flu / A/H1N1	151,700 – 575,400 (as of April 2010)*

*The range in fatalities is due to the underreporting of deaths in third-world countries, and the WHO has acknowledged that official, lab-confirmed reports are an underestimate. Source: Global Security, 2009; WHO, 2009

The magnitude of a pandemic may be exacerbated by the fact that an influenza pandemic will cause outbreaks across the United States, limiting the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventative and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available.

The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or “novel” virus to which the population has no immunity. This emergence of a novel virus is the first step toward a pandemic.

Environmental Impacts

There are no true environmental impacts of pandemics and infectious disease threats, but there will be significant economic and social costs beyond the possibility of disease-related deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. On a national scale, the Congressional Budget Office Estimates that a severe pandemic could cost the US economy more than $600 million, or 5% of the Gross Domestic Product (US DHHS 2005). Social and economic disruptions could be temporary but may be amplified in today’s closely interrelated and interdependent systems of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

Jurisdictional Vulnerability Assessment

In general, jurisdictions that are more densely populated are more vulnerable to disease threats when the disease is directly spread from human to human, but every jurisdiction in the Arizona has some vulnerability to pandemic and infectious disease threats. The decision by a county to profile a hazard is one indicator of the presence of risk from that hazard.

State Facility Vulnerability Assessment

State facilities are no more or less vulnerable to pandemic and infectious disease than the general population. There are some occupation-specific risks that may make some employees more vulnerable, though. For example, those working in direct patient care situations are more likely to be exposed to a pandemic disease.

Jurisdictional Loss Estimation

Jurisdictional losses in a pandemic or infectious disease outbreak stem from lost wages and productivity, not losses to buildings or land. Losses are difficult to estimate because the exact rates of absenteeism and cost of treating a widespread disease will depend on the virus or bacterium in question, the availability of vaccination or treatment, and the severity of symptoms. For historical context, though, the Asian and Hong Kong Flu pandemics killed over 1.5 million people worldwide and caused an estimated $32 billion loss due to lost productivity and medical expenses (Smith, 2004). With Arizona's economy so integral to the national economy, economic losses from a pandemic or infectious disease threat could be significant.

State Facility Loss Estimation

The physical plant and facilities of Arizona are not likely to be damaged by a pandemic disease outbreak. However, high rates of absenteeism associated with a pandemic or an infectious disease will likely lead to significant economic costs in lost productivity and increased medical costs in nearly all state agencies.

Risk & Vulnerability

Based on *the Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Disease are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-18: State CPRI Results for Disease

Risk Due to Disease					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Disease	Possible	Negligible	>24 Hours	>1 Week	**2.35**
	2	3	1	4	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-19: County CPRI Results for Disease

County	CPRI
Pima	2.18

*Only Pima County identified Disease as a hazard in their mitigation plan

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Disease are shown below.

Table RA-20: State Environmental CPRI Results for Disease

Environmental Risk Due to Disease				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Negligible	< 1 month	**.90**
Soil	Unlikely	Negligible	< 1 month	**.90**
Average CPRI Environmental Risk Rating: .90 (max .9)				

Consequences / Impacts

- **Public**

  The Arizona Division of Public Health in the Department of Health Services seeks to prevent infectious diseases from entering the state and control those that are endemic or have already entered. Of particular concern to the Division of Public Health are new pandemic diseases, such as SARS, new strains of HIV, new influenza strains, botulism, and bio-terrorism incidents such as anthrax, small pox, or chemical attacks of sarin or VX gas. The Division of Public Health, Office of Infectious Disease Services monitors and controls more than 70 infectious diseases of public health concern such as measles, rubella, pertussis and hepatitis B, diarrhea diseases and vomiting; excluding HIV/AIDS, which is addressed by the Office of HIV/AIDS.

  Public response to a disease outbreak or pandemic can vary from mild to severe. Panic is a normal reaction to disease outbreaks and pandemics so this must be considered during the planning process for possible protective measures. The probability of a serious outbreak of disease or pandemic to overload medical resources is high so protective measures, to include: education, possible isolation, quarantine, travel deferment, closure of school and universities, closure of government functions, suspension large public gatherings and closure of public travel assets.

  Diseases affecting animals and plants, particularly livestock and agricultural products, are also of major concern. Here, both the supply and quality of human food supplies, potential economic consequences, and impact on foreign trade. According to the National Animal Health Emergency Management System (NAHEMS), an animal health emergency is defined as the appearance of disease with the potential for a sudden negative impact through direct impact on productivity, real or perceived risk to public health, or real or perceived risk to a foreign country which imports from the U.S. (Lautner, April 18, 2002).

- **Responders to the Incident**

  Responders, recovery personnel and volunteers would be quickly overwhelmed if a serious outbreak of disease or a pandemic were to occur in Arizona. Due to population density in the major metropolitan areas, the capabilities to quickly respond, identify and control such outbreaks are crucial. Potential dangers include the rapid onset of disease that moves faster than the response can actively follow, number of responders who could become infected during initial onset causing loss of essential assets and risk of new introduction or spread of infectious diseases due to two of the major metropolitan areas having high volumes of illegal alien traffic and foreign migratory travel.

  The Arizona Department of Agriculture (ADA) and Arizona Game and Fish Department (AGFD) are primarily concerned with plant, livestock and wild animal diseases and infections. The agencies are concerned with animal-to-animal diseases, as well as diseases transmitted from animals or arthropod vectors to humans. The scope and severity of an infectious outbreak could easily over task these departments causing requests for additional resources to be called from outside the State of Arizona.

  The Plant Protection and Quarantine (PPQ) program, also located within USDA's Animal and Plant Health Inspection Service (APHIS), safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests and noxious weeds. Several thousand foreign plant and animal species have become established in the United States over the past 200 years, with approximately one in seven becoming invasive. An invasive species is an alien (i.e., non-native) species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health. Invasive plants, animals, and pathogens have often reduced the economic productivity and ecological integrity of agriculture, forestry, and the other natural resources.

- **Continuity of Operations / Delivery of Services**
  Although it would most likely take a very extreme heath/agricultural issue to maximize resources to a point of operation and service disruption, timing of prevention and control measures such as isolation and quarantine, promotion of personal hygiene and social distancing are critical. To be better prepared to avoid such a disruption, organizations, including government and industry, should develop and implement Continuity of Operations Plans (COOP) to ensure faster response, reduction in impact, ensure public confidence and provide accurate communication and transmittal of information for prevention, control and notification. The COOP should identify assets that can be called in the event that an outbreak occurs within human populations, animal or agriculture.

  The same applies for Farming and Agricultural assets. Agencies and industry must identify essential services and critical operations that are required to be maintained in order to prevent serious environmental impacts. This process must take into account critical inputs such as, materials, services, suppliers and any logistical concerns. Time is also a factor. How long can operations and delivery of service sustain operations during an event? To mitigate environmental impacts, alternative services, security needs and expediting financial requirements are crucial and could dramatically reduce the overall risk of having an infectious disease or pandemic create environmental hardships that could last for years to come.

  According to the Arizona Department of Health Services (ADHS) Emergency Response Plan, ADHS has a comprehensive Business Continuity Plan. This plan is maintained by the Director's Office Strategic Planner.

- **Property / Facilities / Infrastructure**
  Negative impacts on property, facilities and State infrastructure could be catastrophic depending on the type, severity and spread of infectious diseases. This is particularly true of those capable of disrupting the human or animal food chain. During a pandemic, public health professionals may recommend facilities and operating infrastructure limit its use. All non essential infrastructure components could easily be affected as people would chose to stay home rather than risk possible infection. Additionally, facilities directly involved in the line of infection could be shut down for extended periods of time costing time and large sums of money.

  Infectious disease or pandemics that affect the farming community within the State would have serious negative effects. The loss of human and animal life, the loss of tax revenue, the loss of business as these facilities and its supporting infrastructure may be shut down until the disease can be identifies, controlled and clean up could occur.

  In agriculture the same would apply with additional issue of time. Being that crops are seasonal, the turn-around period could be lengthy if the product is a victim of infestation. This scenario could possibly cause a ripple effect in the supporting agriculture infrastructure causing a spike in prices and financial strain on those involved in all aspects of production, distribution and supply or agricultural products.

- **Environment**
  Many other hazards, such as floods, earthquakes or droughts, may create conditions that significantly increase the frequency and severity of infectious diseases. These hazards can affect basic services (e.g., water supply and quality, wastewater disposal, electricity), and supply and quality of food and quickly overload the public and

agricultural health system capacities. As a result, concentrations of diseases may result and grow rapidly, potentially leading to large losses of life and economic value.

Being that each, Population, Farming and Agriculture, are equally tied together it is fair to say that the negative impact on one will definitely have negative impacts on the others causing environmental problems. Just the very presence of a disease or a pandemic outbreak among any of these categories would have significant effects on the others.

Historical events in Arizona have had impacts on Population, Farming and Agriculture all at once. Floods may wipe out crops leaving large amounts of stagnant water. This water is a breeding ground for mosquitoes which in turn can carry viruses and bacteria harmful to humans and animals. Animals can become infected with particular types of viruses that can then be transferred to human beings causing illness and death.

- **Economic / Financial Condition of Jurisdiction**
  Even the threat of a severe infectious disease or pandemic could have severe economic and bring about financial burdens on jurisdictions involved. In studies conducted by the Harvard School of Public Health, an estimated three-fourths+ of Americans would cooperate with public health officials and follow their recommendations involving curtailment of daily activities such as not using public transportation, not going to the mall and not going to large gatherings or sporting events (Harvard School of Public Health, *In Case of an Outbreak of Pandemic Flu,* Press Release 2006). The financial costs to local, state and federal governments could easily shift their financial stability leading to long term debts and budget cuts to recuperate costs associated with incidents.

  With Arizona having a large agricultural and farming economic structure, significant animal and agricultural disease outbreaks can have a severe economic impact on the State. In the past, agricultural diseases have had serious financial impacts on citrus and cotton costs as crops were destroyed due to outbreaks of disease.

- **Public Confidence in Jurisdiction's Governance**
  The probability and magnitude of disease, infestation and particularly an epidemic, is difficult to evaluate due to the wide variation in disease characteristics, such as rate of spread, morbidity and mortality, detection and response time, and the availability of vaccines and other forms of prevention. The ability of public agencies and medical services to quickly act during an outbreak of disease or a pandemic is in direct correlation to public confidence in jurisdictional governance. Failure of these entities to act in a reasonable manner warranted by the magnitude and severity as seen through the public eye, will drastically reduce the public's confidence in the government's ability to accurately control an outbreak. The magnitude of an outbreak can have severe psychological impacts the population. The media, if not monitored, can cause wide spread panic resulting in a severe overload of resources and extreme financial costs to government and the public. Depending on the depth of public perceptions of safety, or lack of, public reaction could span from compliance to lawlessness.

  The same goes for farming and agricultural concerns. The magnitude of a serious disease, infestation or pandemic can vary depending on particular factors to include the ability to identify and respond to affected areas, successfully controlling the spread, allocating needed supplies to treat and inoculate if possible and set into motion additional preventive measures.

Drought

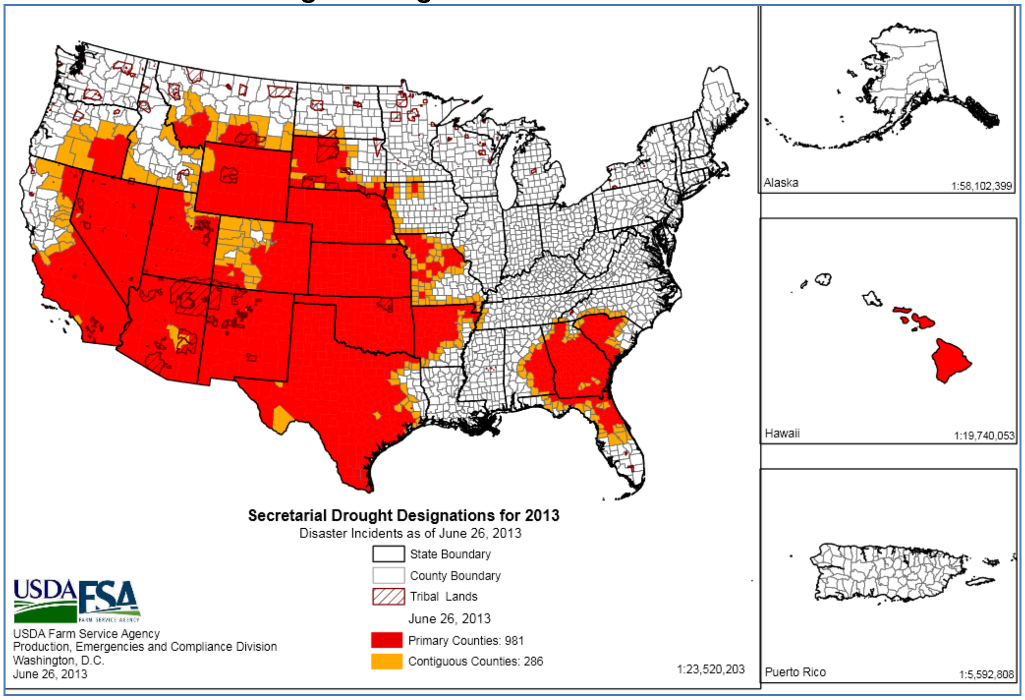
Introduction/History

Drought originates from a deficiency of precipitation over an extended period, usually one or more seasons. Drought can result in a water shortage for some activity, group, or environmental sector. Drought is a complex natural hazard, which is reflected in the following four definitions commonly used to describe it:

- Agricultural – drought is defined principally in terms of naturally occurring soil moisture deficiencies relative to water demands of plant life, usually arid crops.
- Hydrological – drought is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- Meteorological – drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- Socioeconomic – drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. It may also be called a water management drought.

Arizona has experienced 17 droughts declared as drought disasters/emergencies and 93 drought events (droughts affecting multiple years are recorded as a distinct event for each year affected. Between 1849 and 1905, the most prolonged period of drought conditions in 300 years occurred in Arizona (NOAA, July 29, 2003). Another prolonged drought occurred during the period 1941 to 1965, during which time there were no spill releases into the Salt River (ADEM, 2001). The period from 1979-1983 appears to have been anomalously wet, while the rest of the historical records shows that dry conditions are most likely the normal condition for Arizona. That characterization is supported by recent research on Arizona's historical climate using tree-ring records (Meko et al. 2007). In the arid West, drought is characterized by extended periods of below normal precipitation, punctuated by occasional wet years. The current drought began in 1995, but conditions have worsened since mid 2001, with winter 2004 - spring 2005 as the only wet period. As of 2013, all counties within Arizona except Gila were designated primary natural disaster areas due to drought (see figure below).

Figure RA-1: Secretarial Drought Designations for 2013



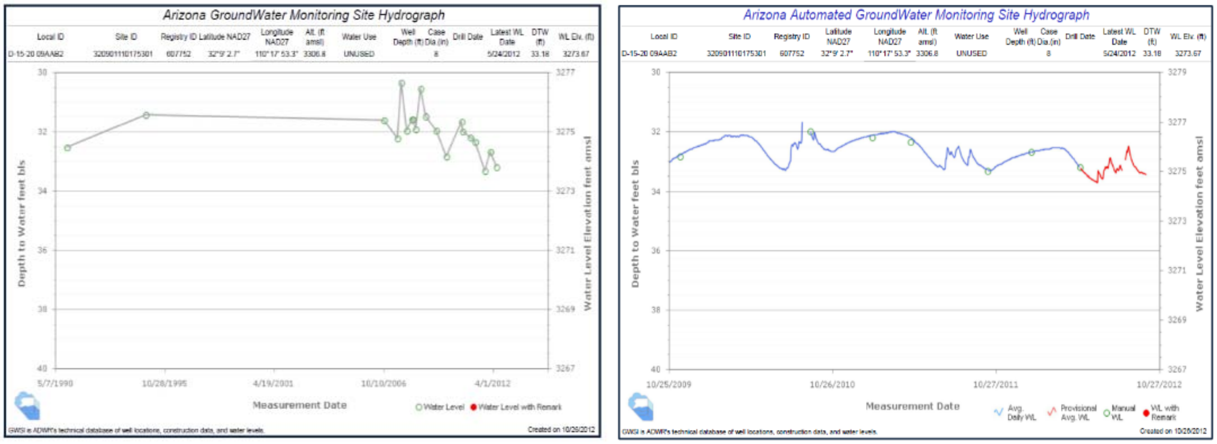
In 2003, Governor Janet Napolitano created the Arizona Drought Task Force, led by ADWR, which developed a statewide drought plan known as the Arizona Drought Preparedness Plan (ADPP). The plan includes criteria for determining both short and long-term drought status for each of the 15 major watersheds in the state, based on precipitation and stream flow. The plan also provides the framework for an interagency group which reports to the governor on drought status, in addition to local drought impact groups in each county and a monitoring technical committee. Twice a year this interagency group reports to the governor on the drought status and the potential need for drought declarations. The counties use the monthly drought status reports to implement actions within their drought plans.

While metropolitan Phoenix depends primarily on surface water stored in the Salt-Verde watershed reservoir system, most of the State relies on groundwater or Central Arizona Project (CAP) water from the lower Colorado River. The statewide drought plan also calls for all water providers to develop drought plans that include an assessment of risk for their water supply and action plans for conservation and more advance management measures when drought reaches critical threshold levels in their water service area. Some of the actions include cutbacks in water delivery and elimination of non-critical water uses. In the case of short term drought, many ranchers throughout the State are faced with the choice of buying feed for their cattle or selling the herd. Arizona and New Mexico are assessed to have the poorest range and pasture land in the United States, so both long and short-term drought have significant consequences to ranchers as well as to wildlife.

Drought Status Change Monitoring

Two (2) of the ADWR groundwater index wells located within the Lower San Pedro and Whitewater Draw watersheds are used to measure the effects of climate for the purpose of providing a qualitative indication of drought status (Figure RA-2). Groundwater levels for these wells show steady overall decline through the 2012 water year, which correlated with long-term drought conditions.

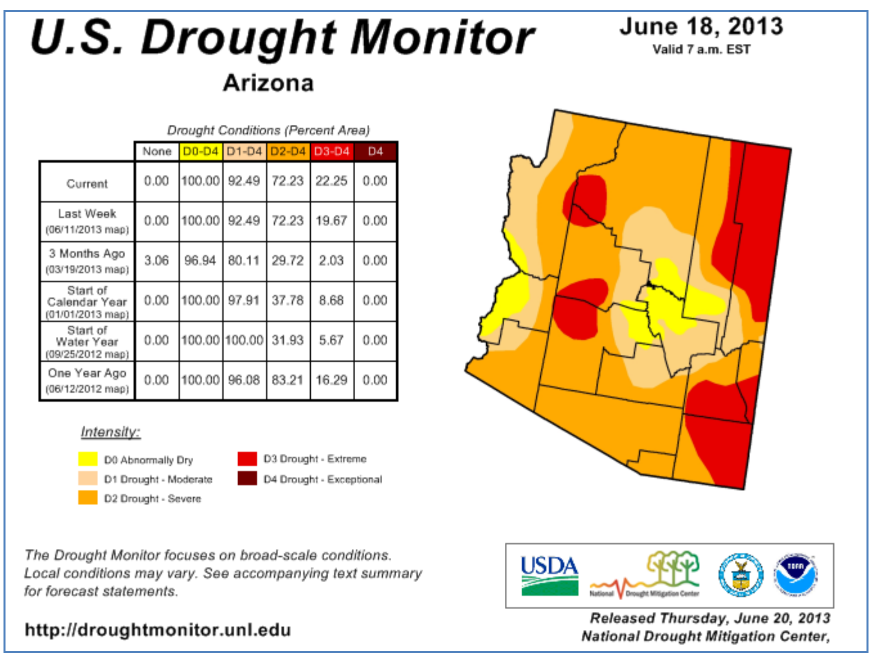
Figure RA-2: Quarterly Groundwater Levels for Drought Index Wells in the Lower San Pedro & Whitewater Draw Watersheds



Source: 2012 Arizona Drought Preparedness Plan Annual Report

US Drought Monitor provides a summary of drought conditions across the United States and Puerto Rico and is developed and maintained by the National Drought Mitigation Center (www.drought.unl.edu). USDM includes the U.S. Drought Monitor Map. This map is updated weekly by combining a variety of drought database and indicators, and local expert input into a single composite drought indicator. The map denotes four levels of drought intensity (ranging from D1 - D4) and one level of "abnormal dryness" (D0). The figure below shows short-term drought status summary for the State of Arizona as of June 18, 2013. With May being the typical driest month statewide, there has been little improvement in drought conditions.

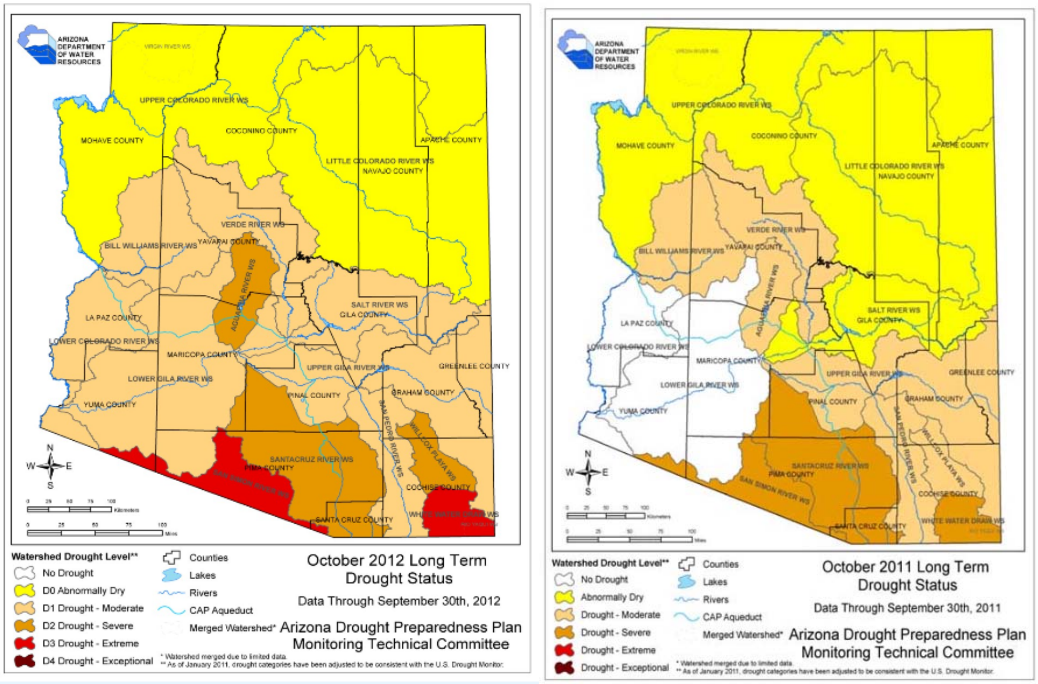
Figure RA-3: Drought Monitor Map for Arizona on June 18, 2013



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	92.49	72.23	22.25	0.00
Last Week (06/11/2013 map)	0.00	100.00	92.49	72.23	19.67	0.00
3 Months Ago (03/19/2013 map)	3.06	96.94	80.11	29.72	2.03	0.00
Start of Calendar Year (01/01/2013 map)	0.00	100.00	97.91	37.78	8.68	0.00
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	31.93	5.67	0.00
One Year Ago (06/12/2012 map)	0.00	100.00	96.08	83.21	16.29	0.00

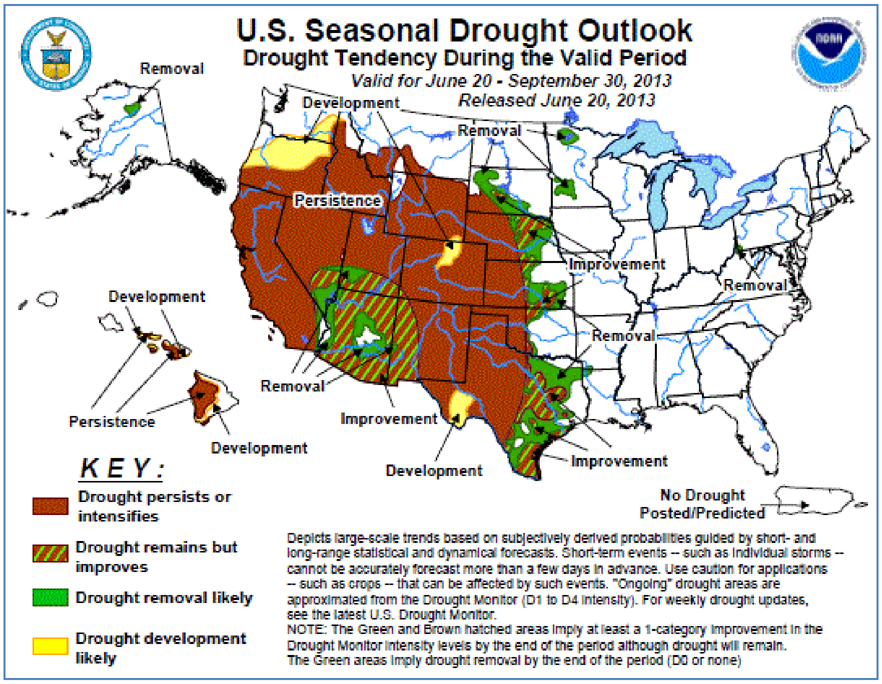
The figure below compares statewide long-term drought status from Oct. 2012 to that from Oct 2011. A number of watersheds saw worsening conditions due to two extremely dry La Nina winters between 2010-2011.

Figure RA-4: Long Term Drought Status for Arizona, Oct 2012 vs Oct 2011



According to the projection, the La Nina event which affected Arizona during the winter of 2011-2012 had diminished by summer of 2012. It is unlikely that Arizona will experience La Nina conditions in the coming winter of 2013, and drought conditions can potentially improve.

Figure RA-5: US Seasonal Drought Outlook, June 20 – Sept 30, 2013 Potential Secondary/Cascading Effects

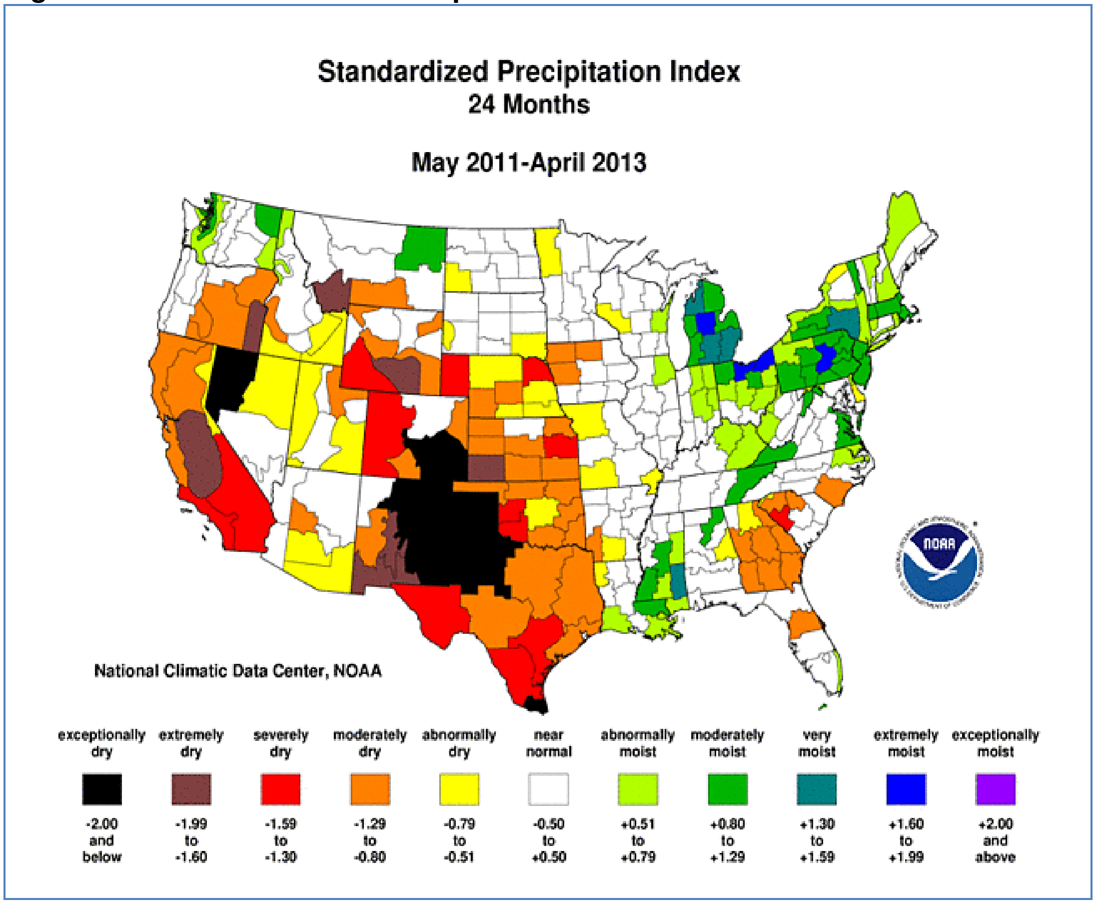


In the west, drought is a cumulative hazard, in that a single week, month, or year of below average precipitation does not define a drought. Since impacts of drought are also slow to develop, secondary and cascading effects may be felt several years after the drought begins. The primary impacts of drought include reduction of surface and ground water resources; increased wildfire activity; loss of livestock and wildlife (biodiversity) due to lack of grazing vegetation and watering holes. The secondary effects include erosion of slopes and river channels due to loss of vegetation; loss of forests due to insect infestation in weakened trees, such as the bark beetle; dust storms and flooding to due loss of vegetation; soil degradation and air pollution; and ground subsidence due to over-pumping of groundwater. Socio-economic secondary effects include increased public health risk, increased food prices, and increased conflict between water users.

Probability and Magnitude

The National Drought Mitigation Center (NDMC) issues a weekly national drought status map. The primary indicators for the Western U.S. are the Palmer Hydrologic Drought Index, and the 60-month Palmer Z-index. No commonly accepted approach exists to assessing risks associated with drought. The Palmer Drought Severity Index (PDSI) is a commonly used index that measures the severity of drought for agriculture and water resource management. It is calculated from observed temperature and precipitation values and estimates soil moisture. However, the Palmer Index is not considered to be consistent enough to characterize the risk of drought on a nationwide basis (FEMA, 1997). Neither of the Palmer indices are well suited to the dry, mountainous western United States, so the State Drought Monitoring Technical Committee uses the Standardized Precipitation Index (SPI - McKee et al., 1995) for the short-term drought status and a combination of the SPI and streamflow for the long-term drought status. This method is based on research by (Steinemann and Cavalcanti, 2006) for the Georgia drought monitoring program, and adapted to conditions in Arizona. As shown in the figure below, the 24-month SPI through the April 2013 for the State of Arizona ranges from near normal to moderately dry.

Figure RA-6: Standardized Precipitation Index 24 Months for U.S.



Source: National Drought Mitigation Center

The entire State is susceptible to a drought at any time, though the critical time for water resources dependent on runoff is April through July. According to recent climate modeling studies by researchers at Columbia University's Lamont-Doherty Earth Observatory, which are part of the International Panel on Climate Change (IPCC) 2007 report, the southwestern United States may become a dust bowl, reminiscent of the 1930s. Dr. Gerald Meehl of the National Cooperative for Atmospheric Research (NCAR), in a 2007 report to the IPCC, found that mega-droughts have occurred in the past and are likely to occur in the future, particularly in areas prone to monsoons, such as the Indian subcontinent and Southwestern North America. A recent study of past droughts (A.D. 762-2005) in the southwest using tree ring data (Meko, et al 2007) found that droughts in the past have lasted as long as 60 years, with reduced streamflow lasting an average of 25 years. The data suggest extended drought is the normal condition in the southwest, and the wet decades of the 1970s and 1980s are uncharacteristic.

It is notable that temperatures in the Western US rose 2-5°F during the 20th century. While this increase was accompanied by precipitation increases of up to 50% in some areas of the West, some places have become drier and experienced more droughts (including Arizona). The most recent report by the IPCC predicts more variability in precipitation, and probably drier conditions over the next 50 to 100 years. However, even if precipitation does not decrease in the future, the higher temperatures will increase the evaporative demand for water and lead to more drought.

Arizona's desert climate directly affects our economy and quality of life. All economic activity, including mining, irrigated agriculture, and growth of cities occurs only where dependable water supplies are available. As a result, Arizona places a high priority on managing its limited water to ensure that secure water supplies are available now and well into the future.

There are basically four categories of water supplies available in Arizona: Colorado River water, surface water other than Colorado River water, groundwater and effluent. The utility of each type of water depends on its quantity, quality, reliability and economic feasibility. Surface water from lakes, rivers and streams is our major renewable resource. However, because of our desert climate, the amount of surface water available can vary dramatically from year to year, season to season, and place to place. In order to make the best use of the surface water when and where it is needed, storage reservoirs and delivery systems have been constructed throughout the State. Most notable are the major reservoir storage systems located on the Salt, Verde, Gila and Agua Fria rivers. Almost all of the natural surface water in Arizona has been developed.

A separate category of surface water in Arizona is the water supplied through the Colorado River. The federal government constructed a system of reservoirs on the river to harness its supplies for use in several states. Arizona, California, Nevada, New Mexico, Utah, Colorado, Wyoming and Mexico share the river's resources. Rights to use Colorado River water are quantified by a string of legal authorities known as the "Law of the River." Based on this body of law, Arizona has the right to use 2.8 million acre feet annually of Colorado River water. Mohave, La Paz and Yuma county water users rely on Colorado River as their principal water supply. The Central Arizona Project delivers approximately 1.5 million-acre feet of Colorado River water to Maricopa, Pinal and Pima Counties.

About 36% of the State's water use comes from groundwater sources. Groundwater is found beneath the earth's surface in natural reservoirs called aquifers. In most cases the water stored in these reservoirs has been in place for millions of years. Throughout this century, groundwater has been pumped out more rapidly than it is being replenished, creating a condition called overdraft. Though a large amount of water remains stored in Arizona's aquifers, its availability is limited by location, depth and quality. By continuing to overdraft the State's groundwater supplies, we challenge our ability to ensure a secure water supply for the future. In recognition of this threat, Arizona implemented the Groundwater Management Code in 1980. The Groundwater Code promotes water conservation and long-range planning of our water resources.

Reclaimed water, or effluent, is the one increasing water source in our state. As our population and water use grows, more treated wastewater will be available. Reclaimed water is treated to a quality that can be used for purposes such as agriculture, golf courses, parks, industrial cooling, or maintenance of wildlife areas.

In 2006, Arizona used approximately 8.1 million acre-feet of water. One acre-foot equals 325,851 gallons. An acre-foot is enough water to serve the needs of a family of four for one year. The table below shows the percentage of water used by each major use category.

Table RA-21: Percentage of Water Use by Category

Water Source	Million Acre Feet (MAF)	% of Total
Surface Water	**3.76**	**54.0**
Colorado River	2.8	75.0
CAP Canal	1.55	
On-River	1.25	
In-State Rivers	0.96	25.0
Salt-Verde	0.5	
Gila & others	0.46	
Pumped from Wells	**2.99**	**43.0**
Reclaimed Water	**0.21**	**3.0**
Total	**6.96 MAF**	**100**

Source: Arizona Department of Water Resources

The heavily populated portion of Arizona is unique, particularly the major metropolitan areas of Phoenix and Tucson. While located in a region subject to hydrological drought, a large supply of water is available via the Central Arizona Project (CAP) Canal. The CAP Canal is a 336-mile long system of aqueducts, tunnels, pumping plants and pipelines running from the Colorado River on the Arizona-California border eastward to the Phoenix area and then southeast to the Tucson area. The CAP Canal supplies approximately 1.5 million acre-feet of water annually to Maricopa, Pinal, and Pima Counties and is the largest single source of renewable water supply in the State. The CAP Canal has more than 80 major customers, approximately 75% of which are municipal and industrial users, 13% are irrigation districts and 12% Indian communities (ADWR; Central Arizona Project).

Vulnerability

The impacts of drought to critical and non-critical facilities and building stock is generally indirect, in that drought is often a contributing factor to other hazards such as flooding, subsidence and wildfire. Extended drought may weaken and dry the grasses, shrubs, and trees of wildfire areas, making them more susceptible to wildfire. Drought also tends to reduce the vegetative cover in watersheds, and hence decreases the interception of rainfall and increases the flooding hazard. Subsidence conditions are aggravated when lean surface water supplies force the pumping of more groundwater to supply the demand without the benefit of recharging from normal rainfall. The sectors most directly impacted by drought are agriculture, ranching, potable water supplies, and recreation/tourism. The vulnerability and potential impact for this risk assessment will focus primarily on the potential economic impacts to Arizona's agriculture and domestic water supplies.

The most direct impacts are to the agricultural community, the development of domestic water supplies, and hydroelectric generation. The State's primary sources of water for agriculture and domestic water supplies come from either:

- The CAP, which is supplied by the CO River Drainage Basin;
- The Salt River Project network of dams and canal systems designed to supplement the Phoenix and Tucson area; and/or,
- Groundwater supplies, which are generally available Statewide.

Statewide public/private drinking water systems consist of over 4,000 groundwater wells and over 100 surface water intakes (AZDEQ, Water Quality database 2006). If the need for groundwater persists, the production and associated costs intensifies to meet EPA safe drinking water requirements. Both agricultural and electric utility resources can be affected during drought periods. With regard to agriculture, when drought conditions persist such as what is currently being experienced statewide, more demand is placed on groundwater supplies. Also, the additional groundwater pumping then translates into increased subsidence conditions.

There are no estimates of drought related losses to state-owned facilities as the primary impacts of drought are typically not related to structures. Also, the entire statewide population is considered to be equally impacted by drought as this hazard tends to be more regional in its impact. From 1995 to 2009, the agricultural community in the State has received over $81 million in disaster related assistance funding from the U.S Department of Agriculture for crop and livestock damages (EWG, 2010). According to the USDA, 35 to 55% of the disaster assistance money (USDA, 2004), in that time period can be attributed to drought related losses. These impacts are translated into the general economy in the form of higher food and agricultural goods prices. Other economic losses associated with drought could include increased domestic water supply costs, increased wildfire risk and firefighting costs, and exacerbation of subsidence conditions.

No risk assessment data tables are provided for this hazard.

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Drought are shown below.

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Drought are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-22: State CPRI Results for Drought

Risk Due to Drought					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Drought	Highly Likely	Limited	>24hours	>1 week	**2.95**
	4	2	1	4	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30) +(Warning Time x .15)+(Duration x .10). Maximum overall score = 4

Table RA-23: County CPRI Results for Drought

County	CPRI
Apache	No Data
Cochise	No Data
Coconino	2.58
Gila	2.53
Graham	2.91
Greenlee	3.05
La Paz	2.47
Maricopa	2.53
Mohave	2.74
Navajo	2.73

County	CPRI
Pima	2.93
Pinal	2.61
Santa Cruz	2.65
Yavapai	No Data
Yuma	2.50
Average	**2.68**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Drought are shown below.

Table RA-24: State Environmental CPRI Results for Drought

Environmental Risk Due to Drought				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Limited	6 months+	**.90**
Soil	Unlikely	Limited	6 months+	**2.1**
Average CPRI Environmental Risk Rating: 1.7 (max 3.6)				

Consequences / Impacts

- **Public**
  There are no obvious direct impacts to public health and safety due to the effects of drought conditions. Indirect impacts are more likely and are typically seen in the form of damage to the environment which could impact agriculture, food supply, and the economy. The economy could suffer if the environment was impacted to a point that if affected businesses that depend on support from the environment. These impacts are translated into the general economy in the form of higher food and agricultural goods prices.
- **Responders to the Incident**
  Similar to the impact to the public, there should be no threat to responders as this is not considered an ‘incident’ response type of hazard.
- **Continuity of Operations / Delivery of Services**
  Overall, drought is not a major threat to the state’s ability to continue effectively functioning. Drought demands cut backs at all levels, but this should not significantly hinder the continued operation of state agencies, services and responsiveness.
- **Environment**
  See the “Vulnerability” section of this profile.

Extended drought may weaken and dry the grasses, shrubs, and trees of wildfire areas, making them more susceptible to wildfire. Drought also tends to reduce the vegetative cover in watersheds, and hence decreases the interception of rainfall and increases the flooding hazard. Subsidence conditions are aggravated when lean surface water supplies force the pumping of more groundwater to supply the demand without the benefit of recharging from normal rainfall.

- **Economic / Financial Condition of Jurisdiction**
  The potential impact to Arizona's economy can be widespread and illustrated many ways, here are a few:
  Agriculture: crop losses and increased irrigation costs.
  Recreation/Tourism: loss of revenue yielded by activities such as hunting and fishing and decreased recreational equipment sales/use and could possibly affect operation of recreational facilities that depend on water.
  Livestock production: reduced milk production and productivity of land for uses related to livestock and limited or increased cost of water for livestock.

  Drought threatens different areas of the state in different ways. Some areas would experience more of a social impact and some, as illustrated above, an economic impact. From 1987 to 2002, the State received well over $300Million in disaster related assistance funding from the U.S Dept of Agriculture for crop and livestock damages, 35-55% of which can be attributed to drought related losses. These impacts are translated into the general economy in the form of higher food and agricultural goods prices.

- **Public Confidence in Jurisdiction's Governance**
  Drought planning is a relatively new framework for dealing with drought. In the past, the emphasis has been on emergency drought relief after the drought and associated damage had already occurred. Now, Arizona is moving toward preparing for and mitigating the effects of drought, with the goal of preventing a drought emergency situation. In 2004, the Arizona Drought Preparedness Plan was finalized. The goals of the Plan are to identify the impacts of drought to water users, define sources of vulnerability, outline monitoring programs, and prepare response options and mitigation strategies to reduce the impacts. Implementation of this Plan, providing public education and awareness and other related activities should maintain and/or increase public confidence. Taking a proactive approach by addressing drought year round as opposed to only when a critical point is reached should help the confidence level as well. Lack of situation knowledge will lead to a misunderstanding of the situation and result in frustration and a negative attitude toward those that are perceived as responsible, which in most cases would be the government. Although it is not proven by studies or research, it is believed that most citizens will and do respond positively.

Resources

Definitions
ADWR – Arizona Department of Water Resources
EAP – Emergency Action Plan
NID – National Inventory of Dams

Sources
Arizona Department of Water Resources – Arizona Drought Task Force
Arizona State University – State Climate Office
Federal Emergency Management Agency
National Drought Mitigation Center

References

Arizona Governor Janet Napolitano, March 24, 2003. Executive Order 2003-12: Arizona Drought Task Force Plan.

Arizona Division of Emergency Management, December 2001, *Arizona's Plan to Mitigate Hazards – Draft*.

AZ Dept of Environmental Quality, Water Quality database 2006.

AZ Dept of Water Resources, Securing Arizona's Water Future.

Central Arizona Project, "Facts." http://www.cap-az.com/about/facts/

Environmental Working Group, 2010, *Farm Subsidy Database.* http://farm.ewg.org/progdetail.php?fips=04000&progcode=total_dis

Federal Emergency Management Agency.1997. *Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy*. http://www.fema.gov/fhm/dl_mhira.shtm .

McKee, T.B.,Doesken,N.J., Kleist, J. 1995. *Drought monitoring with multiple time scales.* Ninth Conference on Applied Climatology, American Meteorological Society, Jan 15-20, 1995, Dallas TX, pp. 233-236.

Meko, D. M., Woodhouse, C.A., Baisan, C.H., Knight, T., Lukas, J.J., Hughes, M.K., Salzer, M.W. 2007. *Upper Colorado River Flow Reconstruction.* http://www.ncdc.noaa.gov/paleo/pubs/meko2007/meko2007.html. From Report: David M. Meko, Connie A. Woodhouse, Christopher A. Baisan, Troy Knight, Jeffrey J. Lukas, Malcolm K. Hughes, and Matthew W. Salzer. 2007. *Medieval drought in the upper Colorado River Basin*, *Geophysical Research Letters* Vol 34, L10705, May 2007.

National Drought Mitigation Center, "US Drought Monitor." http://drought.unl.edu/dm/monitor.html

National Oceanic & Atmospheric Administration, July 29, 2003."Drought Information Center." http://www.drought.noaa.gov/

New Mexico. May 31, 2002. New Mexico Drought Plan.http://weather.nmsu.edu/drought/053102/

Steinemann, A.C. and Cavalcanti, L.F.N. 2006. *Developing multiple indicators and triggers for drought plans.* Journal of Water Resources Planning and Management, Vol 132(3):164-174.

U.S .Department of Agriculture, August 13, 1999."Glickman Declares Pennsylvania, 13 Arizona Counties as Disaster Areas and Announces Additional Drought Assistance." http://www.usda.gov/news/releases/1999/08/0334

U.S .Department of Agriculture, May 17, 2002, "Veneman Designates Arizona as Drought Disaster Area." http://www.usda.gov/news/releases/2002/05/0197.htm

U.S Department of Agriculture, Arizona Agricultural Statistics Service, 2004, *2002 Annual Statistics Bulletin*, as posted at the following URL: http://www.nass.usda.gov/az/02bul/main.htm

U.S. Department of Agriculture, 2004, *News Release No. fs0199.04*, website data at the following URL: http://www.usda.gov/Newsroom/fs0199.04.html

Earthquake

Introduction/History

Despite a lack of public awareness, Arizona lies within and adjacent to seismic zones that have the potential to cause significant damage to critical infrastructure and facilities as well as causing loss of life. As Arizona populations and developed areas grow, so too will the risks posed by earthquake.

Earthquakes have been described as shaking, ground-rolling vibrations caused by strain release along faults. Earthquakes can occur at any time of the year and may result in strong ground motion with a possibility of a ground surface rupture, slope failure (landslide or rockslide), and/or liquefaction. These factors can lead to a particularly destructive effect from this hazard. Even minor earthquakes can cause critical damage and loss of life.

A *surface rupture* is caused by the differential movement stress of two sides of a fault that is released and ultimately expressed at the earth's surface. Linear structures such as railways, highways, pipelines, and tunnels built across active surface faults, are extremely susceptible to being damaged by earthquakes. Displacement along faults, both in terms of length and width, varies but can be significant (e.g., up to 20 feet), as can the length of the surface rupture (e.g., up to 200 miles).

Liquefaction occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing some of the empty spaces between granules to collapse. Pore-water pressure may also increase sufficiently to cause the soil to behave like a fluid (rather than a soil) for a brief period and cause deformations. Liquefaction causes lateral spreads (horizontal movement commonly 10-15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to 12 miles), and loss of bearing strength (soil deformations causing structures to settle, tip or collapse).

Earthquake energy, also referred to as seismic activity is commonly described in terms of magnitude and intensity. Magnitude (M) describes the total energy released and intensity (I) subjectively describes the effects at a particular location. Although an earthquake has only one magnitude, its intensity varies by distance from the epicenter, surface materials (e.g., soil, bedrock), and building types. Magnitude is the measure of the amplitude (height) of the seismic wave and is expressed by the Richter scale. The Richter scale is a logarithmic measurement, where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the seismic waves (and 32 times more energy). Intensity is a measure of how strong the shock was felt at a particular location, and is expressed by the Modified Mercalli Intensity (MMI) scale. Peak ground acceleration (PGA) measures the rate of change of ground motion relative to the rate of acceleration due to gravity. The acceleration due to gravity is often called "g" and is equal to 9.8 meters per second squared (9.80 m/sec^2). This means that every second something falls towards earth, its velocity increases by 9.8 meters per second. Accordingly, a PGA of 25%, for example, is equal to a peak ground surface acceleration of 2.44 m/sec^2.

It is possible to approximate the relationship between PGA, the magnitude and the intensity, as shown in the following table. The relationships are approximate and depend upon such specifics as the distance from the epicenter, depth of the epicenter, and type of surficial material. For example, an earthquake with 10% PGA would roughly correspond to an intensity of V or VI, a magnitude of 5.0-5.9, and could be described as being felt by everyone, overturning unstable objects, and/or moving heavy furniture.

Earthquakes generated within Arizona are largely centered in the north-central portion of the State. The earthquake's size is depicted with a relative sized color-coded circle. The two largest earthquakes to have been estimated and recorded occurred in southern Arizona (San Pedro Earthquake) and north of Flagstaff. Several faults (depicted as brown lineaments) have been identified within Arizona, some of which are known to generate earthquakes. Active faults are known to exist in northern Arizona and California and Mexico have generated large earthquakes that have damaged structures within Arizona's borders. For Arizona, existing studies (Scarborough and others, 1983; Menges and Pearthree, 1983; Pearthree and others, 1983; and Scarborough and others, 1986) define active faults as those that exhibit signs of surface displacement, or movement within about the last 4 million years (Late Pliocene-Quaternary).

Earthquake-related ground failure due to liquefaction is known to cause significant damage in areas affected by earthquakes. Liquefaction has occurred in southern Arizona due to the San Bernardino Valley 1887 earthquake and western Arizona due to several California earthquakes (DuBois & Smith, 1980; DuBois et al., 1982).

Table RA-25: Earthquake PGA, Magnitude and Intensity Comparison

PGA (%g)	Magnitude (Richter)	Intensity (MMI)	Description (MMI)
<0.17	1.0 - 3.0	I	**I.** Not felt except by a very few under especially favorable 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.
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 rock 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.** Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
34 - 124	6.0 - 6.9	VII - 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, 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 with foundations. Rails bent. **XI.** Few, if any (masonry) structures remain standing. Bridges destroyed, rails bent greatly. **XII.** Damage total. Lines of sight & level are distorted. Objects thrown into the air.

Source: Wald, Quitoriano, Heaton, and Kanamori, 1999. This figure has been modified from AZ Earthquake Information Center, AZ Earthquake & Fault Maps web page: www4.nau.edu/geology/aeic/EQ_Fault_maps.html.

Several thousand earthquakes have occurred in Arizona over the last 180+ years (DuBois et al., 1982). Some of these events were estimated and/or recorded at Richter scale magnitude 4.9 or greater and are summarized in the table below. Heavy damage resulted from at least 3 earthquakes (1852, 1887 & 1940), moderate effects have been reported for at least 40 events, and minor effects are consistently reported throughout historic times and number in the several hundred (DuBois, et al., 1982). There have been 14 tremors of intensity V to VII centered within

Arizona's borders (USGS, Sept 12, 2003). A total of 10 major earthquakes were recorded during the 1800s and another 32 recorded during the 1900s. Numerous smaller earthquakes, however, have been recorded throughout the 1900s (Bausch & Brumbaugh, May 23, 1994).

Table RA-26: Arizona Historical Earthquake Events from 1830-2013 Registering Over 4.9

Date	Magnitude / Intensity	Location
29-Apr-1993	5.4	Cataract Creek
25-Apr-1993	4.9	Cataract Creek
4-Feb-1976	4.9	Chino Valley
13-Oct-1959	5	Flagstaff
21-Jul-1959	5.5	Fredonia
17-Jan-1950	5.9	Ganado T Post
4-Jun-1939	5	Duncan
9-Mar-1939	5	Grand Canyon
29-Sep-1938	5	Clifton
8-Apr-1937	5	Ganado
10-Jan-1935	5	Grand Canyon
2-Jan-1935	5	Wellton
1-Jan-1935	5	Grand Canyon
28-Jul-1931	5	Cottonwood
17-Jun-1922	5	Miami
6-Apr-1921	5	Holbrook
12-Dec-1916	5	St. Michaels
30-Mar-1916	5	Nogales
18-Aug-1912	6.2	Lockett Tanks, Flagstaff
24-Sep-1910	6	Cedar Wash
25-Jan-1906	6.2	Flagstaff
2-Feb-1892	5	Flagstaff
10-Jun-1890	5	Yuma*
13-Nov-1888	5	Yuma*
19-Aug-1888	5	Yuma*
25-Jul-1888	5	Tombstone
11-Nov-1887	5.9	Pantano
17-Dec-1878	5	Yuma*
3-Nov-1875	5	Yuma*
2-May-1872	5.9	Yuma*
1830-	6.9	San Pedro

AZ earthquakes recorded or estimated at magnitude 4.9 or greater (Modified from AZ Earthquake Information Center, AZ Earthquakes 1830-2010 webpage, http://www.cefns.nau.edu/Orgs/aeic/eq_history.html -using DuBois et al., 1982, Baker updated the geocoding and supplemented the 2011-2013 data).

Since the 2010 update of this plan there have been over 260 recorded earthquakes in Arizona. Of which the highest magnitude was a 3.7 on March 18th, 2011 in the Clarkdale/Sedona area. There have been 12 events of magnitude 3 or higher from 2011-2013 as seen in the table below. This shows that though it has been a couple decades since the last major earthquake, Arizona is still at risk to high magnitude events.

Table RA-27: Arizona Earthquake Events from 2011-2013 Registering Magnitude 3.0 or Higher

Date	Magnitude / Intensity	Location
7-Jan-2013	3.05	48km WSW Page
29-Oct-2012	3.4	38 Km NNE of Clifton
8-Oct-2012	3.6	38 Km NNE of Clifton
25-Aug-2012	3	42 Km W of Page
8-Jan-2012	3.1	Blue Ridge
14-Dec-2011	3.4	30km SSE Beaver Dam
13-Dec-2011	3.1	Colorado City
25-Oct-2011	3.23	4 Km SW Paulden
8-Jul-2011	3	Grand Canyon N Rim
23-Jun-2011	3.32	Kanab, Fredonia
18-Mar-2011	3.7	N of Clarkdale, W Sedona
23-Jan-2011	3.6	west of Sedona

AZ earthquakes recorded or estimated at magnitude 4.9 or greater (Modified from AZ Earthquake Information Center, AZ Earthquakes 1830-2010 web page, http://www.cefns.nau.edu/Orgs/aeic/eq_history.html -using DuBois et al., 1982, Baker updated the geocoding and supplemented the 2011-2013 data).

The southeastern and southwestern corners of the State have been subject to the greatest intensity earthquakes. The earthquakes affecting the southeastern corner appear to originate in Mexico. Most of the earthquakes felt in Yuma have originated in southern California and northern Mexico. A zone of lesser ground shaking intensity extends from around Flagstaff northward. Within Arizona, earthquakes have most commonly occurred between Flagstaff and the Grand Canyon. The table below provides a summary of recorded earthquake events within Arizona over the 180+ year span. The number of events is compiled by year and the greatest magnitude achieved is listed for that year.

Table RA-28: Events and Maximum Magnitude per Year by County

County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude
Apache	12	5.9	2013	43	3.05	1989	2	3.2
1937	1	5	La Paz	4	4.9	2011	1	1.6
1950	1	5.9	1875	1	4.9	Gila	9	5
1962	1	2.8	1945	1	0	1922	1	5
1976	2	2.5	1964	1	3.3	1923	1	4
1982	1	3	1975	1	2.7	1941	1	0
1985	2	3.3	Maricopa	10	4.9	1963	1	4.1
1986	3	2.6	1875	1	3	1969	1	4.4
2013	1	2.92	1915	1	3.9	1979	1	2.5

County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude
Cochise	15	6.9	1935	1	3	1989	1	3
1830	1	6.9	1937	2	4.9	2000	1	0
1887	1	4.9	1974	2	3	2012	1	1.88
1888	1	5	2005	1	0	Graham	2	4
1893	1	4.9	2010	1	3.58	1938	1	4
1899	2	4.9	2013	1	2.24	2010	1	2.2
1934	1	4.9	Mohave	166	4.9	Greenlee	19	5
1938	1	4.9	1891	1	3.9	1938	4	5
1958	1	4.9	1899	1	4	1939	1	5
1961	1	2.6	1936	2	4	2010	11	3.6
1962	2	2.9	1938	1	0	2012	3	3.6
1989	3	3.1	1941	5	4	Navajo	31	5
Coconino	1045	6.2	1942	1	4.9	1916	1	5
1892	1	5	1946	1	4.9	1918	1	4
1906	2	6.2	1952	2	4.9	1921	1	5
1910	1	6	1962	2	4.4	1931	1	4.9
1912	1	6.2	1963	4	2.9	1948	1	4.9
1913	1	4.9	1964	1	2.5	1962	2	2.9
1918	2	4	1965	1	4.2	1967	1	3.8
1919	1	3.9	1966	6	3.7	1970	1	0
1923	1	4	1970	2	2.6	1971	2	2.2
1931	2	5	1971	3	3	1973	1	3.2
1934	2	4.9	1973	1	0	1987	2	3
1935	6	5	1979	1	3.7	1988	1	3.2
1936	1	4.9	1981	1	3.5	1992	1	2.2
1937	1	4	1982	2	2.9	1998	5	3.9
1939	3	5	1983	1	3.9	2001	1	0
1940	1	4.9	1987	1	3.3	2004	4	3.4
1942	1	3.9	1988	3	3.6	2005	1	1.8
1943	1	4	1989	1	3.2	2010	1	2.7
1944	1	4	1990	1	2.8	2011	2	2.8
1945	1	5	1993	3	3	2012	1	2.6
1947	1	4	1994	7	3.5	Pima	8	5.9
1948	2	4.9	1995	2	3	1887	1	5.9
1951	1	4	1997	17	3.6	1888	1	4
1953	1	4.9	1998	2	3.1	1950	1	4.2
1959	5	5.5	1999	2	3.2	1951	1	4.5
1962	3	4.5	2000	2	0	1964	1	4.1
1965	1	3.7	2001	1	0	1965	1	4.4
1966	7	4.4	2003	1	3	1972	1	3
1967	8	4.6	2005	1	3.5	1973	1	2.3
1970	5	3	2006	1	1.8	Pinal	2	3
1971	4	3.7	2007	1	3.4	1875	1	3

County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude	County/ Year	# of Events	Max Magnitude
1972	1	3.7	2008	1	3.7	2013	1	2.82
1976	4	3	2009	7	3.9	Santa	2	5
1979	1	2.1	2010	23	3.2	1916	1	5
1980	7	3.6	2011	36	3.4	1927	1	4.9
1981	1	2	2012	7	2.32	Yavapai	81	4.9
1982	1	3	2013	7	2.66	1870	2	4.9
1983	1	3	Yuma	44	5.9	1871	1	4.9
1984	1	3	1872	2	5.9	1930	1	4.9
1985	3	2.7	1874	1	4	1932	1	3
1986	2	2.6	1875	2	5	1933	1	4.9
1987	8	3.3	1876	1	4.9	1937	1	4.9
1988	23	3.1	1877	2	4.9	1963	1	2.6
1989	181	4	1878	1	5	1967	1	3.8
1990	22	2.9	1884	3	4	1974	1	3.9
1991	8	4	1888	3	5	1976	6	4.9
1992	72	4.5	1890	2	5	1977	1	2.5
1993	152	5.4	1892	1	3	1984	1	2.5
1994	21	3	1893	1	3.9	1985	1	3
1995	22	4.1	1897	1	3.9	1986	3	2.2
1996	22	2.7	1905	1	4	1987	2	2.4
1997	78	3.7	1907	1	4	1989	1	2.4
1998	23	4.1	1921	3	4	1991	2	3
1999	8	3.4	1923	1	4	1992	1	2.1
2000	14	3.2	1924	1	4	1994	2	3.6
2001	13	2.6	1927	1	4	1997	2	2.9
2002	3	3	1931	1	4	1998	2	1.9
2003	1	1.3	1932	1	4	1999	2	0
2004	8	2.8	1935	1	5	2001	3	0
2005	41	4.6	1940	2	4.9	2002	1	2.3
2007	1	3.2	1953	1	4.9	2006	2	3.02
2008	1	3.5	1963	1	0	2009	2	2.3
2009	51	3	1974	1	2.7	2010	2	2.05
2010	14	3.1	1975	2	4	2011	22	3.7
2011	84	3.32	1976	2	4	2012	9	2.81
2012	41	3.1	1977	1	4	2013	4	2.36
Statewide Events			**1,450**			**Max. Magnitude: 6.9**		

AZ earthquakes recorded or estimated at magnitude 4.9 or greater (Modified from AZ Earthquake Information Center, AZ Earthquakes 1830-2010 web page, http://www.cefns.nau.edu/Orgs/aeic/eq_history.html -using DuBois et al., 1982, Baker updated the geocoding and supplemented the 2011-2013 data).

The following are a few examples of some of the major earthquakes that have affected and/or occurred within Arizona as demonstrated by the previous tables:

Southern Arizona

The earliest recorded earthquake affecting Arizona, and possibly the largest, occurred in 1830. With an estimated intensity of IX recorded at San Pedro, about 25 miles west of Tucson, the earthquake would have caused massive damage to built structures (ADEM, March 1998).

1887, the Sonoran earthquake caused significant destruction in southern Arizona towns, including Tucson, and was one of the largest earthquakes in North American history. The earthquake was caused by the reactivation of a Basin and Range normal fault that is similar to other faults in Arizona (DuBois & Smith, 1980). The epicenter was located approximately 100 miles south of Douglas, Arizona, along the Pitaycachi fault in Mexico, and caused great destruction at its epicenter. The earthquake was so large that it was felt from Guaymas, Mexico to Albuquerque, New Mexico. It is estimated variously to have been an intensity VII and magnitude 7.2 earthquake. In Arizona, water in tanks spilled over, buildings cracked, chimneys toppled, and railroad cars were set in motion. An observer at Tombstone, near the Mexican border, reported sounds ``like prolonged artillery fire'' (ADEM, March 1998; Bausch & Brumbaugh, May 23, 1994; USGS, Sept. 12, 2003; Univ of Arizona). With the increase in development, if such an earthquake occurred today it would cause extensive damage in southeastern Arizona (Jenny & Reynolds, 1989).

Southwestern Arizona

Some of the earliest descriptions of earthquakes in Arizona occurred in the 1800s on the California side of the Colorado River and are recorded at Fort Yuma. Shocks that probably centered in the Imperial Valley of California or in Mexico have been noted in Fort Yuma since late 1852. Yuma has experienced repeated damage from California earthquakes, such as the M 7.1 on May 18, 1940, the M 6.5 on October 15, 1979 & the M 6.4 on Dec. 19, 1979 (ADEM, March 1998; Bausch & Brumbaugh, May 23, 1994).

January 2, 1935, an earthquake cracked walls and plaster at Wellton, located a few miles east of Yuma. While few residents of the small town were frightened by the tremor, everyone felt the ground quivering and homes shaking (USGS, Sept. 12, 2003).

Northern Arizona

In 1906, the first earthquake with recorded magnitude occurred in Flagstaff, registering M 6.2. However, Northern Arizona experienced a rash of earthquakes in the early part of this century. (ADEM, March 1998; UofA). September 10-23, 1910, a series of 52 earthquakes caused a construction crew in the Coconino Forest near Flagstaff to break camp and leave the area as boulders rolled down on the camp from nearby mountains. The shocks grew in intensity over the two-week period until September 23, when a very strong shock was felt throughout northern Arizona. The earthquake was so severe north of the San Francisco Mountains that people fled from the region (USGS, Sept. 12, 2003).

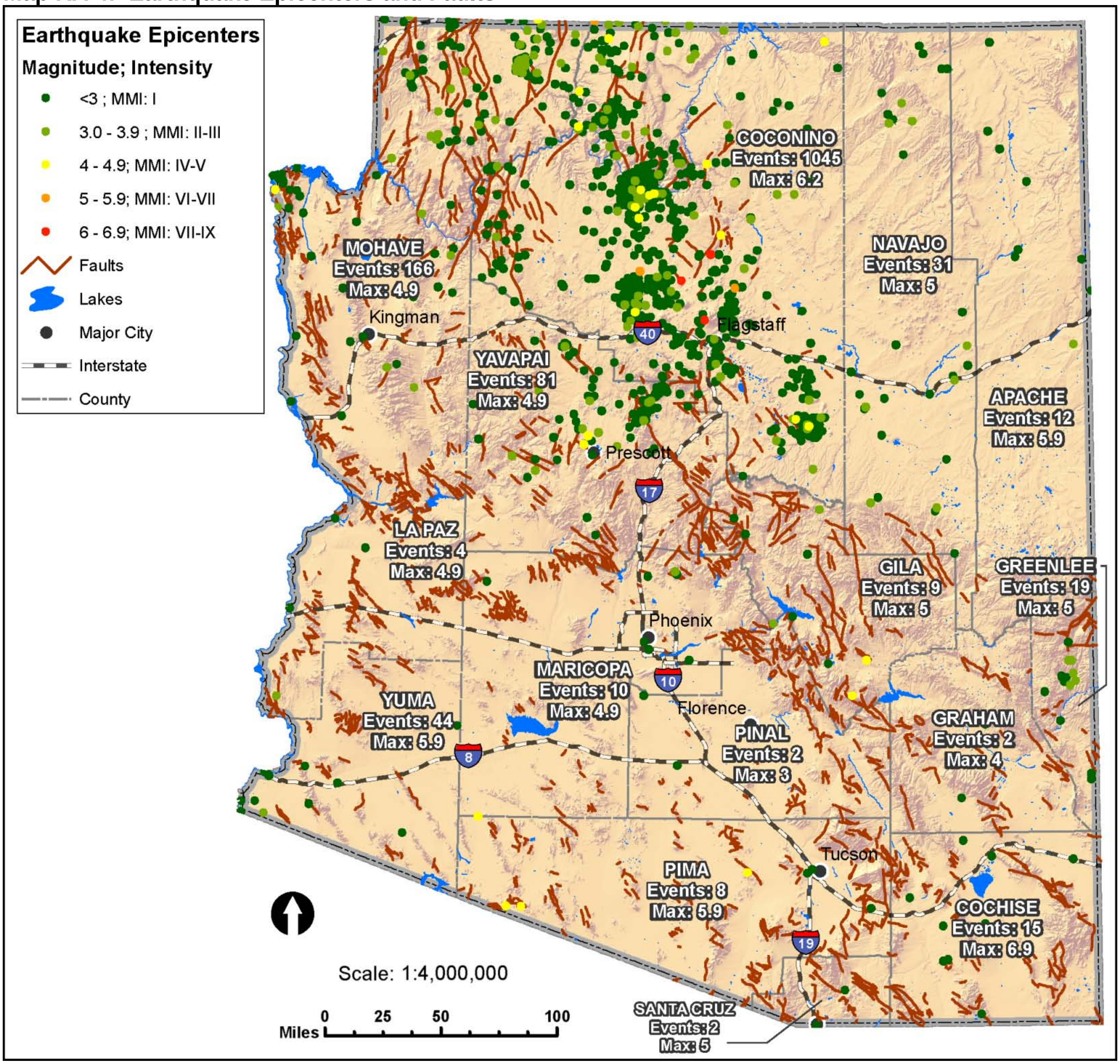
August 8, 1912, an earthquake caused a 50-mile-long crack in the earth north of the San Francisco Range, damaging houses at Williams. The shock was strongest in Coconino County, north of Flagstaff, where rockslides roared down the mountainsides, and the earth seemed to roll “like waves on the Colorado River'' (USGS, Sept. 12, 2003).

January 10, 1935, a slightly stronger earthquake awakened sleepers at Grand Canyon. The distinct subterranean rumble and the movement of houses frightened many. Walls were cracked in some cases, and rockslides occurred in the mountains. Grand Canyon residents felt three slight foreshocks during the first week of January, and one very minor aftershock was noted on January 15 (USGS, Sept. 12, 2003).

Eastern Arizona
January 16, 1950, a strong earthquake (intensity VII) rocked Apache County leaving several cracks in the ground as it rumbled through the small town of Ganado. The cracks, one-half inch wide and up to 12 feet long, extended in a north-south direction near the Ganado Trading Post (USGS, Sept. 12, 2003).

All of these events are visually summarized in the following maps, helping to visualize what the particular parts of the State with increased likelihood of an events occurring.

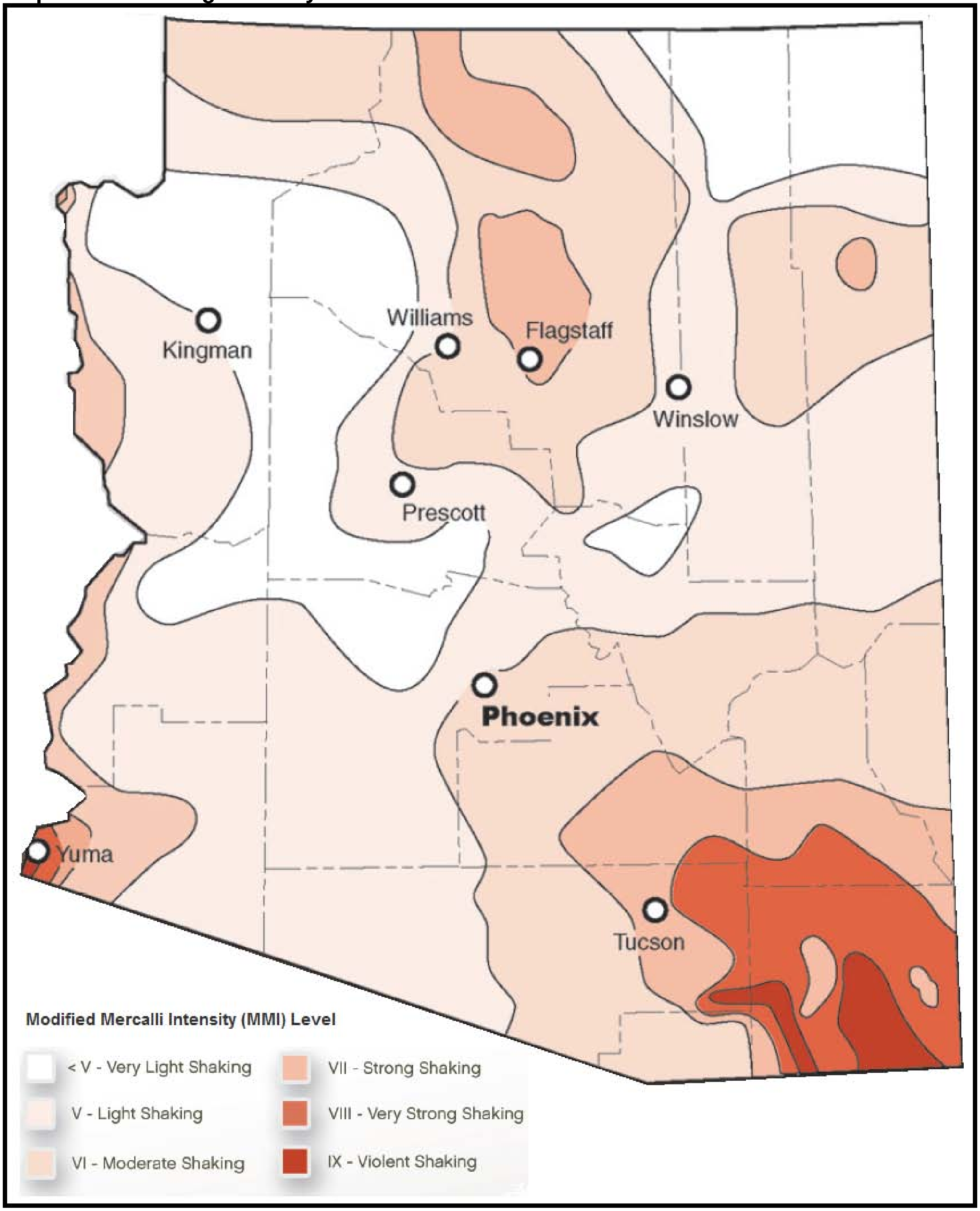
Map RA-4: Earthquake Epicenters and Faults



Source: USGS – Geologic Hazards Science Center, 2013 - AGIC, 2013– Baker, 2013

The Earthquake Epicenters and Faults map presents a depiction of documented earthquake epicenters that have occurred within Arizona between 1830 and June 2013. The map depicts the number of events per county and the maximum recorded earthquake magnitude. It also shows identified fault lines.

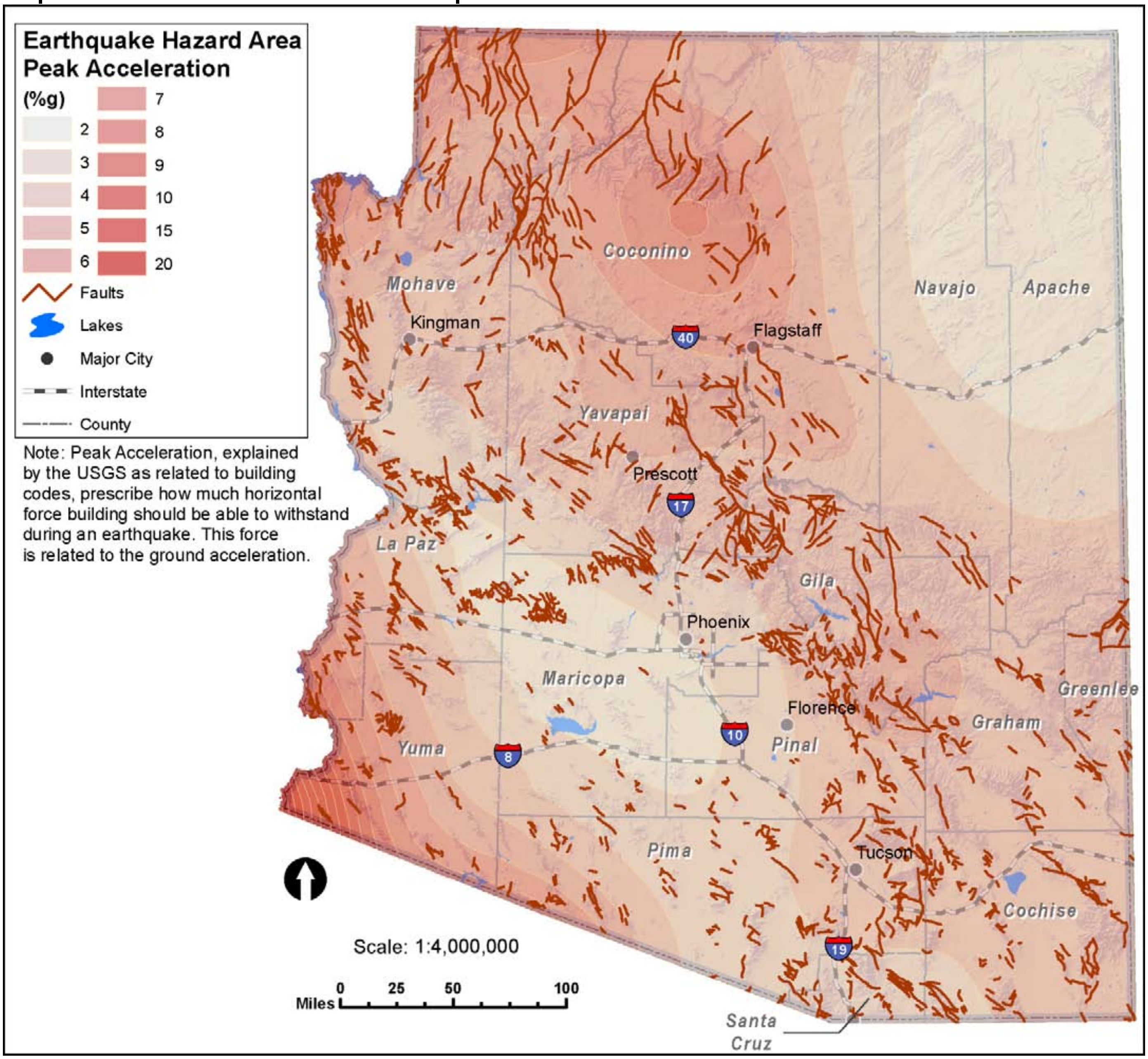
Map RA-5: Shaking Intensity



The Shaking Intensity map helps visualize what Tables RA-6 thru 8 reflect with the magnitude information. Certain parts of the state, such as Cochise, not only have an increased likelihood of an event, but also have the probability of more severe events. The map presents a geographical depiction of the historic maximum intensity using the MMI based on data for the period 1887 to 1999. The Map was produced by Arizona Geological Survey (AZGS) for the seismic hazard awareness brochure (Arizona Shakes).

The next map presents zones of anticipated peak acceleration related as %g for the state, The zones are based on the 2008 grid produced by USGS for the 10% Peak Ground Acceleration (PGA) in 50 years.

Map RA-6: Peak Acceleration for Earthquake



Source: Source: USGS – Geologic Hazards Science Center, 2013 - AGIC, 2013– Baker, 2013

Potential Secondary/Cascading Effects

The range of cascading events associated with earthquakes is controlled chiefly by the magnitude and location of the event, tempered by a suite of other, interrelated factors including:

- proximity to the epicenter;
- nature of the substrate | soil type, solid rock, unconsolidated sediments, saturated sediments …;
- building style (e.g., unreinforced masonry buildings vs. reinforced masonry or wood frame buildings);
- age and type of structures;
- time of day;
- proximity to bodies of water;

Building materials and construction standards play a major role in the extent of earthquake damage, particularly in modest M5-M6, earthquakes. Unreinforced masonry buildings are at higher risk of collapse than are reinforced masonry buildings and wood frame homes.

Cascading events associated with moderate to large-magnitude earthquakes are numerous, disparate and could in their own right – e.g., tsunami, dam rupture, landslide – be catastrophic:

- broken gas lines – initiating fires;
- broken water lines or canals – hampering fire-fighting efforts or resulting in local flooding;
- collapsed bridges and disrupted routes of transportation;
- landslides/rockfalls/debris flows (collectively referred to as mass wasting events);
- liquefaction;
- building collapse;
- dam breach or rupture;
- communications failure;
- tsunami or seiche;
- reactivation of other fault systems, both related and unrelated, leading to additional seismicity.

Probability and Magnitude

Expression of earthquake magnitude and intensity has been previously discussed. Probabilistic ground motion maps are typically used to assess the magnitude and frequency of seismic events. These maps estimate the probability of exceeding a certain ground motion, expressed as peak ground acceleration (PGA), over a specified period of years. For example, the following map displays the probability of exceeding a certain ground motion, expressed as PGA, in 50 years in the Western United States. This is a common earthquake measurement that shows three things: the geographic area affected (colored areas on Map RA-7); the probability of an earthquake of each level of severity (e.g., 10% chance in 50 years); and the severity (PGA) as indicated by color.

Note that earthquake hazard areas depicted in Map RA-7 express a 10% probability of being exceedance and, therefore, there is a 90% chance that the peak ground acceleration displayed will not be exceeded during 50 years. The use of a 50-year return period is based on statistical significance and does not imply that the structures are thought to have a useful life of only 50 years. Similar maps exist for other measures of acceleration, probabilities, and time periods. It is useful to note that according to the USGS, a PGA of approximately 10% gravity (10 %g) is the approximate threshold of damage to older (pre-1965) dwellings or dwellings not made resistant to earthquakes. The 10 %g measure was chosen because, on average, it corresponds to the

MMI VI to VII levels of threshold damage in California within 25 km of an earthquake epicenter. The earthquake hazard maps combine near and distant ground motions indiscriminately and should not be used for particular buildings (USGS, Feb. 7, 2003).

Over half of the State has a PGA of about less than 10%g, with the northwest and southeast quadrants ranging between 10 to 20 % g, and the highest PGA located in the extreme southwest corner. While these values are low in comparison with many parts of California, the National Earthquakes Hazard Reduction Program (NEHRP) a federally established interagency program has designated Arizona a “high risk” state for earthquakes (Bausch & Brumbaugh, May 23, 1996).

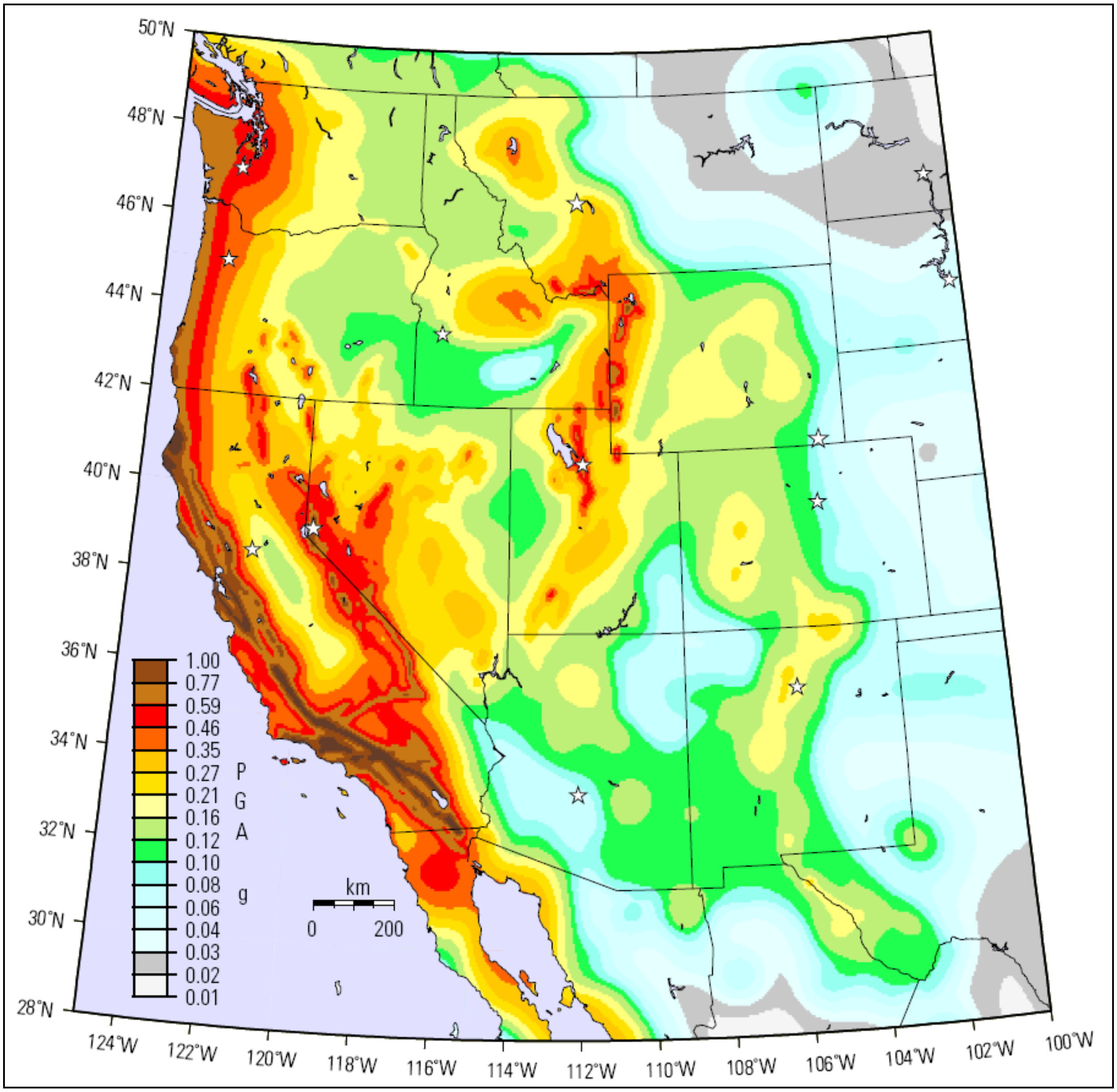
Yuma County, particularly the City of Yuma and nearby communities, face the highest risk from earthquakes in Arizona. Large portions of Yuma County have a PGA of 20%g or higher. Furthermore, the southwestern corner of Yuma County has a PGA of over 30%g, which is the greatest in the state. Earthquakes originating in southern California and northern Mexico cause ground shaking in Yuma on an annual basis.

Four major faults lie outside the state within 65 miles of Yuma: Imperial (28 miles), Cerro Prieto (45 miles), San Andreas (65 miles), and San Jacinto (65 miles). The stretch of the San Andreas Fault nearest Yuma has not ruptured in over 300 years and is considered a likely area to experience an earthquake of M 8.0 or higher (which would cause catastrophic damage in the area). Compounding the earthquake risk is the fact that large parts of the Yuma area will also be subject to liquefaction in the event of a major earthquake (Bausch & Brumbaugh, May 23, 1996).

The seismic hazard in Coconino County, particularly the area north of Flagstaff, is considered second only to that of the Yuma area. This area, which is also known as the Northern Arizona Seismic Belt (NASB), has a PGA range of 10-30 %g and was the source of a number of large (M 6.0 or higher) earthquakes in the early 1900s and numerous smaller earthquakes since then. These events indicate that there is a 50% chance of an M 6.0 or higher earthquake during the next 30 years in the NASB (which would cause significant damage in the area). This event is considered to be the maximum probable earthquake for the Flagstaff area (Bausch & Brumbaugh, May 7, 1997).

A significant portion of Mohave County has a PGA of 10-20 %g. The Hurricane Fault in northern Mohave County has the fastest displacement rate, longest length, and largest maximum credible earthquake (M 7.75) of any Arizona fault. Historic earthquakes in the area include the following: M 5.0 Hoover Dam earthquake on May 4, 1939; M 6.4 Afton (California) earthquake on April 10, 1947; and the M 5.5-5.75 Fredonia earthquake on July 21, 1959. These quakes were felt over wide areas and caused numerous large rock falls and landslides. Earthquake risk factors for Mohave County include three large dams (Hoover, Parker, and Davis), growing population, and a high proportion of unreinforced masonry buildings (Bausch & Brumbaugh, July 30, 1997).

Figure RA-7: PGA Map for U.S. West Coast



Western United States Peak Ground Acceleration Map Source: United States Geological Survey, 2008

Portions of La Paz County are located within 100 miles of the San Andreas Fault system, resulting in a PGA of 10% g. Historically, La Paz County has experienced strong earthquakes from California, including the M 7.1 Imperial Valley earthquake in May 1940, as well as smaller earthquakes from within La Paz county itself. Portions of the county also meet the criteria for liquefaction to occur (Bausch & Brumbaugh, Aug. 31, 1997).

Parts of Yavapai County have a PGA of 8-16% g. The county is subject to significant ground shaking from earthquakes originating on faults within the county and from nearby sources, such as the Hurricane and Toroweap faults and the NASB. The county is also underlain by a series of faults that bisect it from northwest to southeast, and that have a potential for an M 7.25 earthquake (Bausch & Brumbaugh, June 28, 1997).

The seismic risk in the developed portions of Maricopa County is generally low, with PGA zones of 4-6% g in most of metropolitan Phoenix. The southwestern corner of the county has elevated seismic risk where the PGA increases to10% g, although this region is largely uninhabited. The seismic risk to the Phoenix area is elevated, however, due to the large and rapidly expanding population, existence of high rise buildings, predominance of un-reinforced masonry buildings, and lack of earthquake awareness among its population (Bausch & Brumbaugh, June 13, 1994).

The rate of seismicity in the Phoenix area is low, with the most recent quakes originating in Cave Creek in 1974 (M 2.5 & M 3.0) and the Mogollon Plateau near Payson in 2003 (4.6). However, the area has been impacted by major earthquakes in southern California and northern Mexico, including the 1887 Sonoran earthquake (M 7.2), which caused ground shaking and triggered rock falls in the Phoenix area. The largest impact of an earthquake on the Phoenix metropolitan area would be the economic impact from a catastrophic southern California earthquake, which would disrupt approximately 60% of Arizona's fuel and 90% of Arizona's food goods. The Phoenix area could also be significantly affected by a major earthquake in Yuma or the NASB.

A repeat of the 1887 earthquake would result in significant damage to Arizona's population centers, particularly where development is located on alluvial plains and steep slopes, which is the case in much of the Phoenix area. The Sugarloaf and Horseshoe faults are the nearest mapped potentially active faults, both approximately 40 miles northeast of the Phoenix area. An M 6.75 event is the largest credible earthquake that could occur on these faults, which would result in rock falls, dam failure, liquefaction, destructive resonance in reinforced concrete buildings three to four stories in height, and ground motion sufficient to cause damage in other structures (Bausch & Brumbaugh, June 13, 1994).

It should also be noted that although the small earthquakes that commonly occur in Arizona pose low seismic risk to buildings, the repeated shaking could eventually cause structural damage. Small earthquakes may also trigger landslides in unstable areas and cause boulders to roll off mountain slopes (Jenny & Reynolds, 1989).

Vulnerability

To date the impact or losses from earthquakes has generally been low to non-existent in the more developed and populated areas of the State. Small earthquakes with an event specific low seismic risk to buildings occur on a regular basis. The cumulative effect of these repeated shakings, however, may ultimately result in structural damage (URS, Arizona original Plan, 2004). Also, if an earthquake impacts an area of sensitivity or initiates a secondary hazard such as a dam or levee failure, landslide, or rockslide, the damages and loss of life could be substantial.

No estimates of loss to state-owned critical and non-critical facilities have been estimated. Instead, an estimate of exposure to earthquake hazard areas with PGA values of 10%g or above are estimated, since lesser values are not expected to cause much damage.

The risk assessment data tables for earthquake are provided in the tables below. There is a total of 151 state own assets at a medium risk under the previously mentioned parameters. Yuma County in particular is the only one with exposure to medium level earthquakes of (5-5.9 magnitude) with 151 at risk and roughly $77,374K in replacement costs.

Table RA-29: State-Owned Asset Inventory Loss Estimates Based on Earthquake

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost (x $1000)	Estimated Structure Loss (x $1000)
Low Exposure*				
Apache	140	2.82%	$13,973	$0
Cochise	233	4.70%	$78,755	$0
Coconino	388	7.83%	$835,103	$0
Gila	177	3.57%	$29,272	$0
Graham	266	5.37%	$52,713	$0
Greenlee	35	0.71%	$2,146	$0
La Paz	151	3.05%	$11,844	$0
Maricopa	1,368	27.60%	$2,908,848	$0
Mohave	173	3.49%	$27,957	$0
Navajo	172	3.47%	$54,610	$0
Pima	943	19.02%	$2,473,788	$0
Pinal	595	12.00%	$383,353	$0
Santa Cruz	56	1.13%	$12,571	$0
Yavapai	242	4.88%	$49,201	$0
Yuma	18	0.36%	$2,349	$0
Statewide	**4,957**	**100.00%**	**$6,936,481**	**$0**
Medium Exposure**				
Apache	0	0.00%	$0	$0
Cochise	0	0.00%	$0	$0
Coconino	0	0.00%	$0	$0
Gila	0	0.00%	$0	$0
Graham	0	0.00%	$0	$0
Greenlee	0	0.00%	$0	$0
La Paz	0	0.00%	$0	$0
Maricopa	0	0.00%	$0	$0
Mohave	0	0.00%	$0	$0
Navajo	0	0.00%	$0	$0
Pima	0	0.00%	$0	$0
Pinal	0	0.00%	$0	$0
Santa Cruz	0	0.00%	$0	$0
Yavapai	0	0.00%	$0	$0
Yuma	151	100.00%	$77,374	$0
Statewide	**151**	**100.00%**	**$77,374**	**$0**

*Low Exposure: 2-9% g PGA exposure, MMI IV-V, Magnitude 4.0-4.9
**Medium Exposure: 10-20 % g PGA exposure, MMI VI-VII, Magnitude 5.0-5.9
Analysis based on 2008 USGS Conterminous U.S. PGA 10% in 50 years and state facilities data leveraged from 2010 SHMP – Baker 2013

Table RA-30: State Facilities in the Medium Exposure (10-20% g PGA) Earthquake Hazard Area

State Facilities in the Med Exposure Hazard Area	Apache	Cochise	Coconino	Gila	Graham	Greenlee	La Paz	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma	Total
Critical Facilities																
Banking and Finance Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Communications Infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Electrical Power Systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Emergency Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	**3**
Gas and Oil Facilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Government Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	**62**
Transportation Networks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	**6**
Water Supply Systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Non-Critical Facilities																
Businesses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	**18**
Educational	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	**38**
Recreational/Leisure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	**17**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**151**	**151**

Analysis based on 2008 USGS Conterminous U.S. PGA 10% in 50 years and state facilities data leveraged from 2010 SHMP – Baker 2013

As shown in the table below, about 190,000 of the state population are exposed to medium level earthquake hazard areas (5-5.9 magnitude) which amount to about **3%** of the total population. As for the population of those over 65 years of age, 3.3% of people over 65 are at risk exposure to medium level magnitudes of earthquakes, mainly in Yuma County and some in La Paz.

Table RA-31: County Population Exposed to Low & Medium Risk Earthquake Hazard Areas

County	Total	Low*	Medium**	Medium Exposure
Total Population Exposure to Earthquake				
Apache	71,518	70,080	0	0.00%
Cochise	131,346	131,327	0	0.00%
Coconino	134,421	134,421	0	0.00%
Gila	53,597	53,597	0	0.00%
Graham	37,220	37,220	0	0.00%

County	Total	Low*	Medium**	Medium Exposure
Greenlee	8,437	8,392	0	0.00%
La Paz	20,489	20,235	253	1.24%
Maricopa	3,817,117	3,817,117	0	0.00%
Mohave	200,186	200,161	0	0.00%
Navajo	107,449	107,445	0	0.00%
Pima	980,263	980,263	0	0.00%
Pinal	375,770	375,770	0	0.00%
Santa Cruz	47,420	47,419	0	0.00%
Yavapai	211,033	211,033	0	0.00%
Yuma	195,751	6,327	189,408	96.76%
Statewide	**6,392,017**	**6,200,807**	**189,661**	2.97%
Over 65 Population Exposure to Earthquake				
Apache	8,268	8,168	0	0.00%
Cochise	22,688	22,684	0	0.00%
Coconino	11,924	11,924	0	0.00%
Gila	12,450	12,450	0	0.00%
Graham	4,261	4,261	0	0.00%
Greenlee	1,016	1,005	0	0.00%
La Paz	6,683	6,622	60	0.90%
Maricopa	462,641	462,641	0	0.00%
Mohave	46,658	46,650	0	0.00%
Navajo	14,241	14,241	0	0.00%
Pima	151,293	151,293	0	0.00%
Pinal	52,071	52,071	0	0.00%
Santa Cruz	6,224	6,224	0	0.00%
Yavapai	50,767	50,767	0	0.00%
Yuma	30,646	1,587	29,054	94.81%
Statewide	**881,831**	**852,589**	**29,115**	3.30%

*Low: 2-9% g PGA exposure, MMI IV-V, Magnitude 4.0-4.9
**Medium: 10-20 % g PGA exposure, MMI VI-VII, Magnitude 5.0-5.9
+ Analysis based on 2008 USGS Conterminous U.S. PGA 10% in 50 years and census 2010 population

Overall, the State of Arizona is perceived to be at low to medium risk of being shaken by a disastrous earthquake, and not every community within Arizona shares the same level of risk to earthquakes. Although the northern counties of the state have the highest shaking occurrences, Pima and Yuma Counties are the only counties that assessed their vulnerability to this hazard in their mitigation plan. Yuma County mitigation plan is the only one with an estimate for potential losses, as shown in the table above.

Table RA-32: Local Risk Assessment & Loss Estimates Based on Earthquake

County	Total Estimated Asset Value (x $1,000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $,1000)
Statewide Totals	**$382,041,435**	**$382,041,435**	**$3,460**
Apache	$11,101,665	$11,101,665	No Data
Cochise	$10,615,770	$10,615,770	No Data
Coconino	$22,517,439	$22,517,439	No Data
Gila	$6,811,526	$6,811,526	No Data
Graham	$2,999,628	$2,999,628	No Data
Greenlee	$6,747,353	$6,747,353	No Data
La Paz	$2,359,292	$2,359,292	No Data
Maricopa	$189,975,238	$189,975,238	No Data
Mohave	$15,521,558	$15,521,558	No Data
Navajo	$11,908,834	$11,908,834	No Data
Pima	$59,617,168	$59,617,168	$3,460
Pinal	$14,610,551	$14,610,551	No Data
Santa Cruz	$3,044,947	$3,044,947	No Data
Yavapai	$18,491,858	$18,491,858	No Data
Yuma	$12,584,649	$12,584,649	No Data

NOTE: "*No Data*" denotes lack of available information for assessment.
Sources: Individual county mitigation plans earthquake vulnerability tables.

For the local risk assessment summary, the table above combines asset and predominantly HAZUS information for the estimated asset values as reflected in the local plans.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Earthquake are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-33: State CPRI Results for Earthquake

Risk Due to Earthquake					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Earthquake	Possibly	Limited	< 6 hours	< 6 hours	**2.2**
	2	2	4	1	

Table RA-34: County CPRI Results for Earthquake

County	CPRI
Pima	2.35
Yuma	2.56

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Earthquake are shown below.

Table RA-35: State Environmental CPRI Results for Earthquake

Environmental Risk Due to Earthquake				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Negligible	< 1 month	**.90**
Soil	Unlikely	Limited	< 1 month	**1.2**
Average CPRI Environmental Risk Rating: 1.0 (max 3.6)				

Consequences / Impacts

For most of the State, earthquake events are expected to be of minimal magnitude with little to no consequences or impacts in the areas listed below. There is no recent history of injury or death in Arizona due to earthquakes and nearly all of the reported damages are relatively minor. Potential for an earthquake event of significant magnitude does exist in the extreme southwest corner of the state (Yuma area), the north-central portion of the State (mostly Coconino County and northern Mohave County) and also from earthquakes with epicenters located in southeastern California and Mexico. There is also a significant risk of liquefaction during an event for the geologic floodplain of the Colorado River in the Yuma area. The following discussions of consequences and impacts are relegated to these areas, as appropriate.

- **Public**
  In general, earthquakes do not pose a significant threat to the public in Arizona. In the higher risk areas, significant deaths or injuries are not likely, but are more plausible than the rest of the state and as such should prepare for the possibility.
- **Responders to the Incident**
  Response requirements to potential earthquake incidents in the higher risk areas will likely be limited and the greatest impacts posed to responders would be exposure to aftershocks and potential hindrance due to lifeline damages.
- **Continuity of Operations / Delivery of Services**
  In the elevated seismic risk areas of the State, it is unlikely that an earthquake event would render critical facilities and infrastructure useless. A moderate disruption of local services may be experienced in large magnitude event, but would not be expected to last longer than a few days. A larger threat would involve a catastrophic earthquake in Southern California which could likely result in a disruption to the flow of fuel and food goods.
- **Environment**
  For most of the State, impacts to the environment resulting from an earthquake event are expected to be negligible. An earthquake event in the Yuma area may impact the environment in the form of hazardous material spills resulting from building and infrastructure failures due to either ground shaking or liquefaction. Other environmental

impacts could include the manifestation of a permanent surface rupture or sinks/boils in areas of liquefaction.

- **Economic / Financial Condition of Jurisdiction**
  For the State as a whole, it is unlikely that an event would cause enough damage to significantly impact the economy or financial condition statewide, and especially considering the fact that the largest base of economic activity (the Phoenix Metropolitan Area) is located in a low earthquake risk area. In the elevated risk areas, local economies may be more significantly impacted due to potential damages to residential and commercial buildings and the resulting financial hardship for homeowners and business owners alike. Businesses that are affected to the point of lost revenue, may be forced to reduce staff or close or move their business, which in turn results in loss of jobs.
- **Public Confidence in Jurisdiction's Governance**
  Because the impact and losses from earthquakes has generally been low in the more developed and populated areas of the State, the impact or effect on the public's confidence in their jurisdiction's government is negligible.

Resources

Definitions

Richter Scale – a logarithmic measurement, where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the seismic waves (and 32 times more energy)

MMI – Modified Mercali Intensity

PGA – Peak Ground Acceleration

%g – Percentage of the acceleration due to gravity

Sources

Arizona Earthquake Information Center. Northern Arizona Universities seismic network – http://www4.nau.edu/geology/aeic/aeic.html

Arizona Integrated Seismic Network. Eight broadband seismometer – see http://www.azgs.az.gov/fema_award.shtml for locations and access to daily records.

Beyer, Scott, and Pearthree, P.A., 1994, Bibliography of earthquake hazards in Arizona: Arizona Geological Survey Open-File Report 94-03, 44 p.

Brumbaugh, D.S., 1980, Analysis of the Williams, Arizona earthquake of November 4, 1971: Seismological Society of America, Bulletin, v. 70, p. 883-891.

DuBois, S.M., and Smith, A.W., 1980, The 1887 earthquake in San Bernardino Valley, Sonora; historic accounts and intensity patterns in Arizona: Arizona Bureau of Geology and Mineral Technology Special Paper no. 3, 112 p.

DuBois, S.M., Smith, A.W., Nye, N.K., and Nowak, T.A., Jr., 1982, Arizona earthquakes, 1776-1980: Arizona Bureau of Geology and Mineral Technology Bulletin 193, 456 p., 1 sheet, scale 1:1,000,000.

Geologic Map of Arizona. 2000, Product of the Arizona Geological Survey, Online at http://www.azgs.az.gov/services_azgeomap.shtml

Pearthree, P.A., and Calvo, S.S., 1987, The Santa Rita fault zone: Evidence for large magnitude earthquakes with very long recurrence intervals in the Basin and Range province of southeastern Arizona: Seismological Society of America, Bulletin, v. 77, no. 1, p. 97-116.

Earthquake Hazards Program, 2009, US Geological Survey online at http://earthquake.usgs.gov/hazards/products/conterminous/

References

Earthquake hazards in Arizona: P.A. Pearthree and D.B. Bausch, 1999, AZGS Map 34, text and map, scale 1:1,000,000.

Quaternary fault data and map for Arizona: P.A. Pearthree, compiler, 1998, AZGS OpenFile Report 9824, 122 p., scale 1:750,000, 1 disk.

PlioQuaternary faulting and seismic hazard in the Flagstaff area, northern Arizona: P.A. Pearthree and others, 1996, AZGS Bulletin 200, 40 p., 2 sheets, scale 1:50,000 and 1:100,000.

Seismic hazards in Arizona: D.B. Bausch and D.S. Brumbaugh, 1994, Flagstaff, AZ Earthquake Information Center, 49 p., 2 sheets, scale 1:1,000,000.

Arizona earthquakes: S.M. DuBois and others, 1982, AZGS Bulletin 193, 456 p., scale 1:1,000,000.

The 1887 earthquake in San Bernardino Valley, Sonora: Historic accounts & intensity patterns in AZ: DuBois/A.W. Smith, 1980, AZGS Special Paper 3, 112 p.

Arizona State University, May 26, 2003.“Earthquake information for the State of Arizona & the world.” http://activetectonics.la.asu.edu/e-quakes/

Bausch, Douglas B. and David S. Brumbaugh:

- May 23, 1994. Seismic Hazards in Arizona –Arizona Ground Shaking Intensity & 100 yr Acceleration Contour Maps.http://www4.nau.edu/geology/aeic/staterep.txt
- June 13, 1994. Phoenix Community Earthquake Hazard Evaluation, Maricopa County, Arizona.http://www4.nau.edu/geology/aeic/phoehaz.txt
- May 23, 1996. Yuma County Earthquake Hazard Evaluation, Yuma County, Arizona.http://www4.nau.edu/geology/aeic/yumarep.html
- May 7, 1997. Flagstaff Community Earthquake Hazard Evaluation, Coconino County, Arizona.http://www4.nau.edu/geology/aeic/flag.html
- June 28, 1997. Earthquake Hazard Evaluation Yavapai County, Arizona.http://www4.nau.edu/geology/aeic/yavapai.html
- July 30, 1997. Earthquake Hazard Evaluation Mohave County, Arizona.http://www4.nau.edu/geology/aeic/mohave.html
- August 31, 1997. Earthquake Hazard Evaluation La Paz County, Arizona.http://www4.nau.edu/geology/aeic/lapaz.html

Jenny, J.P. and S.J. Reynolds, 1989. “Geologic Evolution of Arizona” in Arizona Geological Society Digest, No. 17.

Petersen, Mark D., Frankel, Arthur D., Harmsen, Stephen C., Mueller, Charles S., Haller, Kathleen M., Wheeler, Russell L., Wesson, Robert L., Zeng, Yuehua, Boyd, Oliver S., Perkins, David M., Luco, Nicolas, Field, Edward H., Wills, Chris J., and Rukstales, Kenneth S., 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

US Geological Survey (USGS):

- February 7, 2003, “Definition of %g – What is the relation to Building Damage?” http://geohazards.cr.usgs.gov/eq/faq/parm02.html
- September 12, 2003, “Earthquake History of Arizona.” http://wwwneic.cr.usgs.gov/neis/states/arizona/arizona_history.html

Wald, David J., Vincent Quitoriano, Thomas H. Heaton and Hiro Kanamori,1999. “Relationship between Peak Ground Acceleration, Peak Ground Motion and Modified Mercalli Intensity in California” in Earthquake Spectra, Vol. 15, No. 3, 557-564. http://pasadena.wr.usgs.gov/shake/pubs/regress/regress.html

Extreme Heat

Introduction/History

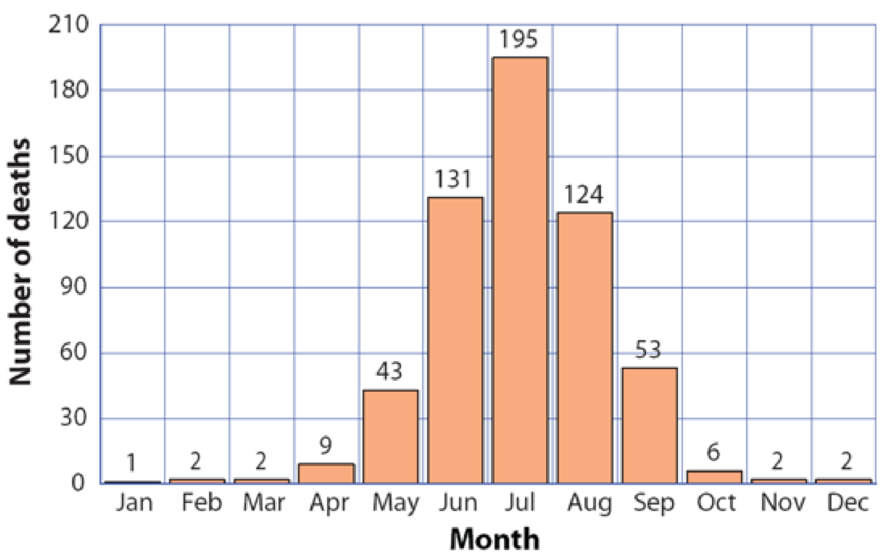
Extreme Heat is the combination of very high temperatures and exceptionally humid conditions that exceed regionally based indices for perceived risk. The major human risks associated with extreme heat are as follows:

- Heat Cramps: May occur in people unaccustomed to exercising in the heat and generally ceases to be a problem after acclimatization.
- Heat Syncope: This refers to sudden loss of consciousness and is typically associated with people exercising who are not acclimated to warm temperatures. Causes little or no harm to the individual.
- Heat Exhaustion: While much less serious than heatstroke, heat exhaustion victims may complain of dizziness, weakness, or fatigue. Body temperatures may be normal or slightly to moderately elevated. The prognosis is usually good with fluid treatment.
- Heatstroke: Considered a medical emergency, heatstroke is often fatal. It occurs when the body's responses to heat stress are insufficient to prevent a substantial rise in the body's core temperature. While no standard diagnosis exists, a medical heatstroke condition is usually diagnosed when the body's temperature exceeds 105°F due to environmental temperatures. Rapid cooling is necessary to prevent death, with an average fatality rate of 15% even with treatment.

In addition to affecting people, extreme heat places significant stress on plants and animals leading to reduced agricultural yields and increased mortality rates.

According to a report prepared by the Arizona Dept of Health Services (ADHS, 2004), 570 people died from heat exposure due to excessive temperatures in Arizona from 1992 to 2002. For the period of 1992 to 2008, there were 537 deaths attributed to excessive natural heat in Maricopa County alone, with 80 and 85 of those deaths occurring in 2005 and 2006, respectively (Mrela, C.K., 2004 and MCDPH, 2009). The overwhelming majority of those deaths occurred during the hot summer months of June, July and August. The table below presents a distribution of the deaths as a function of the month.

Figure RA-8: Number of Heat Related Deaths by Month (1992-2002)



Source: ADHS 1992-2002

A majority of the deaths occurred among residents (55%). On average, 29 Arizona residents die every year from heatstroke or sunstroke. Forty residents died from heat exposure in 2003. Not surprisingly, nearly all of the deaths occurred between May and September, with a peak in July. More than 70% of residents that died from heat exposure were over 45 years old, with 42% over the age of 65. In fact, deaths from excessive heat ranked fifth among the leading causes of accidental death for Arizonans 65 and older. The map below shows a map of statewide average maximum temperature in the month of July overlaid against density of population over the age of 65 and serves to visualize vulnerability to extreme heat events and heat-related illnesses within the State of Arizona.

Deaths of illegal immigrants in the desert areas along the Arizona-Mexico border are also attributed to extreme heat. In 2005, roughly 80 migrants died in the Tucson sector alone from heat exposure, while more than 180 total deaths occurred from heat exposure along the border (Guido, 2008).

Researchers at NASA's Johnson Space center, Arizona State University and the University of CA at Riverside are studying the relationship between temperature variations and socioeconomic variables across metropolitan Phoenix. The research is integrating data with modeling tools to analyze urban systems while keeping health equity and the well-being of vulnerable populations as the center of attention. According to several global climate change models, the southwestern US is predicted to experience higher temperatures and more droughts over the coming century. The project has theoretical and applied focus in trying to develop tools that city planners and emergency responders can use. Urban planners can also use the data to aid plan the city's growth and perhaps use alternative building materials to better absorb the heat. By studying Phoenix, researchers can better understand what these developing cities may face and how their environments may change as populations expand.

Climate Change

The American southwest is rapidly warming and southeast Arizona is no exception. Figure RA-9 below, for example, shows that summer temperatures have risen since 1895 and have remained above the 20th century average for every summer during this century. At the same time, hot days are becoming more common and more extreme. The average annual number of 100+ degree days (62 days) in Tucson from 1981-2010 was 55% higher than from 1951-1980 (40 days). And in 2011, Tucson suffered through seventy 100+ degree days (WWF Climate Change Tucson Summit, 2012).

Map RA-7: Distribution of Population Vulnerable to Extreme Heat

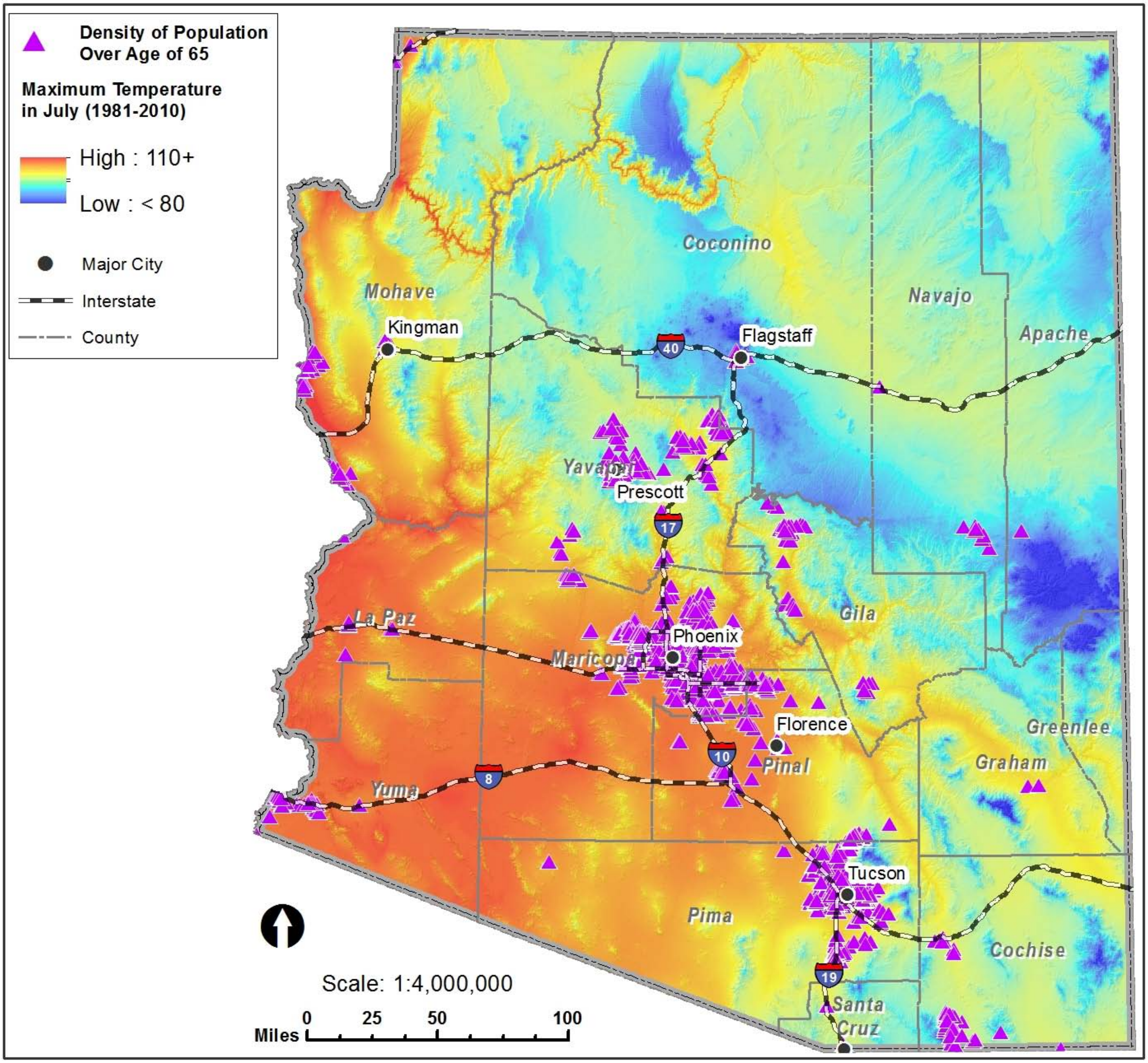
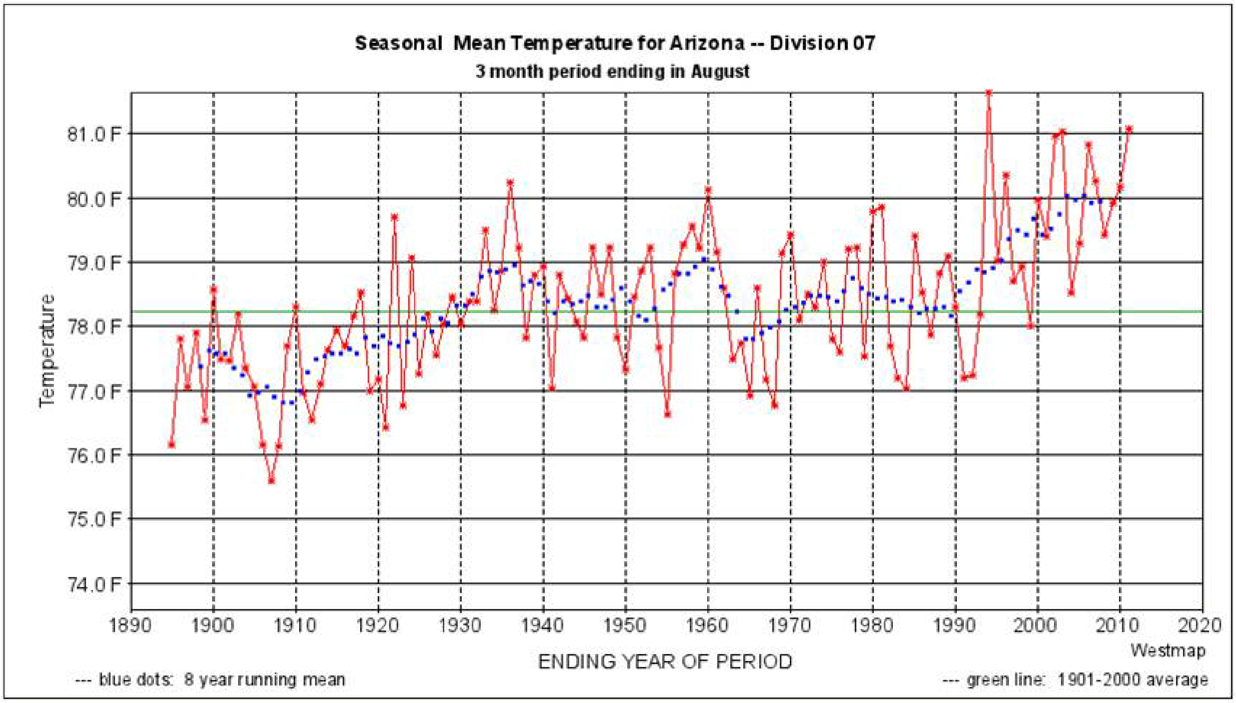
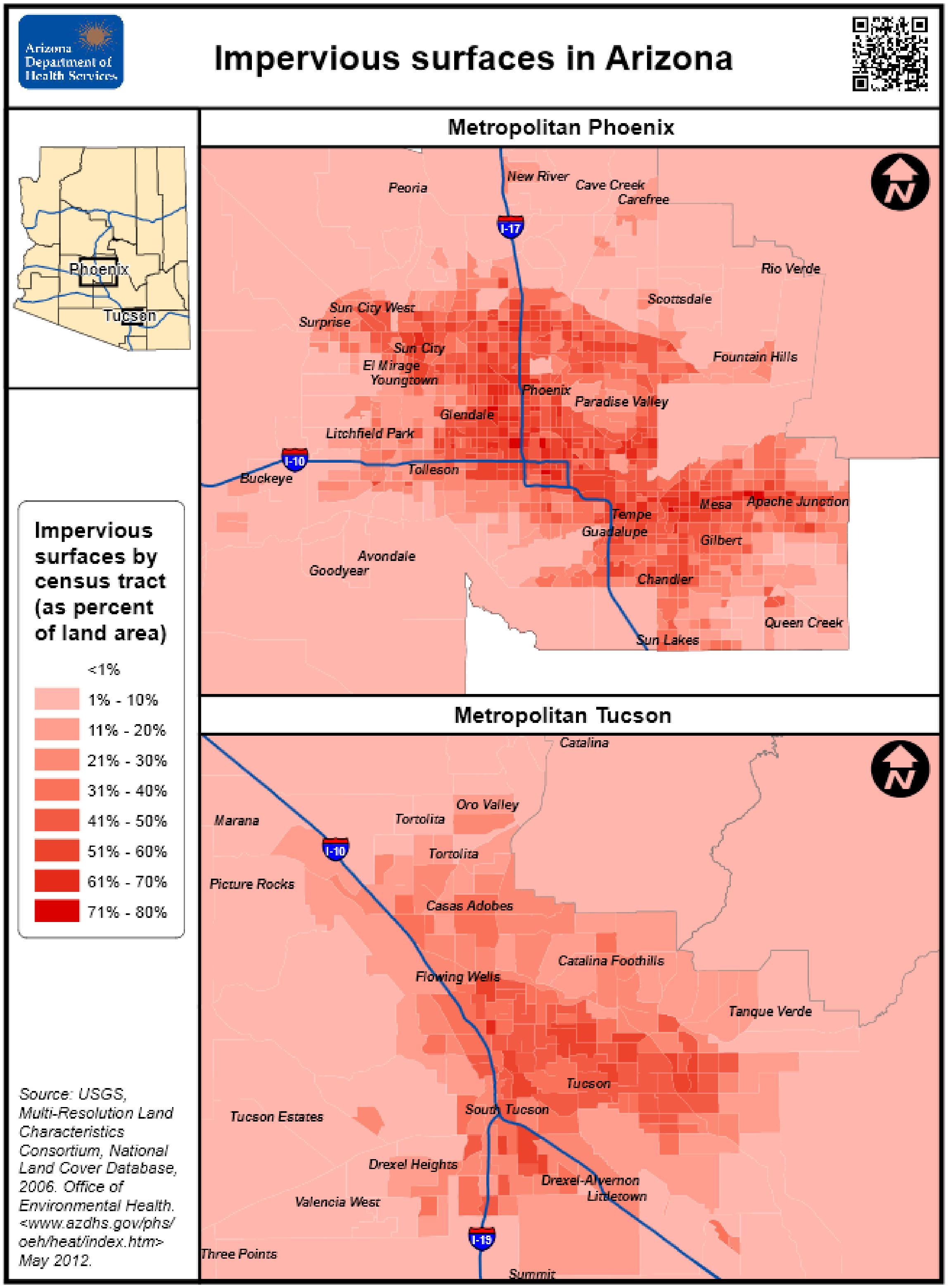


Figure RA-9: Seasonal Mean Temperature for Arizona from 1895-2011



Over the past 60 years, metropolitan Phoenix, Arizona, has been among the fastest-growing urban areas in the United States, and this rapid expansion of impervious surface resulted in an urban heat island (UHI) of substantial size and intensity. According to a University of Arizona study, from 1948 to 2000 urbanization has increased the nighttime minimum temperature in central Phoenix (Sky Harbor International Airport) by approximately 9 degrees F and the average daily temperature by approximately 5.5 degrees F, while Tucson's urban temperatures are approximately 5.5 degrees F warmer than they were in the last century, with more than 3.5 degrees F of the warming occurring in the last 30 years. The figure below shows the distribution and concentration of impervious surfaces in metropolitan Phoenix and Tucson.

Figure RA-10: Impervious Surfaces in Metropolitan Phoenix and Tucson



Source, Arizona Department of Health Services

Potential Secondary/Cascading Effects

For Arizona, periods of extreme heat are a normal part of the weather cycle and the primary effects of this weather are its impacts to the human, animal, and plant communities. Extended periods of extreme heat can contribute to wildfire hazard through a process wherein natural materials, particularly sand and bare soil absorb solar radiation, holding the heat very near the surface, resulting in extremely high surface temperatures. The hot surface heats the overlying air, which rises, carrying the heat upward. The extremely hot surfaces generate strong updrafts, essentially creating local winds that dry surrounding vegetation, increase fuel temperatures and intensify and spread wildfires. The dry vegetation, high fuel temperatures, and high winds increase the static electricity, increasing the potential for spontaneous combustion, particularly during prolonged periods of drought. Extended durations of extreme heat can exacerbate drought conditions and can also lead to excessive power consumption needs causing the potential for brown- and black-outs, which would only make the exposure conditions worse. Extreme heat temperatures can also force the closure of airports due to the lack of sufficient air density for take-offs and landings.

Probability and Magnitude

There are no recurrence or non-exceedance probabilities developed for extreme heat events in Arizona. The most prominent area of extreme heat risk in the State is the Phoenix metropolitan region. The National Weather Service (NWS) Warning and Forecast Office (WFO) in Phoenix, with the technical support of the University of Maryland, designed a science-based, customized, extreme heat derivation technique developed specifically for the Phoenix metropolitan region. During Arizona's hottest months, the NWS WFO in Phoenix issues three types of heat-related messages, which are based on four factors – temperature, humidity, amount of cloudiness, and the expected duration of these conditions. The combination of factors that will trigger one of these heat-related messages varies according to the time of year. For example, a combination of factors that would result in an excessive heat warning in early May might not result in one in mid-July. The three NWS WFO products are:

a. Heat Advisory – issued when the temperature is forecast to be unusually hot but not life-threatening.
b. Excessive Heat Watch – issued when conditions are likely to result in a life-threatening heat emergency within the next 24 to 48 hours.
c. Excessive Heat Warning – issued when a life-threatening heat emergency exists or is imminent.

These products are intended to raise the public's awareness to prevent heat illnesses from occurring. When the NWS WFO Phoenix issues one of its heat products, it should serve as a signal that on that day outdoor activities are not "business as usual". If significantly hot weather is forecast, the NWS WFO Phoenix will issue an Excessive Heat Watch generally two to three days in advance. An Excessive Heat Watch is a way to give the public and emergency officials a "heads up" that extreme temperatures are expected. If significantly hot temperatures remain in the forecast for today or tomorrow, the Excessive Heat Watch will be upgraded to an Excessive Heat Warning, indicating that extreme heat has either arrived or is expected shortly (NWS-WFO Phoenix, 2009).

Another indicator of the degree of danger associated with extreme heat is the Heat Index (HI) or the "Apparent Temperature". According the NWS, the HI is an accurate measure of how hot it really feels when the Relative Humidity (RH) is added to the actual air temperature. The figure on the following page is a quick reference published by the NWS that shows the HI based on current temperature and relative humidity, and levels of danger for HI values. It should be noted that the HI values were devised for shady, light wind conditions and that exposure to full sunshine can increase HI values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

Figure RA-11: Heat Index Chart

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	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										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Vulnerability

Losses due to extreme heat primarily occur in the form of death and illness. There are currently no statistical analyses for projecting heat related deaths in the State, however, ADHS and Maricopa County continue to track data and monitor trends and other factors to determine if a statistical significance exists. Past history would indicate that multiple deaths due to extreme heat are highly likely. The homeless are particularly vulnerable to extreme heat during the summer months when the increased humidity keeps nighttime temperatures above 90°F. The cumulative effects over several days of continuous 24-hour exposure to this heat, without relief, put the homeless at serious risk of heat stress or worse. Others at significant risk are the low income populations who do not have air conditioning, and in many cases do not even have evaporative coolers. The lack of air conditioning means this population, like the homeless, is also lacking night time relief from the heat, elevating their risk of heat stress or other complications.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Extreme Heat are shown below. County CPRI values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-36: State CPRI Results for Extreme Heat

Risk Due to Extreme Heat					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Extreme Heat	Highly Likely	Critical	>24hours	<1 week	**3.15**
	4	3	1	3	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10)

Table RA-37: County CPRI Results for Extreme Heat

County	CPRI
Pima	2.35

Source: Arizona county hazard mitigation plan(s).

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Extreme Heat are shown below.

Table RA-38: State Environmental CPRI Results for Extreme Heat

Environmental Risk Due to Extreme Heat				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Catastrophic	6 months+	**.90**
Soil	Unlikely	Critical	6 months+	**.90**
Average CPRI Environmental Risk Rating: .90 (max 3.6)				

Consequences / Impacts

- **Public**
  Impacts to public health and safety are the most prominent consequence of an extreme heat event. Sickness and death can occur under the certain circumstances without the proper precautions and care. The impacts can also extend to animals and plant life.

- **Responders to the Incident**
  Emergency responders are typically exposed to the same extreme heat conditions as those whom they are helping, and may be impacted to a greater degree if wearing heavy materials.

- **Continuity of Operations / Delivery of Services**
  Overall, extreme heat is not a major threat to the state's ability to effectively function unless the extreme heat durations cause other problems such as major regional power failures. Other impacts such as airport closures or localized power failures may have a local impact, but do not significantly hinder the continued operation of state agencies, services and responsiveness.

- **Environment**
  See the "Vulnerability" section of this profile.

  Periods of extended extreme heat conditions may have an indirect environmental impact by requiring more energy to produce the cool air needed to offset the impacts.

- **Economic / Financial Condition of Jurisdiction**
  The potential impact to Arizona's economy due to extreme heat is generally due to increased utility costs, loss of tourism, decreased agricultural yields. Local economies heavily invested in one of these fields may experience loss and hardship to a greater degree than others.

- **Public Confidence in Jurisdiction's Governance**
  Extreme heat is a normal part of the Arizona climate and the State and local communities are generally prepared to deal with needs during a period of extreme heat. Most governmental agencies participate in cooperative response programs with local non-governmental charities and organizations to address the needs of the public such as distributing water and setting up cooling stations. These efforts tend to maintain public confidence in the governance of the State and local jurisdictions.

Resources

Definitions
ADHS – Arizona Department of Health Services

Sources
Arizona Department of Health Services
Arizona State University – State Climate Office
National Weather Service

References
AZ Dept of Health Services, 2004, Prevention Bulletin, Volume 18, No. 4, http://www.azdhs.gov/diro/pio/preventionbulletin/july04.pdf

FEMA,1997, Multi-Hazard Identification & Risk Assessment – A Cornerstone of the Nat'l Mitigation Strategy.

Guido, Zack, 2008, *Anticipating Summer Heat - A Look at the Impacts and Extreme Temperatures in the Southwest*, Southwest Climate Outlook, May 2008 Issue, University of Arizona, CLIMAS, http://www.ispe.arizona.edu/climas/forecasts/swarticles.html

Maricopa County Department of Public Health, Division of Disease Control, Office of Epidemiology and Data Services, 2009, Heat Caused and Heat Related Death Occurrences in Maricopa County, http://www.maricopa.gov/Public_Health/EPI/pdf/heat/2008annualreport.pdf

Mrela, C. K., 2004, Deaths from Exposure to Excessive Natural Heat Occurring in Arizona, 1992-2002, Arizona Department of Health Services, http://www.azdhs.gov/plan/report/heat/heat02.pdf

NASA, 2010, *NASA Assets Provide Orbital View to Study Phoenix Heat Waves*, http://www.nasa.gov/centers/johnson/home/phoenix_heatwaves_feature_prt.htm

National Weather Service, Warning and Forecast Office – Phoenix, 2009, http://www.wrh.noaa.gov/psr/general/safety/heat/

Fissures

Introduction/History

Earth fissures are linear cracks in the ground that extend from the groundwater table and are a direct result of subsidence caused by groundwater depletion. The surface expression of fissures ranges from less than a yard to several miles long and from less than an inch to tens of feet wide. The longest fissure is in Pinal County, near Picacho, and is over 10 miles long. Earth fissures occur at the edges of basins, usually parallel to mountain fronts, or above local bedrock highs in the subsurface, and typically cut across drainage. Fissures change flood patterns, break buried pipes and lines, cause infrastructure to collapse, provide a direct conduit to the groundwater table for contaminants thrown into them, and even pose a life safety hazard.

The Basin and Range Province that occupies the southern third of Arizona is the primary area that is susceptible to earth fissures; this area encompasses parts of four counties that are particularly prone to earth fissures: Pinal, Maricopa, Cochise and Pima Counties. Pinal County has more fissures than any other county in Arizona. The AZGS combined fissure zones into groups, or planning areas, to facilitate legislative mandate that requires all fissures in Arizona to be mapped and publicly disclosed. Original mapping is complete for the areas listed below, and will be remapped as new areas of concern develop. These areas are also published and available at AZGS Earth Fissure Viewer (http://services.azgs.az.gov/OnlineMaps/fissures.html).

Table RA-39: AZGS Mapped Fissure Areas

Area	County
Bowie-San Simon	Cochise
Croton Springs	Cochise
Dragoon Road	Cochise
Elfrida	Cochise
Sulphur Springs North (pending)	Cochise
Three Sisters Buttes	Cochise
Harquahala Plain	Maricopa
Luke	Maricopa
Mesa	Maricopa
Scottsdale/NE Phoenix	Maricopa
Wintersburg	Maricopa
Apache Junction	Pinal
Greene Wash	Pinal
Heaton	Pinal
Marana	Pinal
Pete’s Corner	Pinal
Picacho	Pinal
Sacaton Butte	Pinal
Santa Rosa Wash	Pinal
Signal Peak	Pinal
Tator Hills	Pinal
Toltec Buttes	Pinal

Source: AZGS 2013.

Fissures have been occurring in Arizona at least since 1927, when the first one was found near Eloy. The number of fissures has increased dramatically since the 1950s because of groundwater depletion, first because of agriculture, and later, due to exponential population growth. The risk posed by fissures is also increased as the population expands into the outlying basin edges and mountain fronts.

Several fissure case histories are outlined below.

San Tan Mountains, Maricopa and Pinal Counties

- Foothills—undermining at least one home, and crossing several roads; dogs trapped in flash flood flowing through the fissure in 2007.
- Y-crack—crosses the Hunt Highway and San Tan Blvd east of Sossaman Road; present at least by 1969; catastrophically re-opened from 195th Street and Happy Road to San Tan in 2005 and again in 2007, damaging roads, corrals, fences, driveways, stranding and trapping vehicles, and killing a horse.

Apache Junction/East Mesa, Maricopa County

- Baseline & Meridian—fissure crosses diagonally under the intersection, fissure zone over one mile long.
- Ironwood and Guadalupe—industrial facilities built on top of several fissures in the area; fissures stop immediately east of subdivision; fissures crossing powerlines.

Mesa, Maricopa County

- Loop 202 (Red Mountain Freeway)—fissure present at least since 1970s; attempted mitigation during construction cost $200,000.
- Sossaman Road and University Drive—fissure runs diagonally through a subdivision along the entrance; fissure known in 1973 and subsequently backfilled.

Picacho, Pinal County

- I-10—Arizona Department of Transportation still trying to determine effective mitigation for the fissure crossing.
- Picacho Pump Station—fissure crosses access road and runs nearly to canal; damaged road in 1984.

Wintersburg, Maricopa County

- Fissure runs perpendicular to power transmission lines near Palo Verde Nuclear Generating Station; made one road impassable.

Scottsdale, Maricopa County

- CAP Canal—fissure paralleling the canal opened within a few feet of the lining on the east side in 2003.
- 40th St and Cholla—discovered in 1980s.

Flood retarding structures, Maricopa County

- McMicken Dam, White Tank Mountains—dam had to be removed and replaced; cost several million dollars.
- Powerline FRS, Apache Junction—fissure just discovered within 1200 feet of the FRS; Flood Control District examining mitigation options.

Avra Valley, Pima County

- CAP Canal—fissure discovered that nearly intersected the canal in 1988.

Willcox, Cochise County

- Nickels Road—in 1984, a fissure opened down one side of the road near where it crosses power transmission lines.

Potential Secondary/Cascading Effects:

The type of cascading events resulting from earth fissures is broad, ranging from accelerated erosion rates which undercut foundations, roads, gas and water lines, to contamination of fresh water aquifers. The latter is the most serious of secondary events, since entire communities may be affected by the contamination. In addition, mitigation may prove difficult, expensive and could require years of pumping and filtering to purge the contaminated waters.

In southern Arizona, cascading events associated with earth fissure formation may potentially include:

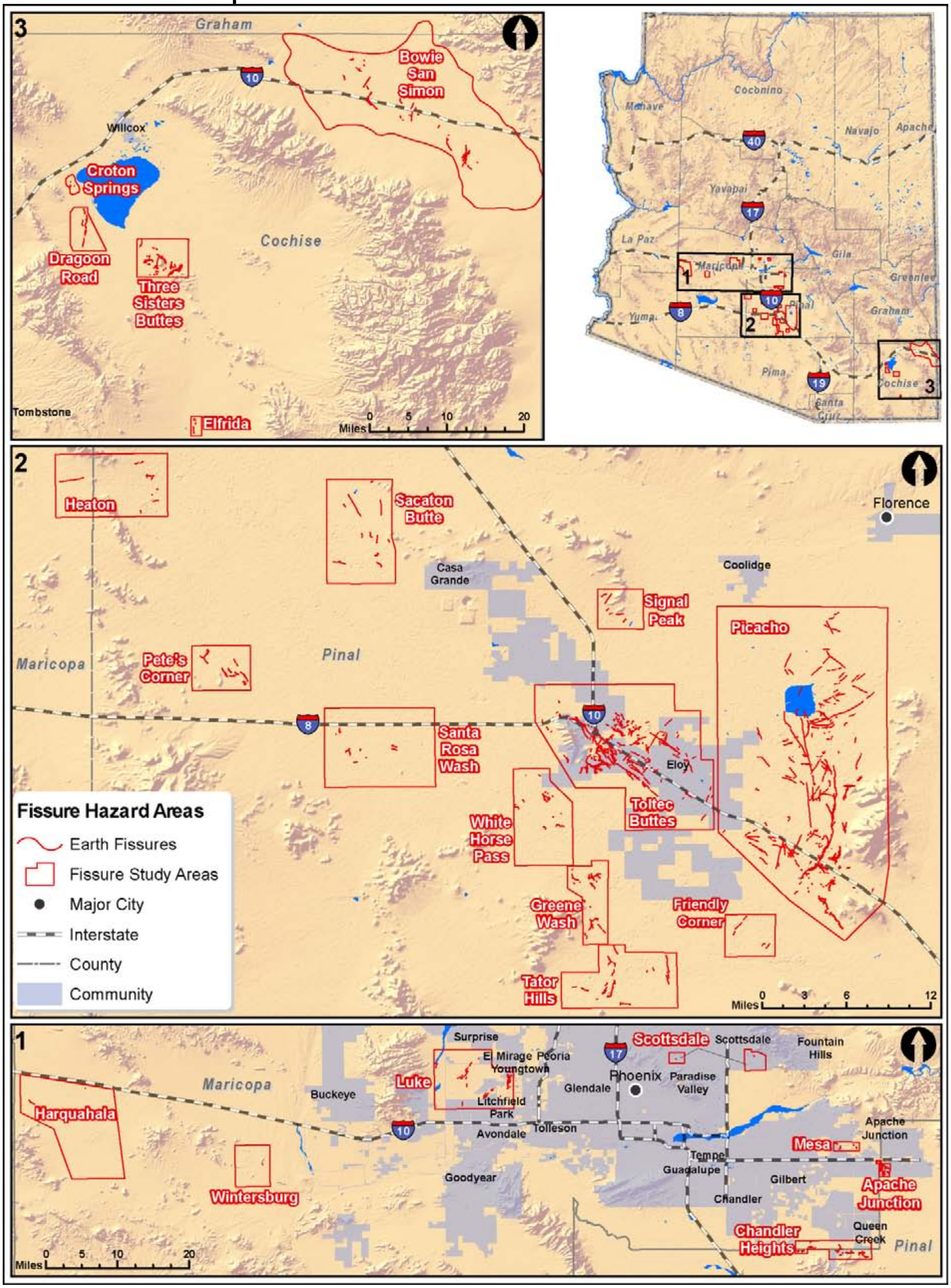
- Harm to livestock – cattle and horses, which can stumble into fissures and find it difficult or impossible to get out.
- Accelerated erosion rates leading to head-cut erosion and soil removal;
- Gully development, which further disrupts natural drainage patterns and impacts agricultural patterns;
- Drainage disruption where captured runoff can lead to local flooding;
- Canal breach where fissures intersect existing canal alignments
- Exhuming buried gas or water lines – potentially leading to broken mains leading to fires or local flooding;
- Despoiled fresh water aquifers – there is no evidence in Arizona for this yet, but contaminating groundwater, with concomitant disruption of water delivery to homes, municipalities, and farm fields, is a cascading event of great concern.
- Dumping of organic and inorganic substances into fissures (tires, appliances and sundry trash items are common features in some fissures);
- Disruption of transportation corridors – roadways and railroads – adversely impacting travel and in the case of train derailment could lead to a toxic chemical spill. According to Slaff (1993), fissure formation misaligned a section of track in the Picacho Basin causing a train to derail.

Probability and Magnitude

There are no methods of quantifiably predicting the probability and magnitude of earth fissures. The locations of increased risk for potential fissures may be highlighted to specific areas if enough information about the subsurface geology and groundwater levels are available. As long as subsidence continues (even if the groundwater levels should rise and stabilize), fissures will continue to occur. The magnitude of the fissures vary with the depth to groundwater, type of surficial material present, amount of groundwater removed, basin depth, volume of runoff from precipitation, and human intervention or lack thereof.

The geographic extent of fissures are tracked and mapped by Arizona Geological Survey (AZGS) across the state. Some historically recorded fissures are not visible or traceable anymore, disturbed or filled due to human activities or natural events (floods, erosions, etc.).
The map shown below illustrates known fissure areas captured in the AZGS GIS dataset.

Map RA-8: Fissure Hazard Map



Source: Arizona Earth Fissures shapefile ((DI-39 v. 03.11.11) - AZGS 2013; Baker 2013. This map is preliminary and subject to change. This map is not to be used for disclosure purposes. The AZGS makes no warranties, expressed or implied with respect to this information.

Risk & Vulnerability

The impacts of earth surface fissures due to subsidence have the potential be economically devastating to developed local areas. During the periods of heavy rains, fissures can enlarge and widen quickly through erosion and create a substantial hazard to people, buildings and infrastructure. Also, fissures provide a conduit for stormwater runoff to carry contaminates to underground aquifers.

State owned assets that are typically most exposed to fissure hazards are roadways. There were no critical or non-critical structures identified within the high hazard areas shown on the map above. Damages to roadways are relatively minor and are best mitigated by keeping stormwater from entering the fissures within the vicinity of the roadways.

The compilation of risk assessment data from local plans indicates that approximately $98 million in locally identified critical and non-critical facilities are exposed to a fissure risk hazard. There are no known state facilities that fall within a critical proximity of recorded fissures and no estimations of losses were made.

Table RA-40: Population Sectors Exposed to Areas with Fissures Risk Monitored by AZGS

County	Total Population	Population Exposed	Percentage Exposed	Over 65	Over 65 Exposed	Percentage Over 65 Exposed
Total Population Exposure to Fissures						
Apache	71,518	0	0.00%	8,268	0	0.00%
Cochise	131,346	1,276	0.97%	22,688	374	1.65%
Coconino	134,421	0	0.00%	11,924	0	0.00%
Gila	53,597	0	0.00%	12,450	0	0.00%
Graham	37,220	0	0.00%	4,261	0	0.00%
Greenlee	8,437	0	0.00%	1,016	0	0.00%
La Paz	20,489	0	0.00%	6,683	0	0.00%
Maricopa	3,817,117	114,654	3.00%	462,641	14,851	3.21%
Mohave	200,186	0	0.00%	46,658	0	0.00%
Navajo	107,449	0	0.00%	14,241	0	0.00%
Pima	980,263	0	0.00%	151,293	0	0.00%
Pinal	375,770	31,497	8.38%	52,071	3,660	7.03%
Santa Cruz	47,420	0	0.00%	6,224	0	0.00%
Yavapai	211,033	0	0.00%	50,767	0	0.00%
Yuma	195,751	0	0.00%	30,646	0	0.00%
Statewide	**6,392,017**	**147,427**	**2.31%**	**881,831**	**18,884**	2.14%

Population counts based on census 2010 blocks intersection with fissures zone areas defined by AZGS.

As seen in the table above, 147,427 of the state population live either in proximity to known earth surface fissures or within fissure hazard areas, which amounts to about 2.31% of the total population (6,392,017). When considering the just special population of those over 65, there is a slight decrease in percentage to 2.14% at risk to exposure.

Table RA-41: Local Risk Assessment & Loss Estimates Based on Fissure Risk

County	Total Est Asset Value (x $1,000)	Asset Value Exposed to Hazard(x $1,000)	Est Potential Losses (x $,1000)
Statewide Totals	**$382,041,435**	**$182,232**	**$0**
Apache	$11,101,665	No Data	No Data
Cochise	$10,615,770	No Data	No Data
Coconino	$22,517,439	No Data	No Data
Gila	$6,811,526	No Data	No Data
Graham	$2,999,628	$0	No Data
Greenlee	$6,747,353	No Data	No Data
La Paz	$2,359,292	No Data	No Data
Maricopa	$189,975,238	$27,436	No Data
Mohave	$15,521,558	No Data	No Data
Navajo	$11,908,834	No Data	No Data
Pima	$50,584,821	No Data	No Data
Pinal	$13,472,739	$70,676	No Data
Santa Cruz	$3,044,947	No Data	No Data
Yavapai	$18,491,858	No Data	No Data
Yuma	$14,750,955	No Data	No Data

NOTE: "*No Data*" denotes lack of available information for assessment.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Fissures are shown below. County and Local CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-42: State CPRI Results for Fissures

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score (max: 4)
Fissures	Likely	Limited	>24 Hours	>1 Week	**2.65**
	3	2	2	4	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-43: County and Local CPRI Results for Fissures

County/Community	CPRI
Cochise	1.88
Benson	2.30
Bisbee	2.05
Douglas	1.45
Sierra Vista	2.05
Tombstone	1.45
Unincorporated Cochise County	1.95
Wilcox	2.85
Coconino	3.23
Coconino	3.85

County/Community	CPRI
Flagstaff	3.90
Williams	3.70
Page	1.45
Graham	3.20
Graham	3.55
Pima	3.15
Safford	3.40
Thatcher	2.70
Maricopa	1.81
Avondale	2.20

County/Community	CPRI
Buckeye	1.10
Carefree	1.00
Cave Creek	1.00
Chandler	1.00
El Mirage	1.10
Fountain Hills	2.50
Fort McDowell Yavapai Nation	1.40
Gila	1.00
Gilbert	2.20
Glendale	2.35
Goodyear	1.45
Guadalupe	1.45
Litchfield Park	1.45
Unincorporated Maricopa County	2.95
Mesa	3.10
Paradise Valley	1.65
Peoria	2.50
Phoenix	1.45
Queen Creek	1.90

County/Community	CPRI
Salt River Pima-Maricopa Indian	2.50
Salt River Project	1.75
Scottsdale	1.90
Surprise	2.20
Tempe	2.05
Tolleson	1.30
Wickenburg	2.50
Youngtown	1.60
Pinal	1.77
Apache Junction	2.20
Casa Grande	2.50
Coolidge	0.90
Eloy	2.05
Florence	1.60
Kearny	1.50
Mammoth	0.15
Maricopa	2.05
Superior	1.75
Unincorporated Pinal County	2.95

CPRI scores for Flooding based on county mitigation plans

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Fissure are shown below.

Table RA-44: State Environmental CPRI Results for Fissure

Environmental Risk Due to Fissure				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Highly Likely	Negligible	< 1 month	**1.8**
Water	Highly Likely	Limited	6 months+	**3.0**
Soil	Highly Likely	Catastrophic	6 months+	**3.6**
Average CPRI Environmental Risk Rating: 2.8 (max 3.6)				

Consequences / Impacts

- **Public**
  There are no obvious direct impacts to public health due to the effects of earth fissures. Public safety is rare and can be eliminated with the use of caution, foresight, and preplanning.
- **Responders to the Incident**
  Similar to the impact to the public, there is no real threat to responders as this is not usually considered an 'incident' response type of hazard.

- **Continuity of Operations / Delivery of Services**
  Fissures do not pose a threat to the state's ability to continue effectively functioning. Though, it may be hampered if key infrastructure is compromised or access is limited/denied.

- **Economic / Financial Condition of Jurisdiction**
  Economic impact due to earth fissures can be a result of damaged transportation systems, buildings, sewage facilities, irrigations systems, water-storage systems, pipelines and agricultural fields, just to mention a few. Areas prone to or experiencing fissures may also be affected by decreased property value as well as increased cost to development projects caused by modifications to plans and structure placement. These costs may directly or indirectly affect the jurisdiction in costs or tax base.

- **Public Confidence in Jurisdiction's Governance**
  Although response is not generally an issue directly related to this hazard, taking a proactive approach by addressing earth fissures through prevention as opposed to only when a critical point is reached is likely to maintain the public's confidence level. Lack of situation knowledge will lead to a misunderstanding of the situation and may result in frustration and a negative attitude toward those that are perceived as responsible, which in most cases is the government.

Resources

Definitions
AZGS – Arizona Geological Survey
GIS – Geographical Information System
Subsidence – (see Section 5.4.10)
USGS – U.S. Geological Survey

Sources
AZGS Earth Fissure Viewer interactive map: http://services.az.gov/OnlineMaps/fissures.html (shows all publsihed AZGS fissure study areas

Earth Fissure Planning Maps for Cochise, Maricopa, Pima and Pinal Counties, Arizona. Map scale 1:250,000, products of the Arizona Geological Survey, 2007, Online at http://azgs.az.gov/efc

Earth Fissure Study Area Map of Arizona. Map Scale 1:24,000, products of the Arizona Geological Survey, 2008-2010, Online at http://azgs.az.gov/efc (As of February 2010, 16 of 23 study area maps are available).

Earth Fissure Publication List, Arizona Geological Survey 2009, Online at http://azgs.az.gov/efc

See http://www.azgs.az.gov/efresources.shtml for numerous other earth fissure resources.

References
Allison, M.L., and Shipman, T.C., 2007, *The role of AZGS in mapping earth fissures in AZ,* Arizona Geology, Vol. 36, No. 4/ Vol. 37 No. 1, Winter/Spring 2007, AZGS, Tucson, AZ.

Allison, M.L., and Shipman, T.C., 2007, *Earth fissure mapping program 2006 progress report*, OFR 07-01, June 2007, AZGS, Tucson, AZ.

AZ Land Subsidence Group, 2007, *Land subsidence and earth fissures in AZ: Research and informational needs for effective risk management*, white paper, Tempe, AZ.

Carpenter, M.C., 1999, Land subsidence in the US [Galloway, D., Jones, D.R., and Ingebritson, S.E., editors], *South-Central Arizona: Earth fissures and subsidence complicate development of desert water resources*, USGS Circular 1182.

Conway, B.D., 2006, *What is land subsidence?*, presentation to Arizona Planning Association Conference, AZ Department of Water Resources.

Fergason, K.C., 2006, *Earth fissure zone investigation report Powerline and Vineyard flood retarding structures, Pinal County, AZ*, AMEC Earth & Environmental, Inc., 25 May 2006, Tempe, AZ.

Gelt, J., 1992, *Land subsidence, earth fissures change Arizona's landscape*, Arroyo, Summer 1992, Vol 6 No. 2, University of AZ.

Harris, R.C., 2001, *A new earth fissure near Wintersburg, Maricopa Co, AZ*, OFR 01-10, Nov. 2001, AZGS, Tucson, AZ.

Harris, R.C., and Allison, M.L., 2006, *Hazardous cracks running through AZ*, Geotimes, August 2006, Geological Society of America, Boulder, CO.

Holzer, T.L., 2000, *Methods for prediction of earth fissures & surface faults caused by groundwater withdrawal*, The Fragile Territory, Congresso Nazionale dei Geologi, 10th, Rome, Proceedings, Consiglio Nazionale dei Geologi, p 179-185.

Leake, S.A., 1997, *Land subsidence from ground-water pumping*, Impact of climate change on the southwestern US workshop, USGS.

Pewe, T.L., 1990, *Land subsidence and earth-fissure formation caused by groundwater withdrawal in Arizona; a review*, in Groundwater geomorphology; the role of subsurface water in earth-surface processes and landforms [Higgins, C.G., and Coates, D.R., eds.], Geological Society of America Special Paper 252, Boulder, CO.

Sandoval, J.P., & Bartlett, S.R., undated, *Land subsidence/earth fissuring on the CAP, AZ*, US Bureau of Reclamation, AZ Projects Office.

Schumann, H.H., & Genauldi, R., 1986, *Land subsidence, earth fissures, and water-level changes in southern Arizona*, Arizona Bureau of Geology and Mineral Technology Map 23.

Slaff, S., 1993, *Land subsidence and earth fissures in Arizona*, Down-to-Earth Series 3, AZGS, Tucson, AZ.

Flooding / Flash Flooding

Introduction/History

Flooding is the most common and most expensive hazard in Arizona. Since February 1966, the State has experienced 63 flooding incidents of sufficient magnitude to prompt Presidential or Gubernatorial disaster declaration. In addition, there have been more than 100 other serious flood events which did not trigger a disaster declaration. These declared and undeclared flood events are reported to have killed 128 persons and injured 252 between 1964 and 2012 according to the Spatial Hazard Events and Losses Database for the United States (SHELDUS™), by far the most of any hazard in Arizona. The Arizona Division of Emergency Management (ADEM) history of disasters in Arizona from 1966 – 2013 indicates there have been more flood declarations than any other hazard category.

Three seasonal atmospheric conditions tend to trigger significant flood events in Arizona:

- **Tropical Storm Remnants**: Historically, the most regionally severe flooding occurs when remnants of hurricanes and tropical storms enter the State. These events occur infrequently (i.e. approximately every ten years), mostly in early autumn, and can bring several days of prolonged, intense precipitation events covering large regions that can cause severe flooding.
- **Winter Rains**: Winter brings the threat of low intensity, long duration rains that cover large areas and cause extensive flooding and erosion, particularly when combined with snowmelt that increases runoff after rain falls on significant snowpack. The El Nino climate phenomenon can influence winter storms and cause severe flooding. El Nino, the periodic warming of Pacific waters, occurs every two to five years and typically lasts 12 months. The most recent El Nino occurred in 2011 and the next one is expected to occur in late 2013.
- **Summer Monsoons**: A third atmospheric condition that causes flooding in Arizona is the annual summer monsoon. In mid to late summer monsoon winds bring humid subtropical air into the State. Solar heating triggers afternoon thunderstorms that can be devastating. Flash flooding may occur as a result of local, intense rainfall in a short period of a time (usually 6 hours). Many Arizona communities get half of their annual rainfall during the summer monsoon from June 15 to September 30. The annual summer monsoons occur frequently, almost daily, and bring intense rainfall to a small area that typically results in severe thunderstorm watches or flood warnings by the National Weather Service.

Post-Fire Flooding

Large-scale wildfires dramatically alter the terrain and ground conditions. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water, creating conditions ripe for flash flooding and mudflow. Flood risk remains significantly higher until vegetation is restored—up to 5 years after a wildfire.

Flooding after fire is often more severe, as debris and ash left from the fire can form mudflows. As rainwater moves across charred and denuded ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. These mudflows can cause significant damage.

The Schultz Pass, which is located in the Coconino National Forest several miles north of Flagstaff, was always considered to be an area with great potential to experience a WUI/wildfire. A fire occurring in that area during high-wind conditions could be quickly pushed down into residential areas. For this reason, local and federal officials took actions prior to the start of the 2010 wildfire season to help mitigate the threat. These actions included the formation of a crew to provide fuel mitigation on private property; extensive wildland and incident management training for department members; the purchase of specialized equipment, such as WUI engines; and the installation of compressed air foam systems on all pumping apparatus, both for firefighting and structure protection.

On June 20, 2010 the long-feared major wildfire threat became a reality: The Schultz Fire started just before noon, caused by an abandoned campfire. Initial-arriving units found a fire covering approximately 2 acres on the ground. The 20–30 mph winds gusted to 50 mph, quickly droving the fire out of the reach of the crews, pushing it across Schultz Pass Road and into the crowns of trees.

Actions included evacuations of 650 homes, cutting dozer lines, burnout operations off the firebreaks around structures and structure protection. In the first 6 hours, the fire burned through seven miles of heavy timber. Fortunately, after the first 9 hours and with the help of the fire breaks and burnouts, the fire moved past the subdivisions and no longer threatened structures.

Ultimately, 15,000 acres were lost to the Schultz Fire. No structures were lost, but 1,800 people were evacuated. Only minor injuries were reported.

While personnel were still fighting the Schultz Fire, officials realized that the next threat to the community would be flooding due to the fact that the fire consumed approximately 15,000 acres on the east side of the San Francisco Peaks, which reach elevations of more than 11,000 feet. The fire not only removed vegetation that would normally hold moisture, but it also baked the soil to the point where it acted like wax paper and would *shed* water, rather than absorb it.

The county and the USFS put several mitigation measures in place in a short period of time; however, on July 20, one month after the Schultz Fire started, the first major monsoon rain hit the area—and the resulting flooding was far more extensive than anyone had predicted.

During the first major flood, 30 million gallons of water ran off the mountain. The residential communities adjacent to the fire experienced flooding and subdivisions 10 miles away were also flooded. Virtually none of the area's residents had flood insurance, as there was previously no reason to purchase it.

To make matters worse, the flood severed a main pipeline that supplied about 20% of Flagstaff's drinking water. Approximately 320 Native American cultural sites were damaged or destroyed during the incident. The floodwaters also caused the death of a 12-year-old girl who was washed away by the powerful current. It was, in the simplest terms, a disaster—and the fourth heaviest monsoon on record in the Flagstaff area.

At this point, 225 properties have been affected, 40 houses damaged and seven homes destroyed. The events have also caused a reduction in property values as the county reassesses the area, and this trend is likely continue over the next 5 to 7 years.

In response to post fire flooding and debris flow issues, a state-wide committee was created. The 'Post-Wildfire Flood Warning and Debris Flow Committee' is activated on a fire specific basis and includes membership of such agencies as ADWR, ADEM, NWS, NRCS, USFS, USGS, AGS as well as representatives from county flood control and county emergency management divisions. The committee's focus is to maintain contact information to be used by BAER Teams and other agencies regarding flood warning/debris flow systems, develop a list of resources that can be used to respond to post-fire flood potential and have a technical expert team that can design a flood/debris flow warning system and make recommendations to local entities impacted by fire.

The following are a few examples of significant floods that have occurred in the State:

- October 3-5, 2010. The Havasupai Reservation experienced severe flooding in Cataract Creek and 3 major surges of water arrived in Supai Canyon. The flood caused damages and destruction of trails, bridges, homes, community facilities, campgrounds and recreation areas in Supai Canyon. Tourists were evacuated and several animals were lost including 3 pack horses that got swept away in the flood. The Havasupai Tribal Council officially declared a State of

Disaster on the Havasupai Reservation and closed Supai Village and the surrounding areas to visitors indefinitely until recovery, repair, rehabilitation and mitigation work is completed.

- July 20-August 7, 2010. Following the Schultz Fire burning more than 15,000 acres of U.S. Forest Service land, the soil became hydrophobic. This condition prevents the soil from absorbing water and is common following wildfires. This soil condition, paired with repeated heavy rains resulted in substantial flooding downslope from the burn area. This event led to Presidential Disaster Declaration FEMA-DR-1940-AZ, and the expenditure of more than $7 million dollars between the State and Federal resources. This is the most recent flood event which triggered significant state and federal expenditures.
- January 18-22, 2010. Severe winter weather hit the northern part of the state and heavy rains fell in the lower elevations causing significant flooding. In February, the Governor declared a State of Emergency and in March, the President declared a major disaster for Arizona. Preliminary damage assessment reports indicated that 51 residences were destroyed, 64 sustained major damage and 474 more were affected or received minor damage. The total individual assistance cost was estimated at $3.6 million. Public assistance damages were primarily related to roads and bridges throughout the impacted areas with over $11.4 million in damages estimated.
- Summer 2008. Heavy monsoon rains in the border area around Nogales caused severe flooding, two fatalities, and millions of dollars of damage; a State of Emergency was declared in Nogales for the second year in row. Floodwaters damaged a concrete-lined drainage channel that protects a large raw sewage pipe. The sewer line, buried beneath the channel, carries sewage from Nogales, Sonora to a wastewater treatment plant north of Nogales US. It is predicted that a break in the sewer line would release contaminated water into the Santa Cruz River, which flows north toward Tucson. (ADEM, 2009)
- Summer 2006. Record rainfall in eastern Pima County triggered unprecedented flooding, slope failure, and debris flows in Tucson and the nearby Santa Catalina Mountains, which culminated with a 4 day rainfall event on July 31 that the National Weather Service estimated as a 1,000 year event in the mountains. Stream flow on the Rillito River through Tucson exceeded the 500 year event. The USGS documented 435 slope failures and debris flow events in the southern Santa Catalina Mountains, which they termed “an extreme event.” (Pima Co Regional Flood Control District, 2008)
- August 1997. Eleven hikers died in a flash flood in Lower Antelope Canyon near Page as a result of a storm that occurred several miles away. One month later two hikers were killed and one injured by a flash flood as they were crossing Phantom Creek in the Grand Canyon National Park. The storm that caused the flood occurred several miles north of the flash flood site (NWS Flagstaff).
- Winter 1993. A persistent El Nino established new record rainfalls and storm intensities throughout the State. Warm temperatures caused snowmelt which exacerbated the runoff over large areas, and rivers, creeks, and washes overflowed their banks, causing extensive erosion. Stream flow velocities and runoff volumes exceeded historic highs. Many flood control channels and retention reservoirs, filled to capacity, diverted water to emergency spillways; in some cases, reservoirs were breached, causing extensive damage. Damages were reported in almost all counties of the State. Gila County sustained severe damage – several homes in Winkelman Flats were completely destroyed by the Gila River; many homes in Tonto Basin and Verde Lakes were severely damaged or destroyed. Bridge crossings on the lower Gila River became impassable, isolating families on the north side. Thousands of acres of valuable farmland were inundated, destroying crops. Releases from Painted Rock Dam on the Gila River were frequent. A presidentially declared disaster was issued; damages were widespread and significant,

impacting over 100 communities. Damages exceeded $400 million; eight (8) deaths and 112 injuries were reported to the Red Cross (FEMA April 1, 1993; ADEM March, 1998).

- Summer 1990. A series of severe thunderstorms in July caused heavy rain, high winds, flash flooding and damage in Gila, Mohave, Pima and Yavapai Counties, resulting in a state of emergency declaration. Additional storms in August caused damage in Pinal and Graham Counties, and a final series of storms impacted parts of Coconino, Maricopa, and Yavapai Counties and the Havasupai and Hualapai Indian Reservations from August 30 to September 5. Sky Harbor International Airport in Phoenix reported over seven (7) inches of rain by the end of the monsoon season, more than two (2) inches above average. Three (3) fatalities occurred and damage to public facilities was estimated near $6.6 million, excluding damage on Arizona Indian Reservations (FEMA, January 1992).

Types of flooding in Arizona can be generally classified into four different categories: riverine, shallow sheet flow, distributary flow, and alluvial fans. Each category represents the unique geology, topography and soils of the arid southwest. The flood hazard for each is treated and mapped by FEMA differently.

Riverine: The most common type of flooding occurs along defined watercourses such as rivers or low-lying ephemeral desert washes that are typically dry until there is significant rain to cause runoff. These systems are generally comprised of a well-defined low-flow channel or floodway, and an overbank floodplain. Riverine floodplains that have been studied in detail are usually delineated by FEMA as a flood zone AE, and may or may not define a floodway.

Shallow Sheet Flow: Another common type of flooding that occurs in areas that are fairly flat with no definable washes or low-flow areas of any significance. The flooding consists of a shallow sheet of water that can be several feet deep. Depending on the slope of the land, there can also be ponding and the sheet flow can be slow, or move fast enough to cause erosion. These are usually delineated as FEMA flood zone AH (ponding areas), zone A, or zone AO (depth 1-3).

Distributary flow: Flooding in relatively flat areas with non-cohesive and erodible soils can create a network of migrating and dendritic channels. Rather than individual tributaries that flow to a larger watercourse, the network is distributary with flow migrating into many channels that may erode or plug with debris and sediment to create new channels that can spread out in many directions. A distributary flow is difficult to model as a floodplain, but may be FEMA flood zone A or zone AO (depth 1-3 feet).

Alluvial fans: Flow out of a steep watershed in the arid southwest can carry heavy sediment loads that get deposited in a fan-shape at the base of the mountain. When the watercourse slope flattens, velocities slow, and sediment begins to deposit. This point of slope change is known as the fan apex. Alluvial fans and distributary flow areas are similar; however, alluvial fans are significantly more active and volatile in moving the main channel and creating new flowpaths. Alluvial fan flooding has been modeled by different methods but is probably best delineated using a geomorphic approach. Flood risk in alluvial fans is usually depicted by FEMA as fan flood zone AO (depth 1-3 feet, velocity given in feet per second). The Flood Control District of Maricopa County has also devised a series of flood risk zones specifically for use with alluvial fans.

During the previous Plan period, ADEM coordinated with other federal, state and local agencies to compile a database of flood control structures within the State. This effort was accomplished using funding awarded through the Hazard Mitigation Grant Program (HMGP) from disaster 1581 Severe Storms and Flooding, December 28, 2004 - January 12, 2005. The database incorporates information collected by ADEM over the past 15 years. Completed in 2008, the database contains a total of 1,148 cataloged structures. Types of structures generally included were: dams, dikes, levees, retention and detention basins, channels, culverts, revetments, siphons and more. For several structures, video documentation has also been obtained and is referenced to the database.

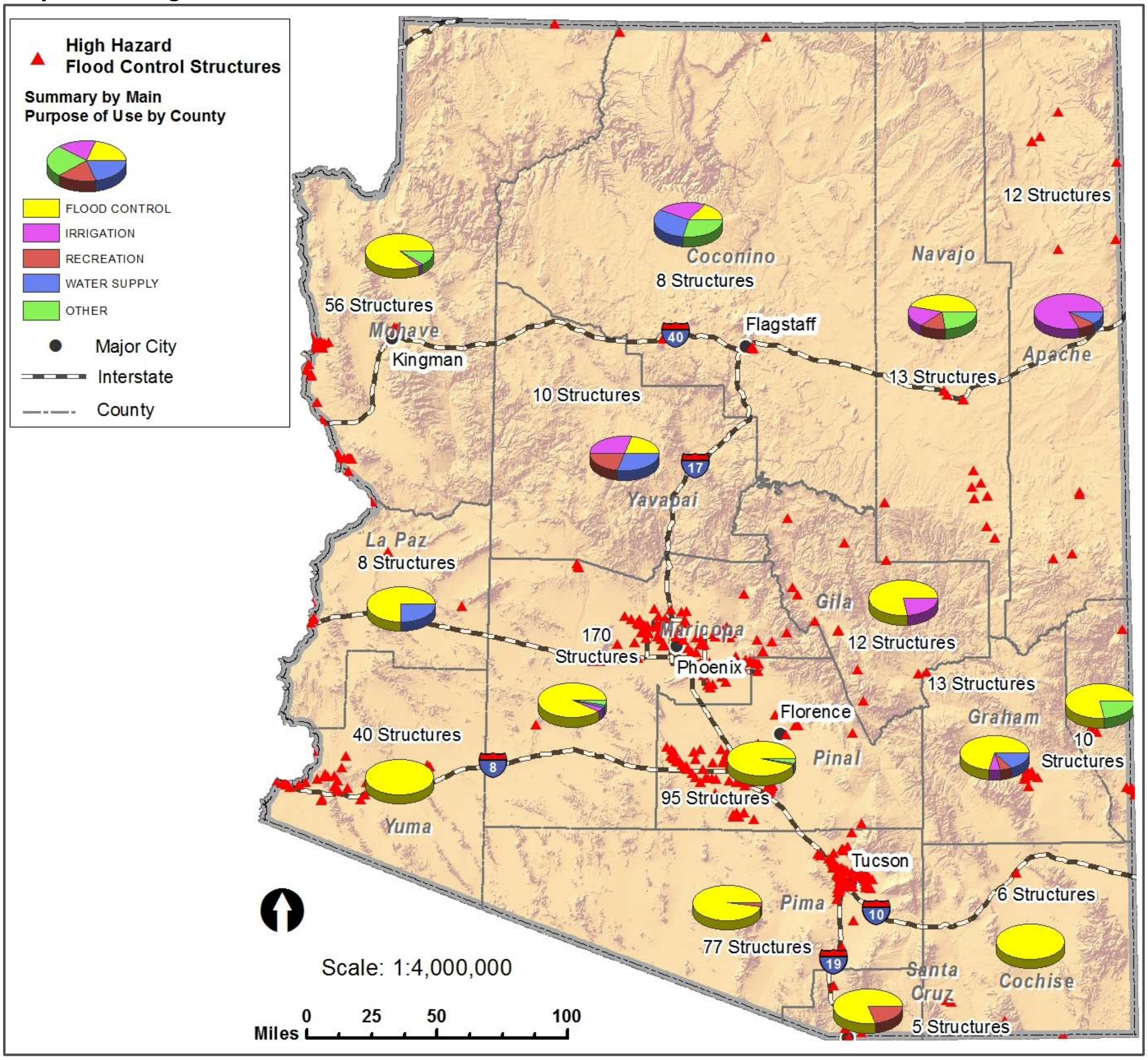
Many of the levees, non-levee embankments and state regulated dams in the database are incorporated in the Dam Failure and Levee Failure subsections of Section 5.4, as appropriate. The table below provides a hazard potential summary for the 1,111 structures identified with a hazard potential rating of High, Significant and Low. The following map reflects the 535 structures in the database categorized as High Hazard Potential. Due to the level of data included, complete listing of structures is not included in this Plan, but is available upon request.

Table RA-45: Flood Control Structure Hazard Potential

County	High	Significant	Low	Total
Apache	12	8	43	**63**
Cochise	6	9	14	**29**
Coconino	8	7	30	**45**
Gila	12	19	60	**91**
Graham	13	12	52	**77**
Greenlee	10	6	15	**31**
La Paz	8	1	0	**9**
Maricopa	170	31	25	**226**
Mohave	56	1	54	**111**
Navajo	13	7	16	**36**
Pima	77	30	36	**143**
Pinal	95	18	19	**132**
Santa Cruz	5	11	6	**22**
Yavapai	10	2	27	**39**
Yuma	40	5	12	**57**
Total	**535**	**167**	**409**	**1,111**

Note: There are 1,158 structures in the database, only 1,111 included hazard potential ratings and are included in this table.

Map RA-9: High Hazard Flood Control Structures



NFIP Program

Congress created the National Flood Insurance Program (NFIP) in 1968 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 Emergency Management Agency (FEMA) manages the NFIP and oversees the floodplain management and mapping components of the Program. The Arizona Department of Water Resources (ADWR) is the State coordinating agency for the NFIP and assists NFIP participating communities. FEMA and the NFIP provide flood maps, flood insurance, and disaster grants to communities that adopt the maps and ordinances to enforce floodplain regulations.

More than 100 Arizona communities 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 (ADWR, 2009). If new buildings are constructed in accordance with the flood regulations for the flood zone, called a Special Flood Hazard Area, identified on the FEMA Flood

Insurance Rate Map (FIRM) panels, they should be safe from the 1% annual chance or 100-year flood. Building and contents damage can be covered by private flood insurance to reduce the disaster costs.

ADWR's floodplain management program is partially funded by FEMA's Community Assistance Program (CAP). One of the main objectives of the CAP is to assure that jurisdictions adopt and enforce floodplain management regulations in accordance with requirements of the NFIP and the Arizona Revised Statutes (ARS). Through this program, Community Assistance Visits (CAVs) are made to the NFIP participating communities in Arizona. It is the goal of ADWR to visit communities periodically to provide updates on state and federal floodplain management program changes, provide technical and programmatic assistance and verify that development in floodprone areas is compliant with local floodplain management regulations.

As of April 30, 2013, 34,982 eligible homeowners in Arizona had purchased flood insurance offered through the NFIP program. It is important to note that flood insurance is mandatory for a building constructed in a federal floodplain that has a federally-backed mortgage.

The following table shows the number of policies held in each county in the State of Arizona. For details on policies held by communities, see NFIP & Flood Loss in this Plan's Appendices.

Table RA-46: National Flood Insurance Program (NFIP) Policy Holders as of 3/31/2013

County	Policies In Force	Insured Value
Apache	114	$23,827,800
Cochise	1,591	$281,793,900
Coconino	1,521	$392,082,000
Gila	483	$81,849,500
Graham	226	$37,491,100
Greenlee	74	$9,334,900
La Paz	316	$64,550,300
Maricopa	18,075	$4,484,894,600
Mohave	2,117	$415,744,900
Navajo	1,018	$168,645,800
Pima	5,118	$1,146,005,900
Pinal	819	$180,054,400
Santa Cruz	775	$169,806,400
Yavapai	1,948	$411,767,200
Yuma	752	$127,580,000
Total	**34,947**	**$ 7,995,428,700**

Source: NFIP Bureau Net online at: http://bsa.nfipstat.com/reports/reports.htm

During the period January 1, 1978 through March 31, 2013, there were 4,133 losses and approximately $35.9 million in payments reported in Arizona's NFIP communities. As expected, Maricopa and Pima Counties, with the highest populations, have the most losses but rural Greenlee County has the fourth highest loss at over $2.4 million.

The table below details the number of claims made by flood insurance policy holders, broken down by county. For details on claims and losses by community, see NFIP and Flood Loss information in this Plan's Appendices.

Table RA-47: National Flood Insurance Program (NFIP) Loss Statistics Jan 1978 thru Mar 2013

County	Losses	Payments	Average Payment
Apache	6	5,743	1,149
Cochise	78	305,400	3,966
Coconino	205	3,131,680	15,276
Gila	127	2,231,391	17,570
Graham	31	165,639	5,343
Greenlee	152	2,412,585	15,872
La Paz	77	816,692	10,606
Maricopa	2017	11,529,414	5,716
Mohave	141	1,021,621	7,246
Navajo	102	966,493	9,475
Pima	452	6,012,563	13,302
Pinal	94	1,588,729	16,901
Santa Cruz	161	1,327,165	8,243
Yavapai	337	579,057	1,718
Yuma	153	1,151,314	7,525
Total	**4,133**	**35,922,981**	**8,692**

Since the 45 years the NFIP was created, flood risks continue and the costs and consequences of flooding are increasing dramatically. In 2012, Congress passed the Biggert Waters Flood Insurance Reform Act of 2012 which calls on FEMA and other agencies to make a number of changes to the way the NFIP is run. These changes are intended to make the program more sustainable and financially sound over the long term. Some of these changes have already been put in place, and others will be implemented in the coming months. Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk and change how Flood Insurance Rate Map (FIRM) updates impact policyholders. The changes will mean premium rate increases for some – but not all – policyholders over time. Subsidized rates for residences and other classes of properties will be phased out over time. Not everyone will be affected by the new law – only 20% of NFIP policies nationwide receive subsidies and should anticipate a rate increase in the near future.

In Arizona, as of 12/31/2012, an estimated 34,848 NFIP policies in effect. Of those, only 6,005 or 17% were subsidized policies and those premiums would likely be affected by the Biggert Waters Flood Insurance Reform Act (Source: http://www.arcgis.com/home/webmap/viewer.html?webmap. Website note: Numbers may differ slightly from the state level data and other available products that are derived directly from the NFIP Flood Insurance Policy database without geocoding).

The Biggert Waters Flood Insurance Reform Act of 2012 also eliminated the Repetitive Flood Claims and Severe Repetitive Loss grant programs and changed the definition of severe repetitive loss and repetitive loss properties which resulted in the number of severe repetitive loss properties in Arizona since our last Plan (see tables in following pages in this section). Repetitive loss and severe repetitive loss properties are eligible for application to the Flood Mitigation Assistance (FMA) grant program, with potential lower state share amounts.

Moving forward, we will be evaluating the policy statistics by County to further estimate the potential impact to the State that may result from premium rate increases. We anticipate this information aiding us in providing awareness regarding the new law and education on what can be done to lower costs. Some options for home/business owners and community officials that may lower premium costs are to participate in the Community Rating System (CRS); obtain a current elevation certificate; incorporate flood mitigation into building, rebuilding; and community-wide mitigation activity.

The CRS is a voluntary incentive program that recognizes and encourages a community's floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions that meet the goals of the CRS program: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance. The resulting premium discounts are based on the CRS class rating a community earns based on program activities that save lives and reduce property damage. (Class ratings range from 1-10, with one being the best rating. The discount increases 5% with each class; Class 1 communities receive a 45% premium discount; Class 10 communities do not receive a discount.) The Arizona CRS ratings for participating communities are as follows:

Table RA-48: CRS Communities within Arizona as of May 1, 2013

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class
40131	Camp Verde	10/1/1991	5/1/2011	7
40080	Casa Grande	10/1/1991	10/1/2012	8
40040	Chandler	10/1/1991	5/1/2004	7
40095	Clarkdale	10/1/1991	5/1/2011	7
40012	Cochise County	10/1/1991	10/1/1991	9
40019	Coconino County	10/1/1991	10/1/1999	8
40061	Dewey-Humboldt	10/1/2007	5/1/2011	7
40020	Flagstaff	10/1/1991	10/1/2007	7
40044	Gilbert	10/1/1991	10/1/1992	8
40045	Glendale	10/1/1991	5/1/2010	7
40067	Holbrook	10/1/1995	10/1/2000	8
40118	Marana	10/1/2012	10/1/2012	8
40037	Maricopa County	10/1/1991	5/1/2012	4
40058	Mohave County	10/1/1995	5/1/2013	6
40066	Navajo County	10/1/1992	5/1/2008	8
40051	Phoenix	10/1/1992	10/1/2002	6
40073	Pima County	10/1/1991	5/1/2007	5
40098	Prescott	10/1/1991	5/1/2011	7
40090	Santa Cruz County	10/1/2003	5/1/2008	7
45012	Scottsdale	10/1/1991	10/1/2007	6
40130	Sedona	10/1/1991	5/1/2011	8
40069	Show Low	10/1/1991	5/1/2010	8

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class
40054	Tempe	10/1/1991	5/1/2012	7
40076	Tucson,	10/1/1991	10/1/2007	6
40093	Yavapai County	10/1/1991	5/1/2013	6

Source: FEMA, 2013 at http://www.fema.gov/business/nfip/crs.shtm

FEMA classifies repeated flooding of the same properties as Repetitive Loss (four or more paid flood losses of more than $1,000 each; or two paid flood losses within a 10-year period, that in the aggregate, equal or exceed the current value of the insured property; or three or more paid flood losses that, in the aggregate, equal or exceed the current value of the insured property). As of June 2013, FEMA records indicate 34 Severe Repetitive Loss (SRL) and 265 Repetitive Loss (RL) properties were identified in Arizona with approximately $9.34 million in RL payments (building and contents value). A review of the RL properties determined that approximately 65% of the total properties have been mitigated. Federal, State, and local efforts will continue to focus on promoting mitigation activities for the remaining RL properties in Arizona in the following ways:

- Maintain close coordination with the State NFIP Coordinator currently working at the Arizona Department of Water Resources for identification of eligible properties;
- Public education and outreach concerning the NFIP and the eligibility requirements for the Flood Mitigation grant program; and
- Assessing structures and their locations to identify specific Counties or jurisdictions that may have a higher number of properties eligible for consideration, and contacting the property owners as to the potential for loss and educating them on the eligible projects:
    - Floodproofing for historical properties
    - Relocation
    - Elevation
    - Acquisition
    - Mitigation reconstruction (demolition rebuild)
    - Minor physical localized flood control projects

Table RA-49: Flood Repetitive Losses (RL) as of June 2013

County	Properties	Loss	Payments
Maricopa	169	386	$4,873,205
Coconino	15	39	$1,300,301
Yavapai	22	57	$1,015,655
Pima	16	34	$637,912
Gila	6	13	$411,016
Greenlee	6	13	$284,509
Pinal	5	10	$227,902
La Paz	3	7	$184,904
Navajo	4	8	$145,285
Santa Cruz	7	15	$124,148
Mohave	6	16	$72,157
Graham	3	9	$47,088
Apache	1	3	$7,281
Yuma	1	2	$5,526

Cochise	0	0	$0
Statewide	**265**	**612**	**$9,336,891**

Source: FEMA Region IX, June 2013

Table RA-50: Repetitive Loss Properties by Mitigation Status as of June 2013

County	Properties		
	Mitigated	Non Mitigated	Statewide
Maricopa	96	73	169
Coconino	15	0	15
Yavapai	14	8	22
Pima	13	3	16
Gila	6	0	6
Greenlee	6	0	6
Pinal	4	0	4
La Paz	4	1	5
Navajo	4	3	7
Santa Cruz	3	0	3
Mohave	3	0	3
Graham	3	3	6
Apache	1	0	1
Yuma	1	0	1
Cochise	0	0	0
Statewide	**173**	**92**	**265**

Source: FEMA Region IX, June 2013

For several years, Arizona has not had properties identified that meet FEMA's criteria as Severe Repetitive Loss. Therefore, repetitively flooded properties in Arizona have been eligible only for FEMA's Repetitive Flood Claims (RFC) grant program, but not the Severe Repetitive Loss (SRL) grant program. Although the RFC and SRL grant programs have been combined with the Flood Mitigation Assistance grant program, there is still grant funding through FEMA's Hazard Mitigation Assistance (HMA) program for these repetitively flooded properties. As indicated in this Plan's Mitigation Strategy, ADEM will notify the Emergency Managers of the properties' respective Counties of these properties and discuss funding program eligibility and offerings.

Table RA-51: Severe Repetitive Loss Properties in Arizona as of July 2013

County	Properties	Losses	Loss (Bldg + Contents)
Coconino	1	3	$ 644,234.36
Graham	1	5	$ 36,549.61
Maricopa	9	20	$ 1,648,636.85
Pinal	2	4	$ 268,443.38
Yavapai	1	2	$ 82,956.55
Statewide	**34**	**34**	**$ 2,680,820.75**

Source: FEMA Region IX

Below is a small sampling of projects funded for and completed on repetitive loss properties:

Table RA-52: Mitigation Success Stories

Type	Project	Description	Cost
Acquisition	Aguila Acquisition Maricopa Co	Residential Acquisition	$486,231
Flood Control	Mesquite Library Maricopa Co	Build floodwall to protect flooded library	$158,431
Drainage Improvement	Calle Azulejo Santa Cruz Co	Drainage & detention basin to protect neighborhood	$542,902
Acquisition	Roosevelt Estates Gila Co	Acquisition/demolition	$298,389

RiskMAP

RiskMAP is a FEMA program that provides communities with flood hazard and risk information and tools they can use to enhance their mitigation plans and take action to ensure community residents are safer. Through flood hazard mapping products, risk assessment tools, technical support for mitigation projects as well as planning and outreach assistance, RiskMAP strengthens a community's ability to make informed decisions about reducing risk. In addition to providing updated FIRMs, the program incorporates risk assessment, mitigation planning and communication into the mapping process. Arizona has been participating in the RiskMAP programs since 2009, below is a sampling of past RiskMAP meetings conducted in Arizona. ADEM supports Arizona's participation in the program and attends meetings whenever possible. ADEM encourages the local jurisdictions' participation and the inclusion of RiskMAP products into their future hazard mitigation plan updates. See this Plan's Appendices for RiskMAP Progress Status information.

RiskMAP Meetings in Arizona				
County/Watershed	**Discovery**	**Scoping**	**Flood Review Meeting**	**Consultation Coordination Officer**
Upper Santa Cruz Watershed	2/16/2012 Tucson			
Cochise (Richland Ranchettes PMR)		2/8/2010 Sierra Vista		
Cochise (Douglas PAL)		9/12/2012 Douglas		
Greenlee (Clifton PAL)		2/9/2010 Clifton		
Phoenix Metro Valley Watershed	2/13/2012 FCDMC, Phoenix			
	2/13/2012 Scottsdale			
	2/14/2012 Prescott			
	2/15/2012 FCDMC, Phoenix			
	2/15/2012 Apache			

	Junction			
Maricopa (Maricopa Co-wide)				12/6/2010 FCDMC, Phoenix
				12/7/2010 FCDMC, Phoenix
Navajo (Zone D PMR)		2/11/2010 Holbrook		7/17/2013 Holbrook
Navajo (Winslow PMR)		2/11/2010 Winslow		
Pinal (City of Maricopa PMR)		12/8/2009 Maricopa	3/28/2011 Maricopa	12/7/2011 Maricopa
Yavapai (Various)		12/7/2009 Prescott (Co meeting)		6/5/2012 Cottonwood (Verde River PMR)
		12/7/2009 Prescott (City meeting)		

Probability and Magnitude

The probability of floods in Arizona is very high and can vary depending on the season (as previously described in Introduction/History Section), geography, and altitude. Generally, southern Arizona poses the greatest risk regarding flooding because it is more densely populated, has large areas with poorly defined drainage channels, and generally less vegetation. Over 90% of Arizona's population lives in the southern half of the State, where development pressure is heavy near flood prone areas. Many flood-prone areas are currently mapped by FEMA and regulated by local jurisdictions, but many more are not mapped making it difficult for counties and communities to mitigate the flooding risk in these areas.

One of the most widely adopted design and regulatory standards for flooding in the United States is an event of a certain magnitude that has a 1% probability of occurring in any given year, or the 1% Annual Flood. The 1% Annual Flood is the standard formally adopted by FEMA and is often referred to with the recurrence interval moniker of "100-year flood" since its probability of occurrence suggests it should only happen once every 100 years. The term "100-year flood" is technically an incorrect expression of the 1% Annual Flood and is often misunderstood by the general public and those not familiar with the statistical significance of the term, because it is thought that a flood of that magnitude can only occur once every 100 years. The reality is that a community could experience multiple 1% Annual Flood events (100-year floods) in a given year. Lower magnitude events that occur more frequently have a higher probability of occurrence in any given year. For example, a 10% Annual Flood (often referred to as the 10-year flood) is a flood event with a 10% probability of occurring in any given year. The 10% Annual Flood would be expected to occur more frequently than a 1% Annual Flood and will not be as large in magnitude. The following table provides a correlation to illustrate the various levels of flood risk.

Table RA-53: Flood Probability Terms

Flood Recurrence Intervals	Statistical Probability of Annual Occurrence
10 year	10.0%
50 year	2.0%
100 year	1.0%
500 year	0.2%

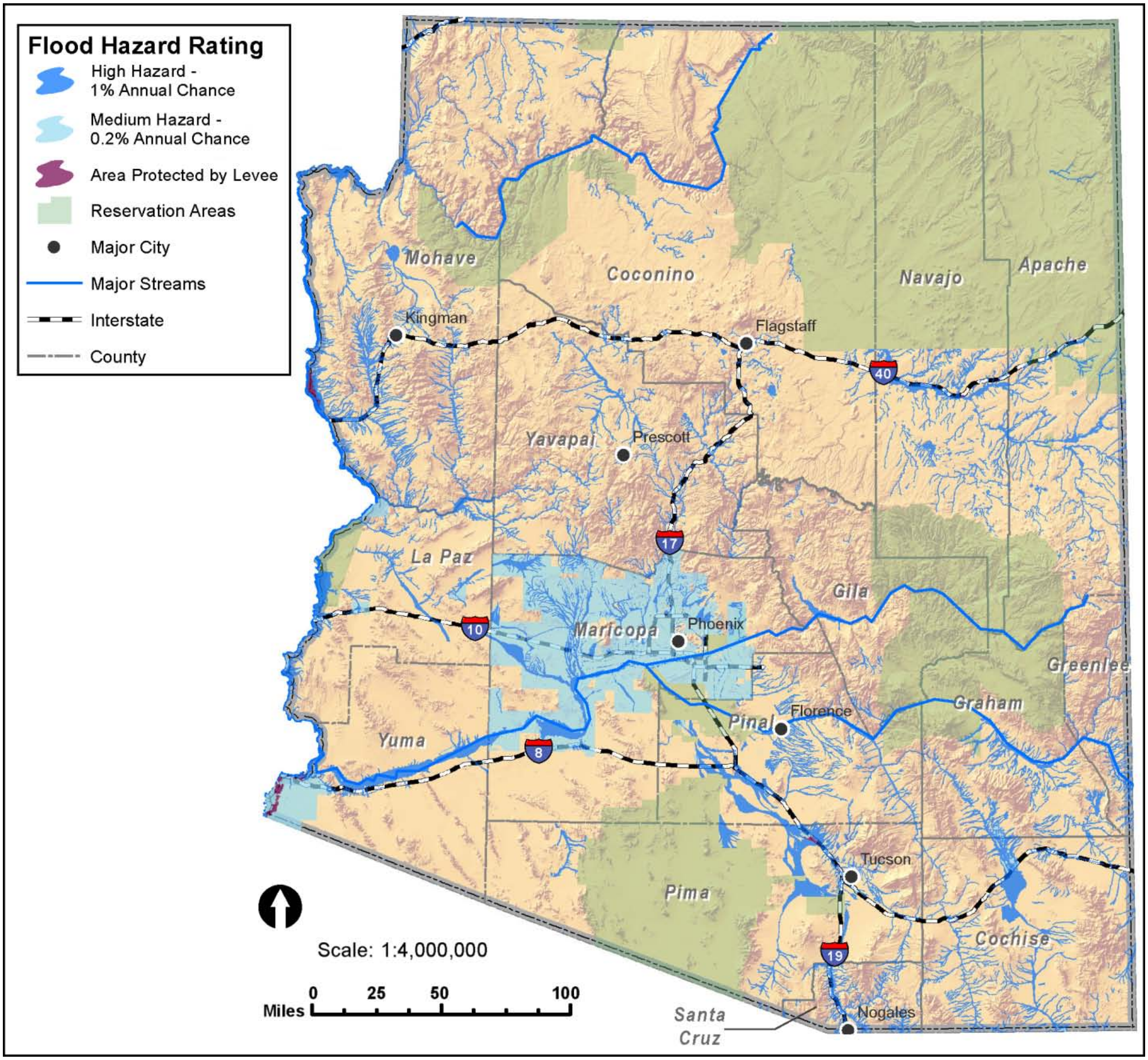
Source: FEMA, August 2001.

The purpose of estimating probability categories is tied to identifying potential flooding risk for actuarial estimates and for estimating flood discharges and volumes for design. The reality is that damages from flooding can occur with any flood event. According to the NFIP, nearly 25% of all flood insurance claims come from moderate to low risk areas (FloodSmart.gov, 2010). Many residential structures have 30-year mortgages, and during that period there is a 96% chance (probability) that the structure will be impacted by a 10% Annual Flood, and a 26% chance it will be impacted by a 1% Annual Flood (Feb 2005 FEMA 480).

For the purposes of this Plan, the depiction of flood hazards across the state is based on the floodplains delineated on FEMA Flood Insurance Rate Maps (FIRMs), which are depicted on the Flood Hazard Areas map below. FEMA is currently wrapping up a map modernization program to update the FIRMs for the state into a digital FIRM (DFIRM) format and the effective date for the new DFIRM maps vary. Some are still preliminary and not yet officially adopted by the corresponding community. The DFIRM floodplain GIS base files were obtained from FEMA and are the basis for the flood hazard depictions in this Plan.

Two designations of flood hazard are used. Any Special Flood Hazard Area "A" zone (e.g. – A, A1-99, AE, AH, AO, etc.) is designated as a "High" hazard area. All "Shaded X" zones and areas protected by levees are assigned as "Medium" hazard areas. All "A" zones represent areas that would be flooded at a depth of one-foot or greater by a 1% Annual Flood (100-year flood). All "Shaded X" zones represent areas that would be flooded at a depth of one-foot or greater by a 0.2% Annual Flood (500-year flood).

Map RA-10: Flood Hazard Areas



Source: FEMA NFHL Feb. 2013; AGIC, 2013; Baker, 2013

Vulnerability

Arizona's vulnerability to flood hazards can be reduced by structural and nonstructural mitigation activities and projects. Structural mitigation such as engineered and constructed drainage channels, levees, floodwalls, and retention basins are expensive and lengthy capital projects that many communities cannot afford. Nonstructural mitigation activities, including land use planning, building codes, stormwater management, elevation, relocation programs, flood insurance, flood warning and evacuation plans, and outreach and educational programs are much more inexpensive and easier to initiate.

Most Arizona communities participate in the NFIP and regulate their floodplains according to the DFIRMs that identify FEMA-delineated 1% Annual Flood floodplains and flood zones. Many of the delineations are from the 1980's and need to be updated for new hydrology and hydraulics. Some Arizona communities have studied other watersheds and produced their own floodplain maps. In all Arizona communities there are unmapped floodplains that increase the vulnerability to floods.

NFIP communities regulate floodplain development responsibly to reduce flood damages and disaster costs. State-wide, Arizona requires new buildings in FEMA flood zones to be elevated 1 foot above the base flood elevation (1% Annual Flood) to reduce vulnerability to flooding. This freeboard serves as an extra factor of safety and is also applied to non-FEMA floodplain maps produced by some Arizona communities.

Flood insurance is mandatory if a building is located in a FEMA-regulated floodplain, commonly referred to as a SFHA (Special Flood Hazard Area), and is financed with a loan from a federally-backed mortgage institution. Educating the insurance industry and the public about flood hazards is important to reduce vulnerability. Flood education and outreach has occurred in many Arizona communities that received new Digital FIRM panels in recent years.

Cooperation by local, state, and federal entities is important to identify flood hazards, to promote flood safety, and to reduce vulnerability. Arizona county flood control districts are required by statute to cooperate with incorporated areas to promote flood safety. As a result, NFIP community flood control, building, inspection, and emergency departments must cooperate to promote flood safety and to educate their elected officials about their own local vulnerability to flood hazards.

During Community Assistance Visits to Arizona NFIP communities, ADWR provides program assistance by working with community officials to understand the responsibilities of participating in the NFIP and meeting the program's minimum requirements. Local floodplain management regulations are reviewed and any deficiencies and violations are discussed, all to promote protecting residents and their property from flood events.

In addition to regulating development responsibly in and near flood-prone areas, a community can decrease its vulnerability to flood events by installing a flood warning system. Many communities in Arizona have advance warning systems in place and participate with other local, State, and Federal agencies to share critical data and evaluate potential threats from flooding.

Losses due to flooding can be estimated by analyzing state-owned critical and non-critical facilities in Special Flood Hazard Areas (SFHAs) using loss estimation data published by FEMA (FEMA Doc #386-2). The loss to exposure ratio for state-owned critical and non-critical facilities located within high hazard areas is estimated to be 0.20 (20%), which assumes three feet or less of flooding. For medium hazard areas, the loss to exposure ratio is estimated at 0.05 (5%).

In summary, $85.5 million and $147.9 million in losses to potentially impacted state-owned critical and non-critical facilities are estimated for the high and medium flood hazard areas. Regarding human vulnerability, a total population of 260,759 people, or 4.08% and 3,851,576, or just over 60.0% of the total 2010 state population, is potentially exposed to a high and medium flood hazard area. The medium flood hazard counts are relatively large and are primarily due to the way Maricopa County has chosen to delineate the "Shaded Zone X" area in a very conservative manner. Based on the historic record, there is a distinct possibility for either deaths or injuries and a high probability of population displacement for most of the inhabitants within the floodplain limits during an event.

The compilation of risk assessment data from local plans indicates that approximately $191 billion in locally identified critical and non-critical facilities are exposed to a "high" flood hazard, with approximately $12.5 billion in potential losses estimated.

The risk assessment data tables for inundation due to flooding are provided below.

Table RA-54: State-Owned Asset Inventory Loss Estimates Based on Flooding

Jurisdiction	# of Facilities In Jurisdiction	Percentage of State-Wide Total	Est. Replacement Cost x $1,000)	Est. Structure Loss (x $1,000)
High Hazard				
Apache	18	6.67%	$2,157	$431
Cochise	37	13.70%	$7,008	$1,402
Coconino	45	16.67%	$353,238	$70,648
Gila	3	1.11%	$199	$40
Graham	20	7.41%	$2,998	$600
Greenlee	0	0.00%	$0	$0
La Paz	10	3.70%	$1,057	$211
Maricopa	18	6.67%	$5,279	$1,056
Mohave	16	5.93%	$3,203	$641
Navajo	14	5.19%	$1,657	$331
Pima	30	11.11%	$42,562	$8,512
Pinal	33	12.22%	$4,249	$850
Santa Cruz	10	3.70%	$2,541	$508
Yavapai	7	2.59%	$460	$92
Yuma	9	3.33%	$846	$169
Statewide	**270**	**100.00%**	**$427,452**	**$85,491**
Medium Hazard				
Apache	0	0.00%	$0	$0
Cochise	17	1.03%	$20,152	$1,008
Coconino	12	0.73%	$48,448	$2,422
Gila	1	0.06%	$1,058	$53
Graham	0	0.00%	$0	$0
Greenlee	0	0.00%	$0	$0
La Paz	74	4.50%	$5,414	$271
Maricopa	1,191	72.49%	$2,710,220	$135,511
Mohave	0	0.00%	$0	$0
Navajo	0	0.00%	$0	$0
Pima	108	6.57%	$46,970	$2,348
Pinal	96	5.84%	$30,895	$1,545
Santa Cruz	0	0.00%	$0	$0
Yavapai	4	0.24%	$1,398	$70
Yuma	140	8.52%	$94,052	$4,703
Statewide	**1,643**	**100.00%**	**$2,958,607**	**$147,931**

Analysis based on FEMA NFHL Feb. 2013 and state facilities data leveraged from 2010 SHMP.

Table RA-55: State Facilities Located in the High Flood Hazard Area

State Facilities in the High Flood Hazard Area	Apache	Cochise	Coconino	Gila	Graham	Greenlee	La Paz	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma	Total
Critical Facilities																
Banking and Finance Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Communications Infrastructure	0	0	4	0	1	0	0	0	1	0	0	0	0	0	0	**6**
Electrical Power Systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Emergency Services	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Gas and Oil Facilities	1	3	0	0	1	0	1	0	1	2	2	2	1	0	0	**14**
Government Services	12	28	0	3	18	0	7	14	10	11	8	18	9	2	2	**142**
Transportation Networks	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Water Supply Systems	1	1	0	0	0	0	1	1	0	0	1	2	0	1	0	**8**
Non-Critical Facilities																
Businesses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Cultural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Educational	0	1	27	0	0	0	0	0	0	1	17	1	0	0	7	**54**
Recreational/Leisure	3	0	1	0	0	0	0	0	4	0	1	6	0	3	0	**18**
Residential	1	4	12	0	0	0	1	2	0	0	1	4	0	1	0	**26**
Total	**18**	**37**	**45**	**3**	**20**	**0**	**10**	**18**	**16**	**14**	**30**	**33**	**10**	**7**	**9**	**270**

Analysis based on FEMA NFHL Feb. 2013 and state facilities data leveraged from 2010 SHMP.

Table RA-56: County population sectors exposed on flooding

Community	Total	Exposed	Exposed	Over 65	Over 65 Exposed	Over 65 Exposed
High Hazard						
Apache	71,518	748	1.05%	8,268	123	1.49%
Cochise	131,346	14,592	11.11%	22,688	2,376	10.47%
Coconino	134,421	7,085	5.27%	11,924	372	3.12%
Gila	53,597	3,375	6.30%	12,450	899	7.22%
Graham	37,220	3,228	8.67%	4,261	486	11.40%
Greenlee	8,437	1,067	12.65%	1,016	203	20.01%
La Paz	20,489	4,037	19.70%	6,683	1,639	24.53%
Maricopa	3,817,117	102,702	2.69%	462,641	10,857	2.35%
Mohave	200,186	12,437	6.21%	46,658	2,949	6.32%
Navajo	107,449	8,369	7.79%	14,241	1,146	8.05%
Pima	980,263	56,172	5.73%	151,293	7,598	5.02%
Pinal	375,770	18,918	5.03%	52,071	1,536	2.95%
Santa Cruz	47,420	7,451	15.71%	6,224	1,195	19.20%
Yavapai	211,033	13,888	6.58%	50,767	3,148	6.20%

Community	Total	Exposed	Exposed	Over 65	Over 65 Exposed	Over 65 Exposed
Yuma	195,751	6,690	3.42%	30,646	1,034	3.37%
Statewide	**6,392,017**	**260,759**	**4.08%**	**881,831**	**35,562**	**4.03%**
Medium Hazard						
Apache	71,518	1,399	1.96%	8,268	174	2.10%
Cochise	131,346	17,425	13.27%	22,688	2,375	10.47%
Coconino	134,421	6,771	5.04%	11,924	470	3.94%
Gila	53,597	1,078	2.01%	12,450	255	2.05%
Graham	37,220	862	2.32%	4,261	147	3.45%
Greenlee	8,437	398	4.71%	1,016	65	6.38%
La Paz	20,489	5,151	25.14%	6,683	2,194	32.83%
Maricopa	3,817,117	3,528,138	92.43%	462,641	415,618	89.84%
Mohave	200,186	16,296	8.14%	46,658	3,554	7.62%
Navajo	107,449	2,850	2.65%	14,241	399	2.80%
Pima	980,263	41,531	4.24%	151,293	4,946	3.27%
Pinal	375,770	43,737	11.64%	52,071	4,613	8.86%
Santa Cruz	47,420	878	1.85%	6,224	151	2.43%
Yavapai	211,033	3,696	1.75%	50,767	922	1.82%
Yuma	195,751	181,364	92.65%	30,646	27,346	89.23%
Statewide	**6,392,017**	**3,851,576**	**60.26%**	**881,831**	**463,228**	**52.53%**

Population counts analysis based on FEMA NFHL Feb. 2013 and 2010 Census population.

Table RA-57: Local Risk Assessment & Loss Estimates Based on Flooding

County/ Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $,1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Apache	36,818	1,130	$4,353,765	$176,433	$20,493
Cochise**	59,633	14,373	$11,794,138	$2,230,452	$286,365
Coconino**	53,466	4,781	$11,823,344	$1,447,872	$196,281
Gila	29,170	3,087	$4,854,321	$560,937	$91,566
Graham	13,130	1,701	$1,935,759	$203,261	$32,430
Greenlee	4,078	899	$510,861	$92,964	$13,121
La Paz	16,200	9,347	$2,888,808	$1,669,414	$183,838
Maricopa	541,259	511,476	$164,894,580	$154,428,928	$8,436,895
Mohave	86,841	14,314	$14,065,296	$2,255,850	$274,759
Navajo	53,472	6,263	$7,668,023	$919,231	$149,945
Pima**	440,794	39,210	$96,840,841	$10,144,920	$1,525,224
Pinal	85,740	20,520	$13,472,739	$2,946,847	$232,585
Santa Cruz	14,217	4,692	$3,098,495	$1,113,224	$217,276
Yavapai	87,895	7,219	$16,149,585	$1,293,164	$219,182
Yuma	68,384	67,128	$12,584,649	$12,421,691	$693,881
Statewide	**1,591,097**	**706,140**	**$366,935,204**	**$191,905,188**	**$12,573,841**

** Does not include Critical Facilities in Total Estimated Asset Value; Total only includes residential structures
Sources: Individual county mitigation plans flood vulnerability tables.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Flooding/Flash Flooding are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-58: State CPRI Results for Flooding / Flash Flooding

Risk Due to Flooding/Flash Flooding					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Flooding/Flash Flooding	Highly Likely	Critical	< 6 hours	< 24 hours	**3.5**
	4	3	4	2	

CPRI Score = (Probability x .45)+ (Magnitude/Severity x .30)+ (Warning Time x .15)+ (Duration x .10).

Table RA-59: County CPRI Results for Flooding/Flash Flooding

County	CPRI
Apache	2.68
Cochise	2.97
Coconino	3.05
Gila	2.91
Graham	3.2
Greenlee	3.7
La Paz	2.97
Maricopa	2.87
Mohave	3.07
Navajo	3.16
Pima	3.31
Pinal	2.98
Santa Cruz	3.62
Yavapai	3.4
Yuma	2.56
Average	**3.10**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Flooding/Flash Flooding are shown below.

Table RA-60: State Environmental CPRI Results for Flooding/Flash Flooding

Environmental Risk Due to Flooding/Flash Flooding				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Catastrophic	6 months+	**2.7**
Soil	Unlikely	Critical	6 months+	**2.4**
Average CPRI Environmental Risk Rating: 2 (max 3.6)				

Consequences / Impacts

- **Public**

  As demonstrated by Arizona's past flood events, the impact to the general public is typically property damage and loss, injury, and in some cases, death. According to the Spatial Hazard Events and Losses Database for the United States (SHELDUS^{TM}), flood related events resulted in 128 fatalities, and losses to properties and crop estimated at $454 million. Without proper mitigation, education, and enforcement of communities' floodplain management regulations, these numbers could increase, especially given the State's record growth in population.

  Several of the deaths, injuries, and rescues associated with flooding often took place when citizens attempted to drive across high or moving waters. Other factors in flood related injuries, illness and death include disease as a result of unhygienic conditions and water-borne diseases.

  In Arizona, most populated areas are located outside mapped floodplains, however, it is estimated that approximately 260,759 people, or 4.08% of the state population are located within high flood hazard areas.

- **Responders to the Incident**
  Flooding is one of Arizona's top hazards, and clean-up activities following floods often pose hazards to workers and volunteers involved in the effort. Potential dangers include electrical hazards, carbon monoxide exposure, musculoskeletal hazards, heat or cold stress, motor vehicle-related dangers, fire, drowning, and exposure to hazardous materials. Because flood disaster sites are unstable, clean-up crews might encounter sharp debris, biological hazards, exposed electrical lines, blood or other body fluids, and animal and human remains. Responders are prone to the same dangers the general public is, but at a higher level as they may be putting themselves in harm's way by performing rescue activities. It is anticipated that in the case of a significant/large scale flood event, emergency responders would be well prepared with protective equipment such as hard hats, goggles, gloves, life jackets, and other necessary equipment.

- **Continuity of Operations / Delivery of Services**
  Public Safety, Military and Department of Transportation have facilities located in flood prone areas and would be critical to response and recovery efforts. Academia and Corrections are important, but not likely to be critical. The Department of Economic Security facility may be critical if it is necessary for public assistance payments during an event. The Continuity of Operations and Delivery of Services of any of these structures will depend on the severity of the flooding and how much damage the facility sustains.

- **Environment**
  Flooding has many adverse effects on communities and their residents and is disruptive to economic activities. Water supplies threatened by flood events can become contaminated, resulting in public health, food supply and livestock issues. Besides being a detriment, however, flooding can provide some environmental benefits such as increasing soil fertility and recharging aquifers.

- **Economic / Financial Condition of Jurisdiction**
  Recovery and rebuilding costs, a decline in tourism, food shortages, lack of infrastructure and the effects on local economies are a few of the contributing factors to economic hardship for the State of Arizona due to flooding. The extent of the hardship will depend on the severity of the event and specific areas affected. For instance, in Yuma County, 1993 and 1997 flooding caused over $330 million dollars of damage, mostly to the local agricultural industry. Tourism, however, might be the industry most affected by severe flood events in Coconino County.

- **Public Confidence in Jurisdiction's Governance**
  Speed of emergency response, efficiency and communication are critical to maintaining public confidence during and after a flood event. The effects of flooding are destructive and disruptive to jurisdictions and often continue after the immediate event has passed. Power outages are likely and travel may be hindered due to flood waters, debris and blocked roads. Sharing information and details with the public about a power outage, for instance (damaged or complete loss of equipment as opposed to simple repair) allows residents to better understand why it may take an excessive amount of time before power and services are restored. Keeping the public well informed as to the extent of damage, status of repairs and providing realistic expectations may have a positive impact on the public's confidence level. Lack of communication can be mistaken for lack of action, resulting in frustration, anger, and unrest.

Resources

Definitions

1% Annual Flood – Flood event with a 1% probability of being equaled or exceeded in any given year (See Base Flood)

10% Annual Flood – Flood event with a 10% probability of being equaled or exceeded in any given year

Alluvial Fan – A geomorphologic feature characterized by a cone or fan shaped deposit of boulders, gravel, and fine sediments that have been eroded from mountain slopes, transported by flood flows, and then deposited on the valley floors, and which is subject to flash flooding, high velocity flows, debris flows, erosion, sediment movement and deposition, and channel migration.

Base Flood – A flood which has a one percent chance of being equaled or exceeded in any given year (also called the "1% Annual Flood" or "100 year flood").

Community Assistance Program (CAP) – Sponsored by FEMA, 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.

Community Assistance Visit (CAV) - A major component of the NFIP's Community Assistance Program (CAP), the CAV is a visit to a community by a FEMA staff member or staff of a State agency on behalf of FEMA that serves the dual purpose of providing technical assistance to the community and assuring that the community is adequately enforcing its floodplain management regulations.

Community Rating System (CRS) - A program developed by FEMA to provide incentives for those communities participating in the National Flood Insurance Program (NFIP) that have gone beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

Debris Flow – Dangerous slurries of rock, saturated sediments and debris that can develop during and after heavy rainfall or rapid snowmelt. They often flow rapidly, striking with little or no warning at avalanche speeds and can travel several miles from their source, growing in size as they pick up trees, boulders, cars, and other materials.

Federal Emergency Management Agency (FEMA) - The federal agency which administers the National Flood Insurance Program (NFIP) and the various grant programs available to communities who suffer flood-related damages.

Flash Flood – A flood event caused by excessive amounts of rain over a short period of time, often less than 6 hours, in which water rises and falls rapidly.

Flood or Flooding – In Arizona, a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of floodwaters or the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) - Official map of a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community.

Floodplain or Flood Prone Area - Any land area susceptible to being inundated by water from any source.

Floodplain Management - The operation of an overall program of corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain, including but not limited to emergency preparedness plans, flood control works, floodplain management regulations, and open space plans.

Floodplain Management Regulations - The ordinance and other zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as grading and erosion control) and other application of police power which control development in flood prone areas. This term describes federal, state or local regulations in any combination thereof, which provide standards for preventing and reducing flood loss and damage.

Flood Warning System – A system of sophisticated gages installed throughout a watershed (in stream and river beds, on hillsides, atop dams) that transmits meteorological data to coordinating agencies and emergency management personnel about potential flooding conditions.

Geomorphology – Geologic study of the configuration and evolution of land forms.

HAZUS (Hazards of the US) - A risk assessment methodology for analyzing potential losses from floods, hurricane winds and earthquakes.

Migrating Channels – Refers to the uncertain flow paths that many desert channels experience over time. Channel migration is affected by a variety of factors, including flow events, bed elevation and sediment characteristics.

National Flood Insurance Program (NFIP) - The program of flood insurance coverage and floodplain management administered under the Act and applicable Federal regulations promulgated in Title 44 of the Code of Federal Regulations, Subchapter B.

One hundred year flood or 100 year flood - The flood having a one percent chance of being equaled or exceeded in any given year. See "Base Flood."

Repetitive Loss Structure - An NFIP-insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978.

Special Flood Hazard Area (SFHA) - An area in the floodplain subject to a 1% or greater chance of flooding in any given year. It is shown on a Flood Boundary and Floodway Map or Flood Insurance Rate Map as Zone A, AO, A1 A30, AE, A99, or, AH.

Sources

Youberg, A. 2012, Southwest Wildfire Hydrology and Hazard Workshop Proceedings. AZ Geological Survey Open-file-report – 12-05, 50 p. 32 presentation available online at http://repository.azgs.az.gov/uri_gin/azgs/dlio/1405

FEMA Website at: http://www.fema.gov/

FloodSmart website at: http://www.FloodSmart.gov

Severe Repetitive Loss Program at: http://www.fema.gov/severe-repetitive-loss-program

References

Federal Emergency Management Agency. August 2001. *How-To Guide #2: Understanding Your Risks – Identifying Hazards and Estimating Loss Potential* (FEMA 386-2).

Loomis, T. R., 2003, *A Brief History of Flooding in the Rural Areas of Arizona, Part II 1964 through 1993*, Arizona Floodplain Management Association Newsletter, Volume 20, Number 1, April 2003.

National Weather Service – Flagstaff .*Northern Arizona Flash Floods*. http://www.wrh.noaa.gov/Flagstaff/summer/flood.html

U.S. Army Corps of Engineers, Los Angles District, 1978, *Flood Damage Report, 28 February-6 March 1978 on the Storm and Floods in Maricopa County, Arizona*, FCDMC Library #802.024

U.S. Army Corps of Engineers, Los Angles District, 1980, *Phoenix Flood Damage Survey*, FCDMC Library #802.029.

U.S. Army Corps of Engineers, Los Angles District, 1994, *Flood Damage Report, State of Arizona, Floods of 1993.*

Hazardous Materials Incidents

Introduction & History

A hazardous material is any substance or material in a quantity or form that may pose a reasonable risk to health, the environment, or property. The category hazardous materials spill include incidents involving substances such as toxic chemicals, fuels, nuclear wastes and/or products, and other radiological and biological or chemical agents. For the purposes of this analysis, only accidental or incidental releases of hazardous materials from two different kinds of incidents are addressed: fixed facility incidents and transportation-related accidents.

Generally, with a fixed facility, the hazards are pre-identified, and the facility is required by law to prepare a risk management plan and provide a copy to the local emergency planning committee (LEPC) and local fire departments. Arizona Tier II forms must also be filed with the Arizona State Emergency Response Commission (AZSERC) at the Arizona Division of Emergency Management (ADEM). For specific site plans, each county LEPC is required by law to maintain a copy of these plans.

The exact location of a hazardous materials accident is not possible to predict. The close proximity of railroads, highways, airports, waterways, pipelines, and industrial facilities to populated areas, schools, and businesses could put a large number of individuals in danger at any time. In addition, essential service facilities, such as police and fire stations, hospitals, nursing homes, and schools near major transportation routes in the State are also at risk from potential hazardous materials transportation incidents. Federal Highway Administration statistics indicate that 1 of 10 motor vehicles is engaged in the transport of hazardous materials of some type.

Increased use and transport of materials across the country has created serious problems for emergency services personnel. Many factors can increase the magnitude of an otherwise simple transportation accident into an incident of potential hazard to high numbers of people. Following are potential factors to be considered:

- Over 14,000 different chemicals are estimated as being shipped by the various transportation modes. Some types of highly toxic chemicals do not require placarding if shipped in quantities of less than 1,000 pounds, even though lesser quantities could devastate a small town.
- Only a few emergency response organizations in the larger cities and counties near the more metropolitan areas have had training for handling peacetime radiological problems. With recent federal grants and programs in place to provide funding for training, exercises, and equipment for local responders, the general capabilities of hazardous materials response personnel and teams statewide is expected to improve.

In addition to traditional chemical hazards, radiological incidents could be a legitimate threat to populations in Arizona. Transport of radioactive materials presents the most probable scenario for a radiological incident. The U.S. Department of Energy is currently shipping radioactive waste by truck to repositories in Texas and Utah.

The federal government has finalized development of long-term repositories for spent fuel and other high-level radioactive wastes, and for transuranics[6] (known as TRU waste), at Yucca Mountain, Nevada, and Carlsbad, New Mexico, respectively. Speculations have suggested that up to 3,600 shipments per year may go to these facilities.

In addition to transportation radiological incidences, scenarios could involve faulty re-entry of nuclear-equipped satellites to earth (such as COSMOS 954 in 1978 and SKYLAB in 1980). This is highly unlikely; however, there are over 3,000 Satellites in orbit currently, of which at least 40 are known to have nuclear power capabilities.

Hazardous material releases are a significant concern in Arizona. AZSERC tracks information on declared hazardous material events. This information comes from the responsible party reports to the National Response Center (NRC) and from reports from responding agencies to the Commission. Local responders, LEPCs and the AZSERC assess reports to ensure appropriate follow-up actions and to assess recurring issues.

During the past decade, from review of significant reports and from AZSERC sponsored Hazardous Materials Commodity Flow studies, it is apparent that flammables, corrosives and gases are the primary hazardous materials of concern and have been receiving the attention of planners and responders to ensure preparedness. Some notable hazardous materials events in Arizona history include:

- July 28, 2012. A rail car released 20,000 gallons of a corrosive liquid in Hayden, Arizona. This spill did not result in any deaths or injuries, but did result in over $400,000 in damages.
- May 21, 2011. A fuel tanker was involved in an accident on SR347 and released over 2,000 liquid gallons of gasoline. Four people were taken to the hospital with injuries that resulted from the accident. This spill generated damages in excess of $7 million.
- June 21, 2006. A fuel tanker releases 7,392 liquid gallons of diesel fuel near Big Park, Arizona. This incident resulted in over $900,000 in damages.
- July 17, 2001. The release of chlorine at the Pima County Waste Water Plant injured one person.
- August 2, 2000. A major fire at a warehouse in Phoenix resulted in five (5) injuries due to chlorine and an estimated $100 million in damages. The fire, extinguished the next day, required four alarms and numerous special apparatus. Over 80 civilians were evacuated from the surrounding neighborhood and several fire fighters and police officers were treated for smoke inhalation. The fire destroyed the 85,000 sq. ft. warehouse. A portion of the building was a home and garden supply business which stored oxidizers (e.g., chlorine), fertilizers, and pesticides (National Fire Protection Assoc. 2000).
- May 15, 2000. Three (3) people were injured by a chlorine release in Phoenix.
- February 28, 1994. An Air National Guard F-16 jet crashed near Duncan, killing the pilot and released hydrazine.
- May 21, 1999. A chlorine release at the Arizona State Prison in Fort Grant injured one (1) person.
- September 25, 1999. Twelve (12) people were injured by a chlorine leak in Nogales.

[6] An artificially made, radioactive element that has an atomic number higher than uranium in the periodic table of elements such as neptunium, plutonium, americium, and others (Nuclear Regulatory Commission). http://www.nrc.gov/reading-rm/basic-ref/glossary/transuranic-element.html

Maricopa County had 72% of the spills reported to the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration from 2010 – 2013.

The AZSERC maintains records on facilities that manufacture, process, or otherwise use hazardous materials over certain quantities. For Extremely Hazardous Substances (EHS), unless otherwise exempted from reporting (for example, household products or products packaged for use by the consumer or agricultural use chemicals), facilities must report at 500 pounds or the threshold planning quantity for that EHS. Those reports are submitted to the AZSERC, LEPC (in Arizona, each County has one (1) Local Emergency Planning District), and to the Fire Department with jurisdiction.

It can easily be understood that hazardous chemicals therefore exist at facilities that are NOT subject to reporting under this one environmental/emergency management statute and may exist in quantities that subject the facility, workers, and community to vulnerabilities. It must also be recognized that there are well over 500,000 chemicals that are required to be reported under this one law as well as recognize that exemptions exist that remove statutory requirements to report to the AZSERC. Further, while there are planning requirements for EHS, in many cases non-EHS may pose a more significant threat because of quantity location, storage, proximity to sensitive areas, etc.

Hazardous materials planning must be an integral part of preparedness, response, recovery and mitigation planning and will undoubtedly be part of emergency management considerations for all possible disaster/emergencies, whether technological or natural.

Facilities submitting reports are heavily concentrated, as you would imagine, in the urban areas of Maricopa County and Pima County (Tucson). Pinal and Yuma Counties also have significant numbers of facilities subject to the Emergency Planning and Community Right to Know laws. Several Local Emergency Planning District (Counties) are close behind.

It must be noted that this is but one source of information on Hazardous Materials. Local jurisdictions, through their fire codes, maintain additional information and Arizona legislation tasks jurisdictions of 75,000 people or greater to develop a management program to maintain listings of building in which hazardous materials are stored. The Department of Environmental Quality, Department of Health Services, Arizona Radiation Regulatory Agency, the Arizona Counter-Terrorism Information Center, Federal Bureau of Investigation, Bureau of Alcohol, Tobacco and Firearms also maintain significant information regarding facilities with hazardous materials.

The AZSERC has, over the past decade, performed a number of hazardous materials commodity flow studies to support local jurisdictions in the understanding of what transits their jurisdictions by road and rail. The prevalent commodities are gases, flammables and corrosives and while transportation has been relatively safe, there are accidents. Flammables and corrosives are the products that appear to be most heavily involved in these infrequent accidents.

Because of security considerations and because this Plan is not a controlled plan, the maps that would normally be included are not being included nor are listings of facilities subject to reporting under the Emergency Planning and Community Right to Know Act. That information, on request, is available through the Commission and members of the Commission staff support operations at the State Operations Center, when activated, to provide information on what may or may not be in/near disaster impacted areas. LEPCs are tasked to develop plans that address their respective facilities of concern and provide outreach to the public regarding procedures to be followed in the event of a chemical release.

Probability and Magnitude

Every day, hundreds of trucks with chemical tanks traverse the State on the thousands of streets, roads, and highways and dozens of chemical cargos cross the State on the railroads. These trucks and railcars constitute potential hazards on wheels. In addition, every day, the fixed facilities that store and use chemicals have the potential for accidents. During an accidental release of toxic chemicals or other emergencies where air quality is threatened, the toxics heavier than air settle on the ground and the people in proximity can breathe these toxics and be affected; the toxics lighter than air spread for several miles and impact distant people.

Comprehensive information on the probability and magnitude of hazardous material events across all types of sources (e.g., fixed facility, transport vehicle) is not available. Wide variations in the characteristics of hazardous material sources and between the materials themselves make such an evaluation very difficult. The probability and magnitude of hazardous materials incidents would best be resourced through the EPA's Risk Management Planning documents/off-site consequence analysis which is available at the AZSERC and at EPA and is shared with the LEPCs but is not made public because of regulatory constraints. A citizen can obtain information by following the guidelines established by EPA and the Department of Justice.

Luckily there have been only two major chemical incidents in the greater Phoenix metropolitan area in the last two decades (the greater probability area). Because of strides taken to minimize potentials for release from a facility (e.g. Risk Management Planning requirements of the Clean Air Act Amendments and OSHA's Chemical Process Safety Managements Standard of 29 CFR 1910.119), the transportation related incidents involving flammables (gasoline) and corrosives (sulfuric acid) substances has been mitigated and minimized.

Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Hazardous Materials Incidents are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-61: State CPRI Results for Hazardous Materials Incidents

Risk Due to Hazardous Materials Incidents					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
HAZMAT	Highly Likely	Negligible	< 6 Hours	< 24 Hours	**2.90**
	4	1	4	2	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-62: County CPRI Results for Hazardous Materials Incidents

County	**CPRI**
Cochise	2.69
Coconino (Profiled as Transportation Accidents)	3.20
Gila	3.17
La Paz	2.88
Pima	2.83
Yuma (Profiled as Transportation Accidents)	3.20
Average	**3.00**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Hazardous Materials Incidents are shown below.

Table RA-63: State Environmental CPRI Results for Hazardous Materials Incidents

Environmental Risk Due to Hazardous Material Incidents				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Likely	Limited	< 1 month	**1.8**
Water	Likely	Critical	< 1 month	**2.1**
Soil	Likely	Critical	<1 month	**2.1**
Average CPRI Environmental Risk Rating: 2 (max 3.6)				

The estimation of potential exposure to a hazardous material incident involving extremely hazardous substances (EHS) is accomplished by intersecting the human and facility assets with the point source and transportation corridor hazard areas. Transportation corridors identified include all Interstates, US, State and County roads. Structural losses due to EHS incidents are usually minor and are primarily focused on clean-up and decontamination.

The primary concern with EHS incidents is the human exposure, wherein a total population of 6,553,255 people, or 100% of the total State population, is potentially exposed to point source and/or transportation incidents. The potential for deaths and injuries are directly related to many factors including the type of chemical spilled, the prevailing wind pattern and speed, air temperature, humidity, and the response time. The potential for death and injury is highly likely given a large enough incident and proximity to populations. For any incident, displacement of people for at least one or more days is possible.

The table below provides a list of vulnerable communities which is based upon historic occurrences. Based upon previous occurrences mitigation measures may be of higher priority in communities with more hazardous material spill. Flammable and combustible liquids and corrosive materials are the most prevalent incidents type affecting local communities. The flowing map provides distribution of hazardous materials by incidents across Arizona by County.

Table RA-64: Communities Vulnerable to Transportation Incidents

City	# of Spills
Phoenix	504
Tucson	163
Tempe	125
Mesa	16
Kingman	15

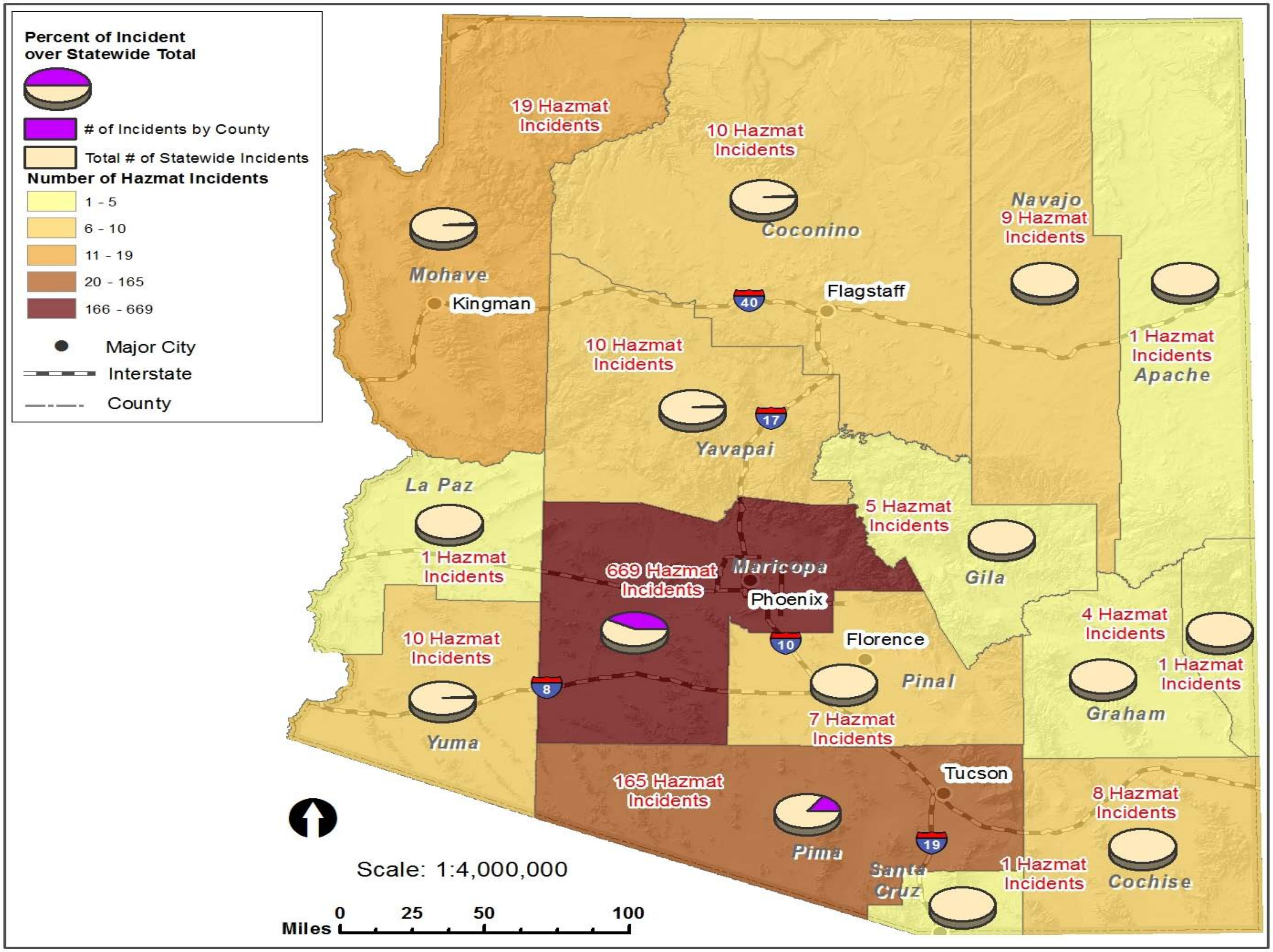
Source: USDOT Spill Data 2010 – 2013 https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/

Table RA-65: Number of Spill Incidents by Type

Material Type	Number of Incidents
Combustible Liquid	60
Corrosive Material	231
Explosive Fire Hazard	1
Explosive No Blast Hazard	3
Flammable – Combustible Liquid	445
Flammable Gas	22
Flammable Solid	3
Infectious Substance (Etiologic)	1
Miscellaneous Hazardous Material	30
Nonflammable Compressed Gas	44
Organic Peroxide	12
Other Regulated Material Class D	28
Oxidizer	32
Poisonous Materials	9
Spontaneously Combustible	1
Grand Total	**922**

Source: https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/

Map RA-11: Hazardous Material Incidents by County



Environmental Impacts

Like the range of magnitude, the environmental impacts of transportation accidents can vary greatly. In the case of a simple motor vehicle crash, train derailment, or aviation accident, the environmental impact is minimal. However, if the accident involves any type of vehicle moving chemicals or other hazardous materials, the impact will be considerably larger and may include an explosion or the release of potentially hazardous material.

Jurisdictional Vulnerability Assessment

In general, jurisdictions that are more densely populated are more vulnerable to hazardous materials incidents, as these areas are more likely to contain fixed facilities or be located along major transportation routes. The decision by a county to profile a hazard is one indicator of the presence of risk from that hazard.

State Facility Vulnerability Assessment

State facilities are no more or less vulnerable to hazardous materials incidents than the general population. There are some occupation-specific risks that may make some employees more vulnerable, though. For example, those working in along major transportation routed, or located near fixed facilities with chemical inventories.

Jurisdictional Loss Estimation

Jurisdictional losses due to transportation accidents will be proportional to the number of road miles in any given jurisdiction. Losses will likewise be proportional to the number and severity of vehicular transportation accidents. However, on a statewide level, ADOT estimates annual economic loss due to reportable motor vehicle crashes. In 2012, this total economic loss exceeded $2.9 billion. This equates to a per-person economic cost of $445.

State Facility Loss Estimation

The physical plant and facilities of Arizona are not likely to be directly damaged by a hazardous materials incident. However, these buildings could be rendered unusable for a period of time, which would lead to significant economic costs in lost productivity.

Consequences / Impacts

- **Public**
  The impact to the public from a Hazardous Materials (HAZMAT) spill or release can be catastrophic and have a long term negative impact on the public long after the incident is over. In the past, HAZMAT incidents have caused injury, disease and death. A HAZMAT release can have long term effects on natural resources and permanently restrict the public from utilizing these resources. These incidents can have a serious impact on air and water quality, property acquisition, fish and wildlife, agricultural and farming which in turn will present serious long-term problems for the public. As has been demonstrated in the past, HAZMAT events involving chlorine releases, radioactive waste material, volatile chemicals and toxic materials have proven extremely painful to the public with costs that go far and beyond the cost of human life. Without proper mitigation, education, planning and training, and the State's recent population growth, HAZMAT incidents will invariably have a deeper and more costly impact on the public.

  In Arizona, common factors that present themselves in HAZMAT incidents involve improper training, improper maintenance and the lack of appropriate emergency response plans and procedures to help mitigate the negative environmental effects of a HAZMAT incident.

  In 2007 alone, the State of Arizona had 3,838 facilities filing Tier II reports for chemicals on site. Of these, 1,472 reported extremely hazardous materials (EHS) on site at or above threshold planning quantities. Of these facilities on about 70% are in compliance with State requirements involving appropriate plans and procedures required to mitigate a negative event.

- **Responders to the Incident**
  The initial recognition of a HAZMAT incident is essential to effectively deal with the incident safely. Often the incident produces toxic clouds that drift and settle on the ground and in the drinking water systems causing extensive clean-up activities. Clean-up activities following HAZMAT incidents are often dangerous and expensive. It is not only the incident and the immediate effects, but people in the contamination zone and initial responders often suffer from long term physical and health problems due to the HAZMAT release. Environmental concerns do not end when the last responder leaves. A process of decontaminating effected ecosystems can take years and often pose additional health hazards to workers and volunteers involved in these efforts. Potential dangers include kidney disease, lung infections, various types of cancer and respiratory disease and failure. Long term risk of disease or illness could cost tax payers millions of dollars in long term recovery costs and rehabilitation not to mention legal costs associated with the incidents.

- **Continuity of Operations / Delivery of Services**
  The disaster preparedness plans, otherwise called Continuity of Operations (COOP) plans, establish guidance and procedures to ensure the execution of Arizona's mission essential functions. Due to the complex nature of HAZMAT incidents provision addressing personnel safety, ability to continue essential operations, protect critical components and assets; minimize damage and orderly response and recovery. The size and duration of a HAZMAT incident could seriously drain local capabilities and require additional support from HAZMAT responders from various areas. Numerous facilities that manufacture, ship and store extremely hazardous chemicals reside within cities limits or highly populated urban areas. These incidents could also have a significant effect on law enforcement as they try to secure an area, emergency medical systems as they try and move and treat injured and hospitals as they attempt to triage and treat persons contaminated with hazardous substances.

- **Property / Facilities / Infrastructure**
  See Section 1.1.1 and tables 1.1.1.1 and "Hazardous Materials Incidents: History" in the above section.

- **Environment**
  After a HAZMAT incident, the environment could have long lasting serious negative impacts. Agriculture, hydrology, urban settlements, economic activities and personnel health and welfare of the populace would all be impacted and in certain catastrophic events, severe loss of life, like those of Bopal, India and Chernobyl, USSR. Due to dwindling water resources in Arizona and random monsoons contamination of a water supply source could be devastating. The impact could be carried on for years as monsoon rains wash chemicals into the ground water and daily household water supply systems. Severe impact to the safety of the State's water supply will most likely result in public health, food supply and livestock issues. Dry contaminated soil could easily become airborne during the hot and windy season causing people and animals to breathe in toxins which could present serious medical problems in the future.

- **Economic / Financial Condition of Jurisdiction**
  Recovery and rebuilding cost, clean-up and recover, agriculture contamination, superfund site, law suites and long term medical issues as a result of a HAZMAT incident could easily lead to financial stress for the State of Arizona. The extent of the hardship will depend on the severity of the HAZMAT incident and areas affected. For instance, a serious release of Chlorine Gas from any rail car traveling through a metropolitan area could create a deadly plume, that if weather conditions allowed, could kill and seriously injure hundreds of people. This is evident in the proximity of certain chemical manufacture facilities located near schools and highly populated

residential and business areas. A serious release could easily have a financial impact on the facility and its employees, the surrounding community, surrounding businesses and the legal fallout from such an event.

- **Public Confidence in Jurisdiction's Governance**
  As the public understands most natural hazards, it does not accept the effects of a man made hazard and usually move swiftly to find someone or some government organization to blame. Knowing this, swift response, proper regulatory reporting and accurate planning are essential to mitigate the outcome of a HAZMAT incident. As proven in past HAZMAT incidents, these can be very devastating to the regulatory agency and even more devastating to the public. HAZMAT incidents on non-forgiving and jurisdictional governance can only respond swiftly and with all the resources and equipment needed to put an immediate end to the situation. If they fail to do so, public confidence will plummet and key government personnel will be held responsible for failure to protect the public from such an event.

Landslide / Mudslides

Introduction/History

Landslide is the generic term used to describe the downslope movement of earth materials due to gravity. Landslides may be triggered by earthquakes, extreme precipitation, flooding, or otherwise removing support from the slope. There are several different types of landslides that are categorized by the depth of failure, the type of material moved, the water content, and rate of movement (see below). Landslides may also cause flooding, either by displacing great volumes of water with surficial materials, or by damming a stream until it breaches and floods. Each physiographic region in Arizona is susceptible to various types of landslides.

The Colorado Plateau in the northern part of the state typically experiences landslides, debris flows, and rock falls along canyons, buttes, and mesas. These events may be triggered by rain, snow melt, or rain on snow events, and vary tremendously in size. Because this region is sparsely populated, the number of events is underreported. The US Geological Survey (USGS) classifies the Colorado Plateau as one of the four most landslide-prone places in the US (Godt, 1997).

The Transition Zone is the range of mountains that trends SE-NW across the state. Rock falls, landslides, and debris flows occur along the steep mountain slopes, canyons, and along road cuts. Extreme precipitation and snowmelt are the primary triggers here as well; however, flows may occur with less precipitation than usual in areas burned by forest fires. The number of events reported in this region has largely been restricted to those along highways because this region is also sparsely populated, with much of the land belonging to the US Forest Service or various tribes.

The Basin and Range Province occupies the southern portions of Arizona and is characterized by alternating valleys (basins) and mountains (ranges). Debris flows, rock falls, and landslides typically occur in the steep slopes of the ranges; however, the materials can be transported to the valley floors, and are frequently deposited at the base of slopes and at canyon mouths. Debris flows are the most common type experienced, and the area is especially vulnerable to post-fire debris flows. The fastest urban growth areas are along the mountain fronts in areas with past debris flow deposits.

The following are descriptions of various types of landslides/mudslides, which are followed by a graphic depiction of each.

<u>Rotational Landslide</u> – It's characterized by large blocks of material and a failure plane that is relatively deep. The movement of material moves straight or almost straight lines downhill. It occurs in relatively cohesive, homogeneous soils and rock. The soil mantle may be greater than five (5) feet thick, but sliding is not restricted to the zone of weathering. Failure commonly occurs along bedrock bedding planes that are deep-seated and dip in the same direction as the slope surface. In saturated conditions, incompetent clayey bedrock material may fail under overburden weight and high pore pressures, resulting in a deep-seated rotational-type failure.

<u>Translational Landslide</u> – Commonly are controlled structurally by surfaces of weakness such as faults, joints, bedding planes, and contacts between bedrock and overlying deposits.

<u>Block Slide</u> – A mass of soil and rock that moves along a straight failure surface without rotation or internal deformation in the landslide mass.

<u>Rockfall</u> – Quantities of rock falling freely from a cliff face. A rockfall is a fragment of rock (a block) detached by sliding, toppling, or falling, that falls along a vertical or sub-vertical cliff, proceeds down slope by bouncing and flying along ballistic trajectories or by rolling on talus or debris slopes. (Varnes, 1978)

Topple – The forward rotation out of the slope of mass of soil or rock about a point or axis below the center of gravity of the displaced mass. Toppling is sometimes driven by gravity exerted by material upslope of the displaced mass and sometimes by water or ice in cracks in the mass". (Varnes, 1996)

Debris Flow – Usually are characterized by long stretches of bare, generally unstable stream channel banks that have been scoured and eroded by the extremely rapid movement of water-laden debris. They commonly are caused by debris sliding or the failure of fill materials along stream crossings in the upper part of a drainage during high intensity storms. Debris flow is formed by the failure of water-charged soil and organic material down steep stream channels. They are often triggered by debris slide movement on adjacent hill slopes and by the mobilization of debris accumulated in the stream channels themselves. Debris flows commonly entrain large quantities of inorganic and organic material from the stream bed and banks. Occasionally, the channel may be scoured to bedrock. Once the momentum is lost, scoured debris may be deposited as a tangled mass of large organic debris in a matrix of sediment and finer organic material. Such debris may be reactivated or washed away during subsequent events. The erosion of steep debris slide-prone stream banks below the initial failure may cause further failure downstream.

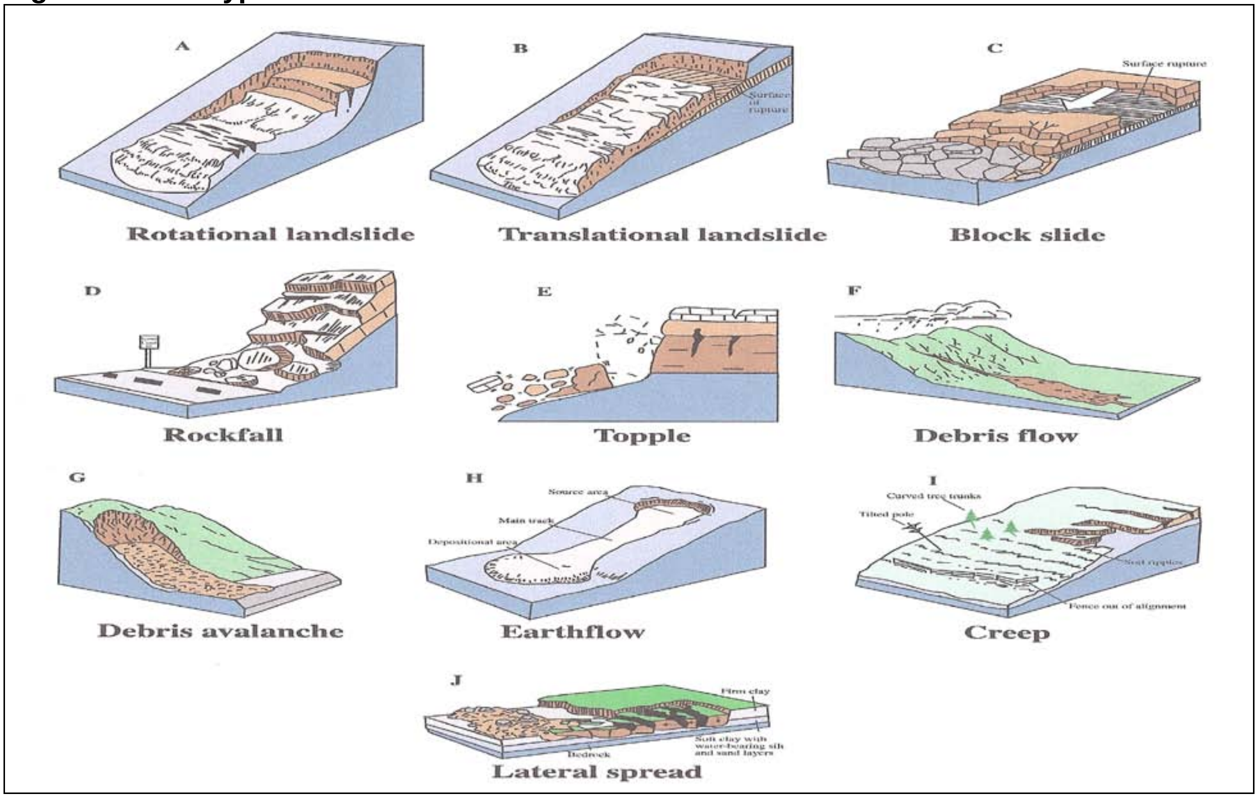
Debris Avalanche – A debris avalanche is caused when unstable slope collapses and debris is transported away from the slope. Large scale avalanches normally occur on very steep volcanoes. There are two general types of debris avalanches: those that are "cold" and those that are "hot". A cold debris avalanche usually results from a slope becoming unstable whereas a hot debris avalanche is the result of volcanic activity such as volcanic earthquakes or the injection of magma which causes slope instability.

Earthflow – It is a landslide resulting from a slow to rapid movement of saturated soil and debris in a liquid state. After initial failure, the earthflow may move, or creep, seasonally in response to destabilizing forces. Earthflows are composed of clay-rich materials that swell when wet, causing a reduction in friction between soil particles. When saturated, the fine-grained, clay rich matrix may carry larger, more resistant boulders with them in slow, creeping movements. Slide materials erode easily, resulting in gullying and irregular drainage patterns. The irregular, hummocky ground characteristic of earthflows is generally bare of trees. Failures commonly occur on slopes that are gentle to moderate, although they may also occur on steeper slopes where vegetation has been removed. Undercutting of the toe of an earthflow is likely to reactivate downslope movement.

Creep – Slow, imperceptible movement of soil and rock downslope. A sluggish form of mass wasting that sometimes moves as slowly as one centimeter per year.

Lateral Spread – "Spread is defined as an extension of a cohesive soil or rock mass combined with a general subsidence of the fractured mass of cohesive material into softer underlying material. (Varnes, 1996)

Figure RA-12: Types of Landslides



Diagrams A, B, D, and F are typical of the Colorado Plateau; Diagrams D, E, A, B, C, F, and I are typical of the Transition Zone; and diagrams F, D, A, and B are typical of the Basin and Range. (Diagram from USGS Fact Sheet 2004-3072.)

In March 1978, a landslide occurred on the flank of Camelback Mountain, in Phoenix, that practically destroyed a home (Harris/Pearthree, 2002). During the course of the 2006 Presidentially declared disaster 1660, over 259 debris flow initiation points (with fewer total flows due to coalescing channels in the upper parts of the watersheds) occurred in the Santa Catalina Mountains alone, destroying roads, blocking canyons, and filling one home with sediment. The 1887 earthquake near Bavispe, Sonora, Mexico caused rockfall throughout the state, and catastrophic landslides in the southeastern part of the State (Jenney/Reynolds, 1989).

In December 1995, a massive landslide blocked the Moenkopi Wash near Tuba City in Coconino County. The landslide deposit created an unstable dam and with the threat of an imminent flash flood impacting downstream communities, a Gubernatorial emergency was declared (ADEM, March 2003; Arizona Nat'l Guard, 1997). The town was evacuated until the threat passed and no deaths or injuries were reported. The Grand Canyon is also littered with landslides of various types that occasionally dam the river and collapse, causing flash floods and $7,762 in damages.

In July 2006, Southeastern Arizona experienced an extremely wet interval near the end of July 2006 that generated floods and numerous debris flows (sediment-rich slurries) in some of the mountain ranges of this region. Hundreds of debris flows occurred on steep mountain slopes and larger debris flows coursed down several canyons Sabino Canyon in the Santa Catalina Mountains and Coronado National Memorial in the southern Huachuca Mountains were temporarily closed due to debris flows and flood damage, and Mount Lemmon Highway was damaged in several places.

In March 2008, a rotational slump landslide buckled pavement on State Highway 87 between Sunflower and Rye, in the Slate Creek area. The southbound lanes of the four-lane divided highway were most severely affected. The road was closed for over a week and the southbound lanes were closed for several months while repairs were made (AZGS, 2008)

In January 2010, a large mudslide covered State Highway 87 about 2 miles south of Sunflower, causing closure of 4-lane roadway for several days. The mudslide was precipitated by major rainfall in the area during the January 18-22, 2010 flooding that ultimately resulted in the FEMA-1888-DR presidential disaster declaration.

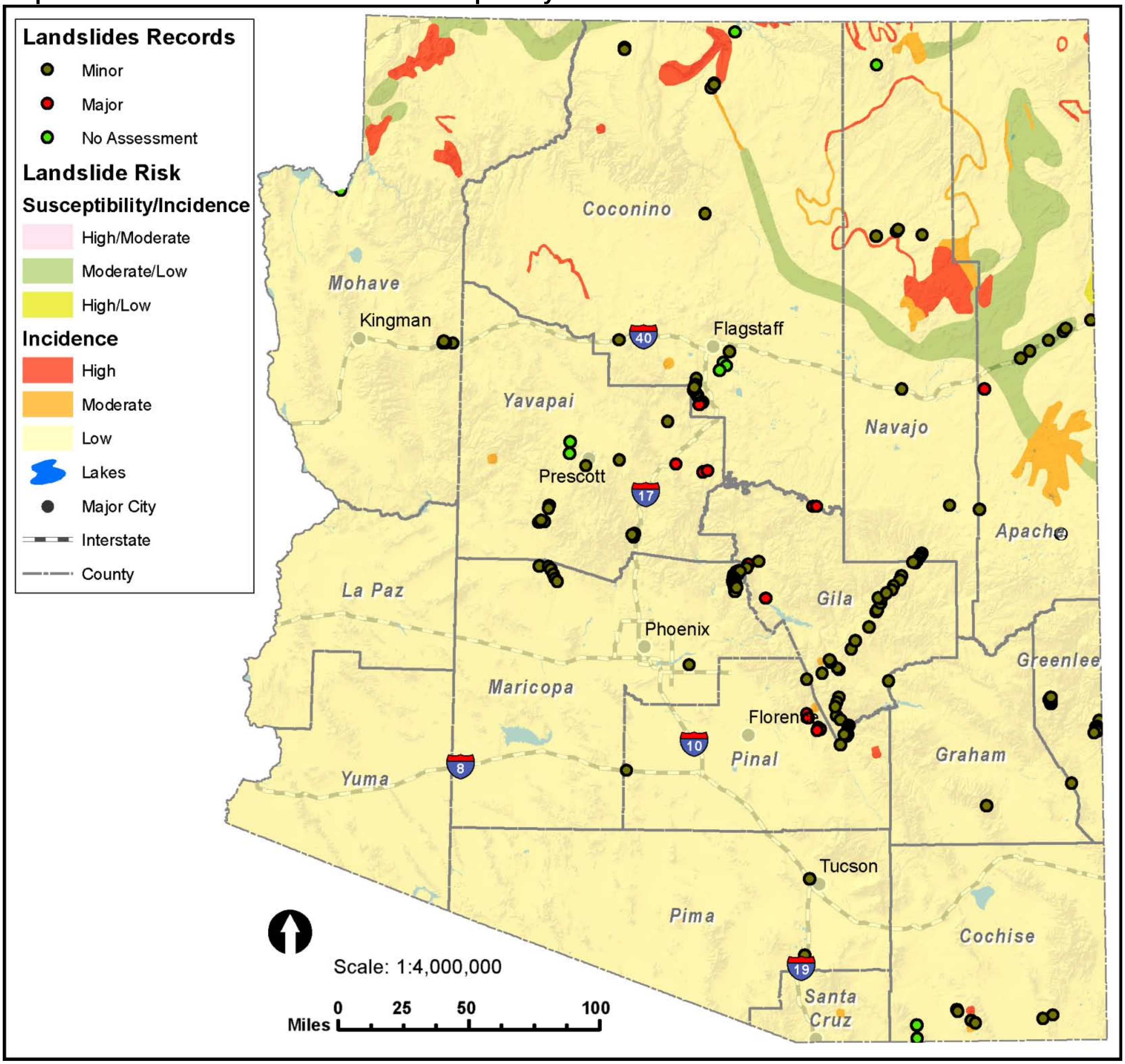
On Feb 20th, 2011 a section of the of mountain slope, which US route 89 was built upon, gave way and left large tears in the road. The entire 23 mile route has been closed and a detour is under construction known as the "Page Detour". In the meantime ADOT engineers will be examining the mountain and road bed to determine the cause of the slide.

The only other notable specific landslides identified were the widespread rock falls, rock slides, and avalanches reported throughout Arizona due to the 1887 earthquake in Sonora, Mexico. Huge blocks of rock are reported to have fallen throughout the State and the southeastern part of the State was severely affected by various forms of catastrophic down slope movement (Jenney & Reynolds, 1989).

Landslides in Arizona caused nearly $1 million in damage between 1980 and 1985 (in 1985 dollars), with the majority of the reporting coming from the Arizona Department of Transportation (Realmuto, 1985). However, a few large slides occurred on USFS land in Coconino County during that same time frame. Landslide risk is increasing as the population expands into previously uninhabited areas that are prone to slope failure.

Map 28 presents areas identified by the USGS as susceptible to landslides. Also shown are locations of historic landslides recorded by ADOT for the period of 1980 to 1985 (Realmuto, 1985) in addition to two major landslides that impacted US route 89 and Highway 87.

Map RA-12: Landslide Incidence and Susceptibility



Source: USGS – National Atlas of the United States of America, 2001 – ADOT, 2007 – AGIC, 2013– Baker, 2013
Note: the Map depicts landslide Events that were recorded by ADOT 1980-1985 and 2 recent that impacted highways.

Potential Secondary/Cascading Effects

Every slope carries the potential for collapse or landslide; in the broadest sense, a landslide is any downslope movement of soil, mineral or rock under the influence of gravity. Creep, which can occur on the shallowest of slopes, exhibits rates of movement on the order of 1-foot in several years. Rock fall along a vertical cliff can accelerate at a rate equal to that of gravity, 10-meters per second per second. Most landslides, of course, exhibit rates of movement between these extremes.

The nature of cascading events associated with landslides stems from the mass, volume, water content, soil | rock conditions, rate of movement, and environs in which the landslide occurs. (It is important to note, that landslides are commonly triggered by other events, e.g., an earthquake or flood, and thus may constitute a cascading event in their own right). At higher elevations in northern Arizona, snow avalanches should probably be considered as a special case of landslide.

The largest category of landslides and debris avalanche, result from sector collapse of an unstable volcanic edifice. The probability of sector collapse in Arizona is remote. There is, however, clear evidence that the east face of San Francisco Mountain, Flagstaff, Arizona, collapsed catastrophically between 0.43 and 0.22 million years ago. Such an event, while exceedingly rare, is potentially among the most catastrophic of events destroying or burying everything in its wake.

Common cascading events associated with landslides include:

- Damaged or destroyed transportation lines – roads, railways, rivers
- Flooding – resulting from damming of river or water displacement resulting from the landslide mass encroaching on a body of water -- natural lake, river, canal or reservoir
- Broken infrastructure – gas pipelines, water mains, sewer lines, utility lines, canals buildings
- Secondary landslides following a primary slide
- Defoliation which can lead to rapid erosion or further episodes of mass wasting

Probability and Magnitude

Most of the state is susceptible to landslides. High intensity or long duration precipitation may cause a previously stable slope to move. Even precipitation of medium intensity and short duration may cause instability in areas that have been severely burned by forest fires. Removal of support from the slopes where highways and roads are emplaced will continue to cause landslides, as will development up the mountainsides. Earthquakes may also cause landslides.

The landslides range in size and frequency, from small, nuisance events (minor shallow landslides, rockfalls) along roads or uninhabited areas, to large, fast-moving, destructive debris flows (commonly referred to as mudslides), with varying effects depending on location.

Vulnerability

The impacts from landslides can cause deaths and damages without warning, throughout many parts of Arizona. In the United States some of the economic factors that result from landslides include:

- Cost $3.5 billion a year in damages.
- Causes between 25 and 50 deaths annually.
- Reduction in real estate values and tourist revenue
- Lead to lost human, industrial, agricultural, and forest productivity
- Cause damage to the natural environment (USGS, 2005).

State-owned facilities most vulnerable to landslides/mudslides are the roadways and bridge/culverts along known debris flow areas. Losses are difficult to estimate given a lack of accepted standards, however, the State spends significant time and money removing and repairing landslide/mudslide occurrences along the state highways, and especially following precipitation events.

There are no local risk assessment data for landslide/mudslide and no risk assessment tables are provided.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Landslide/Mudslide are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-66: State CPRI Results for Landslide/Mudslide

Risk Due to Landslide/Mudslide					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Landslide/ Mudslide	Likely	Limited	< 6 Hours	< 6 hours	**2.65**
	3	2	4	1	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-67: County CPRI Results Landslide/Mudslide

County	CPRI
Yavapai	2.19
Camp Verde	1.85
Chino Valley	1.45
Clarkdale	2.45
Cottonwood	1.40
Dewey-Humboldt	1.85
Jerome	2.95
Prescott	3.40
Prescott Valley	2.20
Sedona	2.30
Unincorporated Yavapai County	2.10
Yavapai-Prescott Indian Tribe	2.10
Average	**2.19**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Landslide/Mudslide are shown below.

Table RA-68: State Environmental CPRI Results for Landslide/Mudslide

Environmental Risk Due to Landslide/Mudslide				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Possibly	Negligible	6 months+	**2.1**
Soil	Likely	Limited	6 months+	**2.7**
Average CPRI Environmental Risk Rating: 1.9 (max 3.6)				

Consequences / Impacts

- **Public**
  Our best historical records for the State do not indicate any injuries or fatalities due to landslides/mudslides. However, the risk to this hazard increases as the population expands into previously uninhabited areas that are prone to slope failure. Probably the most threatening aspect of this hazard to human life is rockfall/slide and toppling. Adding to that risk is the low warning time associated with slides. The risk to the public from these types of slides will be largely dependent on the size and location of the rocks/material falling, sliding or toppling.

- **Responders to the Incident**
  Similar to the impact to the public, the risk level to responders will be dependent on the size, magnitude and location of the activity. Responders to this type of event will typically be rescuing those that have been isolated or possibly injured by rockfalls/slides. Additionally, those tasked with cleanup of rocks/debris are susceptible to injury as these materials may be heavy and have the ability to cause great injury.

- **Continuity of Operations / Delivery of Services**
  Overall, landslide/rockslide is not a major threat to the state's ability to continue effectively functioning as our records do not indicate state assets in high probability areas.

- **Environment**
  Landslide events can result in substantial soil erosion and/or the loss of topsoil as well as contribute a significant amount of sediment to streams and can adversely affect fish habitat.

- **Economic / Financial Condition of Jurisdiction**
  Landslides in Arizona caused nearly $1 million in damage between 1980 and 1985, with the majority coming from the Department of Transportation. This data does not indicate a significant economic impact from damage to structures (residential or commercial). The State could suffer economic impact as a result of landslide in several ways including temporary or permanent closure of highways and railroads and damaged agricultural regions. The cleanup, repair and recovery in these cases can be costly and time consuming to a jurisdiction.

- **Public Confidence in Jurisdiction's Governance**
  As is typical of most natural hazards, swiftness of response is critical. Because of the nature of them, landslide/mudslide has the potential to be disruptive and costly to a jurisdiction. It is in the jurisdiction's best interest to keep the public well informed of the damage extent, status of repairs and provide realistic expectations. Doing so may have a positive impact on the public's confidence level by letting them know the situation is being resolved and is controlled. Lack of communication can be mistaken for lack of action, resulting in frustration, anger, negativity, etc.

Resources

Definitions
AZGS – Arizona Geological Survey
USGS – U.S. Geological Survey

Sources
Krieger, M.H., 1977, Large landslides, composed of megabreccia, interbedded in Miocene basin deposits, southeastern Arizona: U.S. Geological Survey Professional Paper 1008, 25 p., 4 sheets, scales 1:125,000, 1:12,000, and 1:6,000.

US Geological Survey, 2009, Landslides Hazards Program, online at http://landslides.usgs.gov/

References
Arizona Division of Emergency Management. March 6, 2003, *Current Open Disasters,* http://www.dem.state.az.us/r2m/Current%20Open%20Disasters%20.doc

Arizona National Guard.1997, A*nnual Report 1997 – Appendix F: Arizona Division of Emergency Management,* http://www.az.ngb.army.mil/AnnualReport97/annual report F.htm

Diaz, M., Gotee, B., 2008, *Preliminary Report on Highway 87 Landslide*. Online at http://www.azgs.az.gov/hazard_hwy87landslide_mar08.shtml

Godt, J.W., 1997, *Digital compilation of landslide overview map of the conterminous united states, 1982*. USGS, OFR 97-289.

Harris, R.C., & Pearthree, P.A., 2002, *A home buyer's guide to geologic hazards in Arizona*. AZGS, Down-to-Earth 13.

Holm, R.F., 2004, *Landslide preconditions and collapse of the San Francisco Mountain composite volcano, Arizona, into cold debris avalanches in Late Pleistocene*. Journal of Geology, v. 112, no. 3, p. 335-348.

Jenny, J. P. and S. J. Reynolds.1989, *Geologic Evolution of Arizona,* in Arizona Geological Society Digest, No. 17.

Pearthree, P.A., Youberg, A., 2006, *Recent Debris Flows and Floods in Southern Arizona*, Arizona Geology, Vol. 36, No. 3

Realmuto, V.J., 1985, Preliminary map of selected mass movement events in Arizona. AZGS, OFR 8

Youberg, A., Cline, M.L., Cook, J.P., Pearthree, P.A. and Webb, R.H., 2008, Geologic mapping of debris-flow deposits in the Santa Catalina Mountains, Pima County, Arizona. Arizona Geological Survey, Open-File Report 08-06, 49 p., 11 map sheets.

Levee Failure

Introduction/History

Levees have been part of the Arizona landscape for over a hundred years, first along rivers and streams and then in agricultural communities to protect fields and facilitate irrigation. In urban areas, flood control systems were constructed to increase the amount of developable land and to protect existing populations from flooding. The Federal Emergency Management Agency (FEMA) defines levees as “man-made structures, usually earthen embankments designed and constructed in accordance with sound engineering practices to contain, control or divert the flow of water so as to provide protection from temporary flooding.” Currently there is no State or Federal Levee Safety Program and no official levee inventory. It is anticipated that FEMA will institute a National Levee Safety Program in the near future and the State of Arizona plans to participate.

The structural integrity of levees with regard to flood protection has been discussed at a national level since the early 1980s but was elevated to a high priority after the collapse and breach of New Orleans’ levees after Hurricane Katrina in 2005. National flood policy now recognizes the term “levee” to mean only those structures which were designed and constructed according to sound engineering practices, have up to date inspection records and current maintenance plans, and have been certified as to their technical soundness by a professional engineer. FEMA has classified all other structures that impound water or impede flow but are not levees as “non-levee embankments,” such as the embankments associated with canals, railroads, and highways and irrigation berms and dikes.

Many levees and non-levee embankments intersect drainage features, impounding water on their upstream side as a result of storm events. FEMA urges communities to recognize that all areas downstream of levees and embankments are at some risk of flooding. There are no guarantees that a levee or embankment will not fail or breach if a large quantity of water collects upstream.

The table below is a summary of communities with levees accredited on FEMA’s Flood Insurance Rate Maps (FIRMs), which means the levees are shown as providing protection against the 1% annual chance flood on these maps.

Table RA-69: Accredited Levees and Watercourses

Communities with FEMA-Accredited Levees	Affected Watercourses
Clifton (Greenlee County)	San Francisco River
La Paz (La Paz County)	Colorado River
Pima County and communities	Big Wash Canada del Oro Rillito Creek Santa Cruz River
Maricopa County and communities	Agua Fria River Cave Creek East Maricopa Floodway Indian Bend Wash New River Pass Mountain Diversion Scatter Wash

Communities with FEMA-Accredited Levees	Affected Watercourses
	Salt River
Holbrook (Navajo County)	Little Colorado River
Winslow (Navajo County)	Ruby Wash
Yavapai County	Lynx Creek Dry Creek
Yuma County, La Paz County, Mohave County, and communities	Colorado River Gila River

Source: 2013 FEMA Mid-Term Levee Inventory Database.

There are no recorded failures of FEMA accredited levees for Arizona. There have, however, been several failures of non-levee embankments that were intended to function as levees as follows:

- In 1993. A 345 foot long section of Winslow Levee breached by overtopping and flooded Ames Acres, Bushman Acres, and Winslow Plaza subdivisions. The resulting flooding inundated 204 parcels and 140 structures, and required the evacuation of 900 people for as long as three (3) days. Fifty (50) homes were flooded up to four (4) feet deep. One business and one farm received damages. At McHood Park the recreational lake silted up. The Corps of Engineers repaired the breach during the flood at a cost of $350,050. Navajo County worked in 24-hour shifts to continue reinforcing the breach. (USACE, 1994 and NCDC, 2009).
- In 1993. The National Guard was called out to repair and reinforce the dike around San Lucy cemetery, near Gila Bend. Three houses north of Gila Bend were inundated from the rising water from Painted Rock Reservoir. Crops and fields were also inundated by floodwaters.
- In late 2004. A piping failure developed through Winslow Levee and was believed to have been caused by desiccation cracks, root channels, rodent burrows, a structural flaw, and other factors. Emergency repairs to the levee were estimated at $75,000. (Navajo County BOS, 2005).
- In 2005. Smaller dikes in the Town of Duncan broke allowing water to backup into the town. Damage occurred to a residence near Duncan High School, and a trailer downstream of the high school. Also, Hwy 70 near the high school was covered with four feet of water and the approach ramps to the highway were overtopped with flowing water. East Avenue and low lying areas in the west end of Duncan were evacuated on the evening of Saturday February 12, 2005. The railroad tracks also on the west end of Duncan were covered with water and power went out in the west side of the town. Damages were estimated at nearly $1.5 million. (NCDC, 2009).

Potential Secondary/Cascading Effects

The downstream or lateral flooding as a result of a levee breach or failure will depend on many variables, including the condition of the levee, the volume of water impounded by the levee, size of the watershed, duration and size of the storm event, and downstream slope, vegetation, and soil characteristics. Secondary effects of a breach or failure are similar to flood events, and could include moderate to severe erosion, flooded cropland, downstream sediment deposition and additional economic losses from downstream land-use restrictions.

Probability and Magnitude

The probability and magnitude of a levee failure or breach will be determined by many factors, the most important being the structural integrity of the levee, the design conveyance capacity and the magnitude of the storm causing the breach. Routine inspection and maintenance programs of these structures will ensure they provide the flood protection for which they were designed. Communities should plan accordingly with respect to residences and businesses that are located downstream, especially if the structure was not designed and constructed to provide flood protection (canal, highway, and railroad embankments). Residents should be notified that they could be flooded if the embankment failed or breached, and be aware that road closures can cause limited emergency vehicles access.

Vulnerability

No losses were estimated for levee failure due to a lack of defined hazard areas. It is anticipated that the new DFIRM data provided by FEMA will incorporate new flood zones that depict pre-levee floodplain areas as "Areas Protected by Levees". FEMA is currently in the process of revising its procedure for mapping behind non-accredited levees. Both processes will revise the way levees and their associated areas of protection will be mapped, but as of today the information is incomplete for the purpose of state-wide vulnerability assessment.

Several local jurisdictions have evaluated levees and that data is provided in the tables below. The compilation of risk assessment data from local plans indicates that approximately $2.2 billion in locally identified critical and non-critical facilities are exposed to a "high" flood hazard, with approximately $306 million in potential losses estimated. The table below provides a summary of local risk assessment and loss estimates based on limited information on levee failure.

Table RA-70: Levee Failure State Asset Exposure

County/ Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value	Asset Value Exposed to Hazard	Estimated Potential Losses
			(x $1000)	(x $1,000)	(x $1,000)
Apache	36,818	No Data	$4,353,765	No Data	No Data
Cochise**	59,633	No Data	$11,794,138	No Data	No Data
Coconino**	53,466	No Data	11823344	No Data	No Data
Gila	29,170	No Data	4854321	No Data	No Data
Graham	13,130	No Data	1935759	No Data	No Data
Greenlee	4,078	229	$510,861	$26,541	No Data
La Paz	16,200	No Data	$2,888,808	No Data	No Data
Maricopa	541,259	4,355	$164,894,580	$1,083,042	$216,608
Mohave	86,841	3,618	$14,065,296	$446,588	$89,318
Navajo	53,472	1,457	$7,668,023	$190,216	No Data
Pima**	440,794	954	$96,840,841	$332,011	No Data
Pinal	85,740	1,092	$13,472,739	$135,466	No Data
Santa Cruz	14,217	No Data	$3,098,495	No Data	No Data
Yavapai	87,895	No Data	$16,149,585	No Data	No Data
Yuma	68,384	No Data	$12,584,649	No Data	No Data

Source: Data was compiled from AZ county hazard mitigation plans.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Levee Failure are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-71: State CPRI Results for Levee Failure

Risk Due to Levee Failure					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Levee Failure	Possible	Limited	< 6 hours	< 6 hours	**2.8**
	4	2	4	1	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-72: County CPRI Results for Levee Failure

County	CPRI
Apache	N/A
Cochise	N/A
Coconino	N/A
Gila	N/A
Graham	N/A
Greenlee	3.23
La Paz	N/A
Maricopa	1.79
Mohave	1.9
Navajo	2.57
Pima	1.67
Pinal	1.91
Santa Cruz	N/A
Yavapai	N/A
Yuma	N/A
Average	**2.2**

Source: AZ county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Levee Failure are shown below.

Table RA-73: State Environmental CPRI Results for Levee Failure

Environmental Risk Due to Levee Failure				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Limited	< 1 month	**1.2**
Soil	Unlikely	Limited	< 1 month	**1.2**
Average CPRI Environmental Risk Rating: 1.1 (max 3.6)				

Consequences / Impacts

- **Public**
  The public affected by a levee failure or breach are generally those that are located downstream or alongside the levee. Impacts are similar to those of sudden flood events or dam failures, namely property loss and damage, personal injury, and possible fatalities. Proximity to the structure, potential warning time, and planned evacuation routes should all be considered by communities with levees.
- **Responders to the Incident**
  Post-flood clean-up activities often pose hazards for workers and volunteers. Potential dangers include electrical hazards, carbon monoxide exposure, musculoskeletal hazards, heat or cold stress, motor vehicle-related dangers, fire, drowning, and exposure to hazardous materials. Because flood disaster sites are unstable, clean-up crews might encounter sharp debris, biological hazards, exposed electrical lines, blood or other body fluids, and animal and human remains. Responders are prone to the same dangers the general public is, but at a higher level as they may be putting themselves in harm's way by performing rescue activities.
- **Continuity of Operations / Delivery of Services**
  Any critical facilities damaged or hindered as a result of flooding from a levee breach or failure would impact continuity of operations and delivery of services. The degree of disruption would depend on the severity of the flooding and how much damage critical facilities sustain.
- **Environment**
  Flooding from any source has adverse effects on communities and their residents and is disruptive to economic activities. Water supplies threatened by flood events can become contaminated, resulting in public health, food supply and livestock issues. Besides being a detriment, however, flooding can provide some environmental benefits such as increasing soil fertility and aquifer recharge.
- **Economic / Financial Condition of Jurisdiction**
  The extent of the hardship will depend on the severity of the event and specific areas affected downstream of the levee breach or failure. Recovery, rebuilding, and lack of infrastructure are a few of the economic costs affected jurisdictions will suffer.
- **Public Confidence in Jurisdiction's Governance**
  Emergency response time, efficiency and communication are critical to maintaining public confidence during and after a flood event. Power outages are likely and travel may be hindered due to flood waters, debris and blocked roads. Sharing information and details with the public about a power outage, for instance (damaged or complete loss of equipment as opposed to simple repair) allows residents to better understand the time it takes before power and services

are restored. Keeping the public well informed as to the extent of damage, status of repairs and providing realistic expectations may have a positive impact on the public's confidence level. Lack of communication can be mistaken for lack of action, resulting in frustration, anger, and unrest.

Resources

Definitions

Levee – man-made structures, usually earthen embankments, that were designed and constructed in accordance with sound engineering practices to contain, control or divert the flow of water so as to provide protection from temporary flooding.

Dike/Berm – earthen embankment that is usually constructed to protect agricultural fields or other areas from flooding. Berms and dikes are not usually designed and constructed using engineering practices.

Non-Levee Embankments – embankments that impound or redirect storm runoff as a secondary effect to their primary function. Examples include, canals, highways, railroads. FEMA also includes non-accredited dikes and berms in this category as well.

Sources

FEMA - http://www.fema.gov/plan/prevent/fhm/lv_intro.shtm

Navajo County, Board of Supervisors, April 21, 2003 BOS Meeting Minutes

NCDC Storm Events Database - http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

References:

U.S. Army Corps of Engineers, 1994, *Flood Damage Report, State of Arizona, Floods of 1993*

Severe Winds

Introduction/History

Atmospheric or seasonal storm events are general accompanied by flooding and/or severe winds which cause extensive damage across the State. The 2007 Arizona State hazard mitigation plan included Monsoon, Thunderstorm/High Winds, Tornado/Dust Devils, and Tropical Storms/Hurricanes as uniquely identified hazards. Each of these hazards has been eliminated from the State Hazard Mitigation Plan, and the damaging effects of severe winds are now incorporated and addressed in this section.

Severe winds result from extreme pressure gradients (such as the Santa Ana winds in southern California), or from thunderstorms. Thunderstorms occur in Arizona in all seasons, and are associated with cold fronts in the winter, monsoon activity in the summer, and tropical storms in the late summer or early fall. In Arizona, thunderstorms occasionally spawn tornadoes, which also cause severe wind damage. To date, Arizona has not experienced anything higher than an F3 category tornado, but has experienced many F0, F1, and F2 tornadoes (refer to Fujita Tornado Scale below). According to the National Climatic Data Center (NCDC), there were 234 tornadoes ranging from F0 to F3 on the Fujita scale recorded across Arizona between 1950 and 2013. The total property damage was approximately $47.9 million with 3 fatalities and 147 injuries. Total crop damage was approximately $30,000. As shown, The Fujita scale ranks tornados by wind speed, with F0 having winds less than 73 mph, F1 has winds between 73 and 112 mph, F2 has winds between 113 and 157 mph, and F3 has winds between 158 and 206 mph. Since 1950 there have been three F3 tornadoes in Yavapai, Maricopa and Coconino Counties. There have also been a total of fifteen F2s reported in Arizona with six in Maricopa County, six in Coconino County, two in Pima County and one in Yuma County. Tornados have been reported in all counties except Graham and Greenlee with the most tornados (58) reported in Maricopa County. The other highly populated counties of Coconino, Yavapai, Navajo, Pima and Pinal each had at least 14 tornados (NCDC Storm Events Database, searching 1950-2012).

Table RA-74: Fujita Tornado Scale

Category	Wind Speed	Description of Damage
F0	40-72 mph	Light damage. Some damage been seen to poorly maintained roofs; unsecured lightweight objects, such as trash cans, are displaced.
F1	73-112 mph	Moderate damage. Minor damage to roofs occurs; windows are broken; larger and heavier objects become displaced; minor damage to trees and landscaping can be observed.
F2	113-157 mph	Considerable damage. Roofs are damaged; manufactured homes on nonpermanent foundations can be shifted off their foundations; trees and landscaping either snap or are blown over; medium-sized debris becomes airborne, damaging other structures.
F3	158-206 mph	Severe damage. Roofs and some walls, especially unreinforced masonry, are torn off structures; small ancillary buildings are often destroyed; manufactured homes on nonpermanent foundations can be overturned; some trees are uprooted.
F4	207-260 mph	Devastating damage. Well-constructed homes, as well as manufactured homes, are destroyed; some structures are lifted off their foundations; automobile sized debris is displaced and often tumbles; trees are frequently uprooted and blown over.

Category	Wind Speed	Description of Damage
F5	261-318 mph	Incredible damage. Strong frame houses and engineered buildings are lifted from their foundations or are significantly damaged or destroyed; automobile sized debris is moved significant distances; trees are uprooted and splintered.

Source: FEMA, 1997.

Table RA-75: Tornado Occurrences

Magnitude	Number	Deaths	Injuries	Property Damage	Crop Damage
F3	3	0	0	$202,530	$0
F2	15	2	66	$35,000,000	$0
F1	64	1	69	$12,185,430	$30,000
F0	120	0	0	$404,900	$0

Source: Data compiled from the National Climatic Data Center (1950-2012)

In addition to tornadoes, another severe wind event generated by thunderstorms is the downburst. Downbursts are columns of air moving rapidly downward through a thunderstorm. When the air reaches the ground, it spreads out in all directions, creating horizontal wind gusts of 80 mph or higher. Downburst winds have been measured as high as 140 mph and have the potential to generate a new thunderstorm cell. Downbursts are called macrobursts when the diameter is greater than 2.5 miles, and microbursts when the diameter is 2.5 miles or less. Downbursts can be either wet or dry, meaning they either contain precipitation that continues to the ground, or the precipitation can evaporate on the way to the ground, decreasing the air temperature and increasing the air speed. In a microburst the wind speeds are highest near the location where the downdraft reached the surface, and are reduced as they move outward due to the friction of objects at the surface. Typical damage from microbursts includes uprooted trees, downed power lines, mobile homes knocked off their foundations, block walls and fences blown down, and porches and awnings blown off homes.

Thunderstorms are also capable of producing straight line winds at speeds of 75 mph or higher. As thunderstorms reach the mature stage, cold air downdrafts reach the ground and move outward from the storm, creating straight line surface winds. In the most extreme case, this would be a microburst or macroburst as discussed above. However, these winds tend to be sustained and are frequently responsible for generating dust storms and sand storms, reducing visibility and creating hazardous driving conditions.

According to NCDC data, at least 733 significant thunderstorm events were identified in Arizona between 1950 and 2012. Most of the significant thunderstorm events were identified using the National Climate Center (NCDC) Storm Event Database, which has a large number of well-recorded events from approximately 1950 forward. For all 733 events, 1 death, 34 injuries, and $86.5 million in damages were recorded.

The Spatial Hazard Events and Losses Database for the United States (SHELDUS) is another source that includes storm data information. Currently, SHELDUS data contains only those events that generated over $50,000 in property or crop damage or resulted in at least one fatality. Future releases of SHELDUS will remove those thresholds and will include all reported storm events. From 1959 - 2011, the SHELDUS database recorded a total of 1,527 severe weather events that include wind damages. More specifically, 429 of those events were considered severe wind events, where the primary contributor of reported damage was caused by wind. The 429 severe wind events resulted in 54 fatalities, 512 reported injuries, $526,500 in crop damage and approximately $31 million in estimated property damages.

Some of the severe wind events identified in the NCDC and SHELDUS databases include the following:

- September 2, 2012. Monsoon moisture fueled another outbreak of thunderstorms over the Mojave Desert. Some storms produced flash flooding and/or severe weather. The front windows were broken out of a retail store, injuring one person. Numerous trees and power poles were blown down, and about 30 homes had wind damage to the roofs, mainly in the Plantation Drive area.
- September 10, 2011. Strong thunderstorm winds occurred on Tucson's south side for the second day in a row, downing numerous power poles, electric lines, street signs, and trees. As many as 25,000 were left without power. One power pole was downed on a trailer leading to the evacuation of the trailer park near East Drexel and South Country Club Roads. Another Tucson resident woke up to a power pole entering the dwelling. Part of a roof was also blown off a residence on Valencia Road, blowing across the road into another home damaging the roof. Damages were estimated to exceed $500,000 (NCDC Storm Event Database).
- September 24, 2011. Isolated to scattered showers developed across the central Arizona deserts during the evening hours on September 24th. No lightning was reported in the greater Phoenix area, however the very dry lower atmosphere allowed strong gusty winds to develop near the showers and associated virga. A local utility company reported that power lines were downed on Sherman Street between 19th Avenue and 23rd Avenue, and resulted in the loss of power to 1,100 customers. The damaging winds were sub severe and according to radar estimates and surrounding observations ranged from 40 to 45 mph. However, damage to the power lines was estimated at nearly $30,000 (NCDC Storm Event Database).
- January 21, 2010. Three (3) large trees were blown over at Bell Road and 16th Street. A large tent at the Russo Steele Auction in Scottsdale near Mayo Blvd and Scottsdale Rd was destroyed and blown into nearby State Highway Loop 101 when winds collapsed the tent onto many classic cars. There was also small damage at a nearby Barrett Jackson Auction. Three minor injuries reported and losses were estimated to exceed $1.5 million. In Kingman, thunderstorm winds snapped 20 power poles, bent several stop signs at 45 degree angles, and tore a carport off a home and wrapped it around a utility pole. A spotter measured a gust of 101 mph. Damages were estimated to exceed $200,000 (NCDC Storm Event Database).
- August 28, 2008. A series of strong thunderstorms moved across central and eastern Maricopa County with winds up to 85 mph, uprooting hundreds of trees and power lines, damaging aircraft and terminal buildings, blowing windows out of high rise buildings, causing $20 million in property damage, fortunately no deaths were reported (NCDC Storm Event Database).
- July 21, 2008. Microburst winds took down a total of 55 power poles in Mesa, leaving as many as 12,000 SRP customers without power. About 31 homes were damaged at a trailer park on North Recker Road, with 4 roofs blown off. On Southern Avenue near Power Road, 15 poles were knocked down with lines impacting 7 vehicles, including a bus. There were 2 reported injuries with one attributed to cuts from broken glass. Total damages were estimated to exceed $1.0 million (NCDC Storm Event Database).
- June 21, 2008. Strong outflow winds from a thunderstorm complex caused severe winds across the Douglas area. Strong winds blew down a storage shed in Douglas, knocked down several trees and caused a partial roof collapse. Damages were estimated at $50,000 (NCDC Storm Event Database).
- August 22, 2006. Strong thunderstorm winds, probably from a microburst, knocked down approximately 50 power poles in Glendale, just west of Phoenix, leaving 18,000 people without

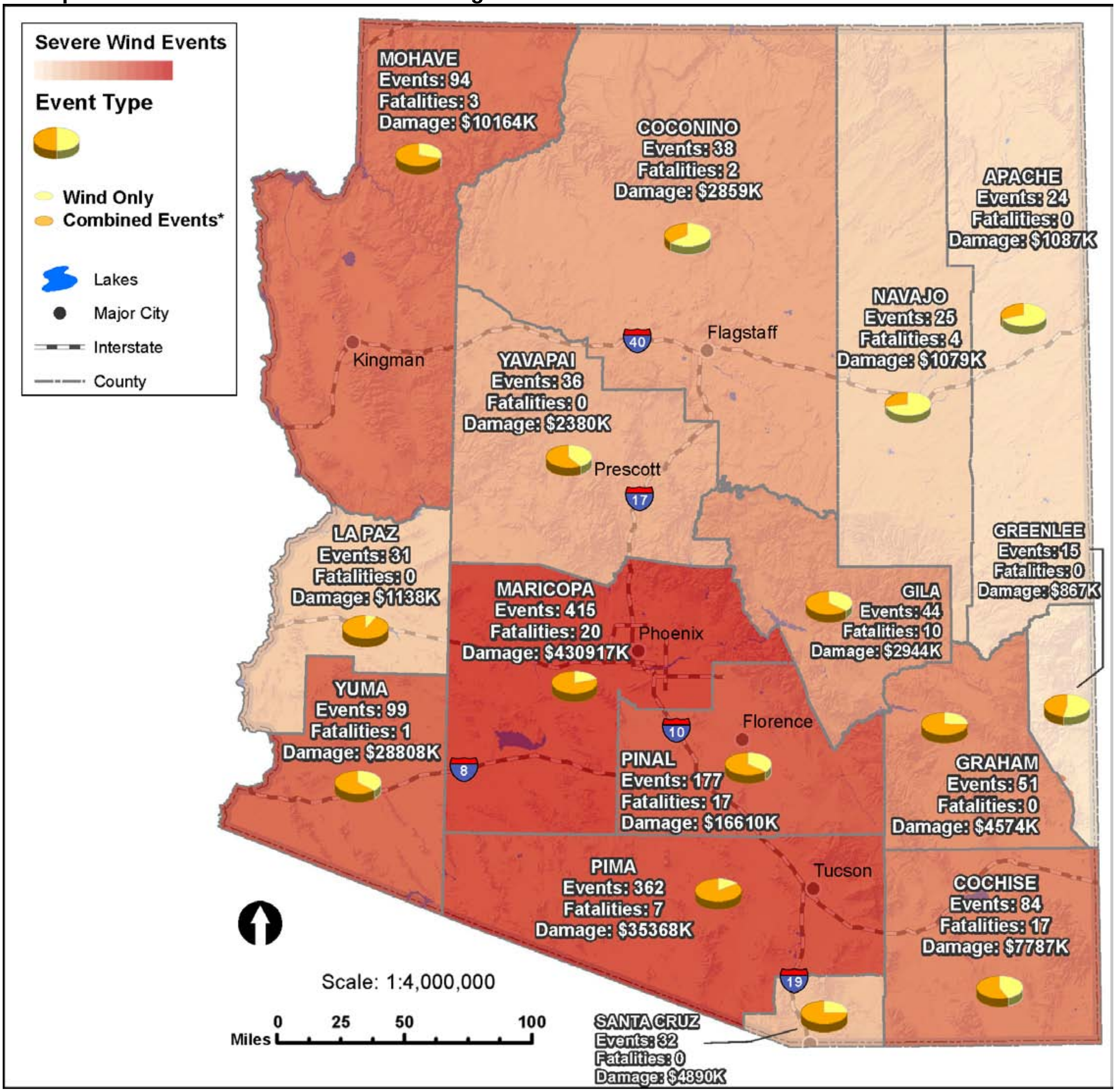
power and causing $200,000 of property damage. Shingles were torn off roofs and flagpoles were snapped (NCDC Storm Event Database).

- July 14, 2002. A second microburst event struck Sky Harbor Airport at the Postal facility and the West economy parking lot. A large thunderstorm complex, with strong microburst winds estimated at 100 mph struck Sky Harbor International Airport. Southerly winds and dense blowing dust initially spread across the East valley and converged with a fast-moving thunderstorm in North Phoenix. These merging systems developed into a severe thunderstorm with winds that uprooted trees, took down power poles and damaged homes and businesses near the airport. Several hangars sustained major damage. Flying debris damaged five commercial aircraft, several private planes and hundreds of cars in the nearby parking lots. Numerous flights were diverted during the overnight hours due to the debris that was scattered on the runway. Property damage was reported at $30 million (NCDC Storm Event Database).
- July 14, 2002. Two (2) microbursts struck the Phoenix area. Winds from the first microburst heavily damaged the Arizona Public Service power sub-station at 7th Ave & Thomas. Widespread damage was reported across the greater Phoenix metropolitan area caused by the storm's high winds and heavy rainfall with up to 2 inches in 90 minutes. Utility companies reported that 22 power poles were downed, leaving at least 47,000 homes and businesses without electricity for many hours. Homes in Scottsdale and Ahwatukee were struck by lightning and set on fire. The microburst caused an estimated $20 million damages (NCDC Storm Event Database).
- July 14, 2001. A microburst hit Scottsdale and Tempe with very strong winds and heavy rain. Many homes and businesses sustained damage, with at least 19 power poles blown down. One pole landed on a vehicle near Scottsdale and Indian Bend roads, killing the driver. About 6,000 residents were left without power, including the nearby Radisson Resort. Winds ripped the roofs off four homes in the McCormick Ranch area, and dumped them up to two blocks away. Numerous trees were uprooted. A total of 1 fatality and $5 million property damage were reported (NCDC Storm Event Database).
- September 19, 1999. Microburst winds struck the Desert Sands Trailer Park, destroying at least 14 homes and damaging 340 homes. Over 200,000 customers lost power after more than 40 power poles were snapped by the winds and rain. Talley Industries, on Greenfield Road received about $500,000 in damage as a large portion of the roof was removed by wind. A large truck was overturned near 80th Street and Baseline Road. Trees were uprooted in nearby Gilbert. A total of 2 injuries and $3 million property damage were reported (NCDC Storm Event Database).
- August 14, 1996. Every town in the north and western half of the Phoenix Metropolitan Area reported some damage due to a severe thunderstorm and microburst. Severe thunderstorms moved from Crown King rapidly southwestward across the west valley, producing widespread damaging winds and very heavy rainfall. The hardest hit areas were in northwest Phoenix, Glendale, and Peoria. Other towns that sustained damage were Sun City, Surprise, El Mirage, Tolleson, Avondale, Goodyear, and Buckeye. Approximately 400 power poles were knocked down throughout these towns, 100 owned by SRP and 300 owned by APS. An Arizona record wind gust of 115 miles per hour was recorded at the Deer Valley Airport. There were from 70,000 - 75,000 homeowner claims and an estimated $160 million in damage. Numerous minor injuries were also recorded (NCDC Storm Event Database, National Weather Service - Phoenix).
- August 5, 1993. A severe thunderstorm in Avondale resulted in one (1) injury and $5 million worth of damages. Strong winds from nearby thunderstorms exceeded 50 mph in many areas of the Valley. Homes and businesses sustained damage, trees were uprooted and power lines were downed. Arizona Public Service reported 10,000 customers without power. An 8-year-old boy in Avondale was severely injured after a window burst and glass cut his jugular vein. The roof of a convenience store was blown off, as well as some damage to a church and an

elementary school. A one (1) mile section of a 69,000-volt power line near Perryville was knocked down. High winds blew tree limbs onto power poles and took shingles off several homes (NCDC Storm Event Database).

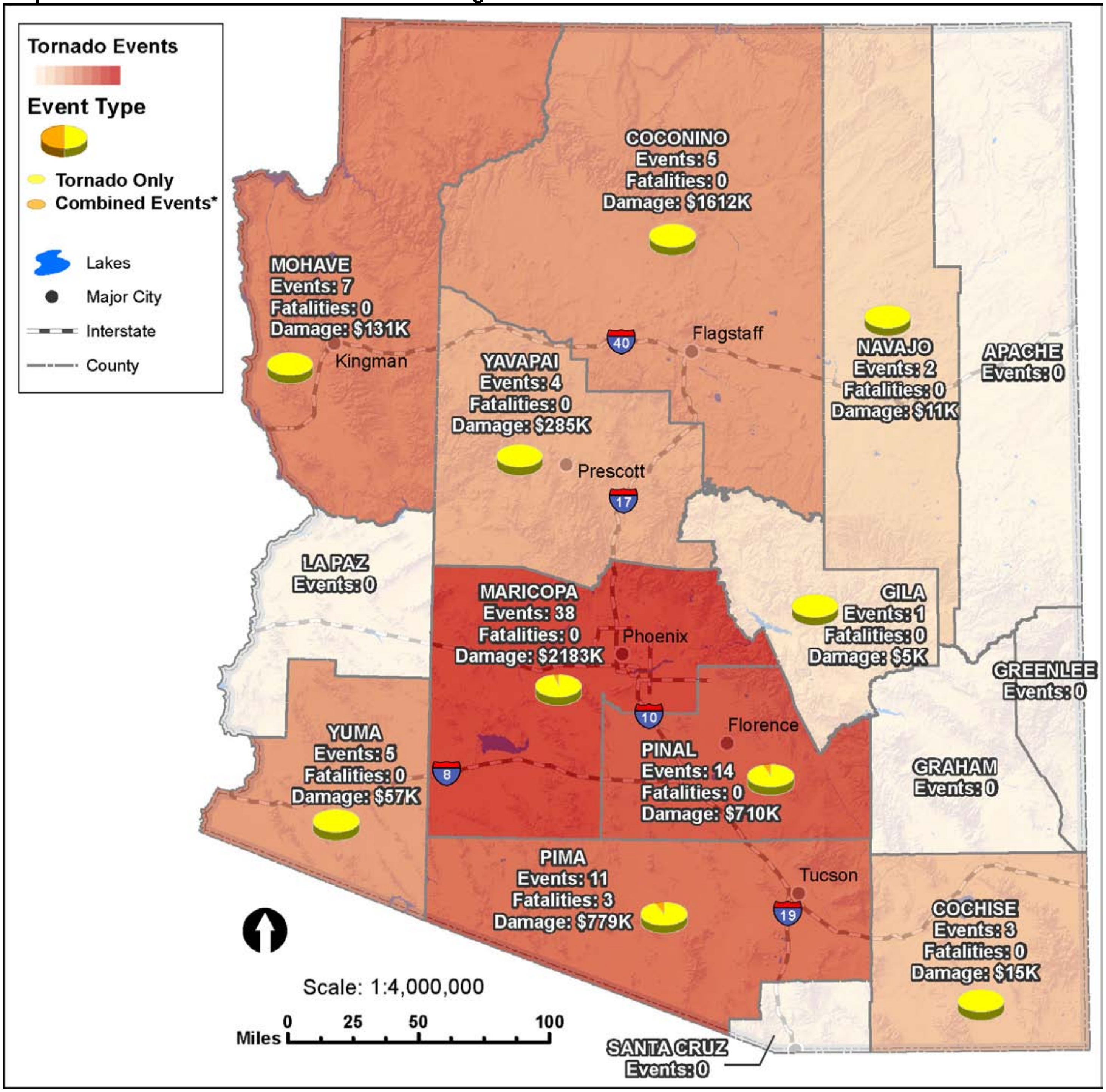
- June 26, 1990. A severe thunderstorm in Gila County caused six fatalities (NCDC Storm Event Database).
- August 27, 1988. A severe thunderstorm caused two (2) deaths and injured 17 in Pinal County (NCDC Storm Event Database).

Map RA-13: Severe Events of Wind Damage



Map 1 is a depiction of the number of severe wind events, fatalities, and damages tabulated by county that have impacted the state from 1959 to 2011, as compiled by SHELDUS.

Map RA-14: Severe Events of Tornado Damage



A depiction of the number of tornado events, fatalities, and damages tabulated by county that have impacted the state from 1959 to 2011, as compiled by SHELDUS. Combined events include tornado events that also involved an additional weather event such as flooding, thunderstorms or hail.

Potential Secondary/Cascading Effects

The most common secondary effect of high wind events is power outages from downed power lines. Power outages are a serious consequence because most of these high wind events are associated with summer thunderstorms. The lack of power for air conditioning and refrigeration leaves many people at risk for heat stress and heat stroke. Power outages may last from a few hours to several days, depending on the number of power lines down, their locations, and the voltage of the transformers that may have been damaged. Another common secondary effect of high winds is dust storms and/or sand storms reducing visibility on roadways.

Probability and Magnitude

Most Arizona tornadoes occur from March through October, with nearly all being category F0 and F1 on the Fujita scale. Only 15 F2 and three F3 tornados have been reported in Arizona since 1950. Compared to Oklahoma which receives on average 7.5 tornadoes annually, the highest state rate of occurrence per 10,000 state square miles, tornadoes are rare in Arizona, occurring at a rate of 0.3 annually per 10,000 state square miles. The State experiences less than three F0 tornadoes per year on average and less than two F1 or stronger tornadoes per year on average, between 1971 and 2012.

Most high wind events are associated with thunderstorms; in fact the NCDC Storm Event Database combines High Wind events with Thunderstorms in their search criteria. Thunderstorms occur throughout the year in Arizona, but are most common during the monsoon season, the seasonal wind shift that brings a dramatic increase in moisture. One thunderstorm feature, microbursts, generate localized, straight-line winds reaching from 60 to over 100 mph. Microbursts are quite common in Arizona, cause significant damage and are frequently the cause of high wind events. On rare occasions thunderstorms can develop much larger “macroburst” winds that have an affected outflow area of at least 2.5 miles wide and peak winds lasting between 5 and 20 minutes. Intense macrobursts may cause tornado-like damage (NWS Phoenix). Macrobursts also frequently create dust or sand storms that can travel a hundred miles or more, causing hazardous driving conditions.

The probability of a severe thunderstorm with high winds occurring, increases as the average duration and number of thunderstorm events increases. The NWS collects information on the number of thunder days (days with a thunder clap), number and duration of thunder events, and lightning strike density. Unfortunately these data are only available at the NWS forecast office sites and other airport locations. The airport locations have too short of a record to determine the geographical extent of thunderstorms. The Planning Team explored the use of a lightning flash density map as a proxy for the geographical distribution of thunderstorms. However, the lightning density is most extreme in the higher elevations, which in most cases are not areas most at risk for wind damages associated with thunderstorm events, with the exception of lightning-caused wildfires. The lightning flash density map did not adequately reflect the thunderstorm risk in the lower deserts. Instead, the Planning Team chose to map the average annual number of thunderstorm damage reports by county, as noted in the NCDC Storm Event Database between 1970 and 2010. The majority of storm damage reports are in the major urban areas of metropolitan Phoenix, Tucson, Yuma, Prescott, Kingman and the lower Colorado River communities of Lake Havasu & Bullhead City in Mohave County. While severe thunderstorms occur everywhere in the State, the population centers are the most at risk from storm damage.

The duration of thunderstorms in Arizona is among the longest in the nation. An area stretching northwest from Flagstaff to the junction of the Arizona, Utah, and Nevada borders has an average annual thunderstorm duration of 110-130 minutes. The minimum average duration time for thunderstorms in Arizona is 70 minutes, although individual storm cells may last less than 30 minutes before a new cell propagates.

Despite the long duration time, the highest number of thunderstorms on average in Arizona is 70-80 annually, again concentrated north of Flagstaff to the Arizona-Utah border. This is significantly lower than in the Southeastern US, but is largely due to the concentration of most thunderstorms in Arizona during the summer monsoon season.

Lightning strikes are another indicator of thunderstorm hazard. Two concentrations of lightning strikes are apparent in one again in northern Arizona and another in southeastern Arizona which, respectively, have 14-16 and 12-14 lightning strikes per square kilometer annually.

The American Society of Civil Engineers (ASCE) has identified a 3-second wind gust speed as the most accurate measure for identifying the potential for damage to structures, and is recommended as a design standard for wind loading. Most of Arizona has a design 3-second gust wind speed of 90 mph, indicating relatively low levels of risk from severe winds (ASCE, 1999). However, parts of Coconino and Navajo Counties have been designated a special wind region which should be examined for unusual wind conditions and given special consideration for design wind speeds. ASCE recommends consultation with a wind engineer and additional measures specified in local building codes.

Likewise, FEMA identifies most of Arizona in design wind speed Zone I. In this zone, a design wind speed of 130 mph is recommended for the design and construction of community shelters. FEMA also specifies the same special wind region covering parts of Coconino and Navajo Counties (FEMA, July 2000).

Vulnerability

In Arizona, the annual probability of severe winds are highly likely, the magnitude/severity is typically critical, the warning time is less than 6 hours and the duration is usually less than 24 hours. These factors resulted in a CPRI rating of 3.50 out of a maximum possible of 4.0

The entire state is assumed to be equally exposed to severe wind hazards although the risks is much greater in the more populated urban areas due to the amount of exposure. Typically, individual incidents are fairly localized and damages associated with individual events are relatively small. As previously summarized, the State has been impacted by at least 429 severe wind events (SHELDUS, 2011), with 512 reported injuries and $31 million in estimated property damages. The National Weather Service estimates that the state typically endures an average of 60 to 70 thunderstorm events per year, however not all events produce damaging winds.

Damages to state-owned critical and non-critical facilities are difficult to estimate without more detailed data on individual building type, construction material, and building size. According to the technical documentation for the wind loss component of the hurricane module of the HAZUS MH program, annualized building losses for wind speeds likely to be present in Arizona are generally less than 0.1% and in most cases, negligible (FEMA, 2009). The HAZUS MH program currently does not include wind damage data sets for Arizona, although that is an intended direction for the model in future releases. Accordingly, no severe wind related losses are estimated for state-owned critical and non-critical facilities. There are also no local risk assessments that provide any loss estimations to locally identified critical and non-critical facilities.

Risk & Vulnerability

The table below reveals the compilation of risk assessment data from Arizona State local county hazard mitigation plans, indicating that the total building stock of approximately $367 billion in assets are considered exposed to severe winds. As mentioned previously, loss estimates for severe wind were not calculated due to the lack of available HAZUS MH wind damage data sets for Arizona.

Table RA-76: Severe Wind State Asset Exposure

County/ Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $,1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Apache	36,818	36,818	$4,353,765	$4,353,765	No Data
Cochise**	59,633	59,633	$11,794,138	$11,794,138	No Data
Coconino**	53,466	53,466	$11,823,344	$11,823,344	No Data
Gila	29,170	29,170	$4,854,321	$4,854,321	No Data
Graham	13,130	13,130	$1,935,759	$1,935,759	No Data
Greenlee	4,078	4,078	$510,861	$510,861	No Data
La Paz	16,200	16,200	$2,888,808	$2,888,808	No Data
Maricopa	541,259	541,259	$164,894,580	$164,894,580	No Data
Mohave	86,841	86,841	$14,065,296	$14,065,296	No Data
Navajo	53,472	53,472	$7,668,023	$7,668,023	No Data
Pima**	440,794	440,794	$96,840,841	$96,840,841	No Data
Pinal	85,740	85,740	$13,472,739	$13,472,739	No Data
Santa Cruz	14,217	14,217	$3,098,495	$3,098,495	No Data
Yavapai	87,895	87,895	$16,149,585	$16,149,585	No Data
Yuma	68,384	68,384	$12,584,649	$12,584,649	No Data
Statewide Total	**1,591,097**	**1,591,097**	**$366,935,204**	**$366,935,204**	No Data

Note: "No Data" denotes lack of available information for assessment.
** Does not include Critical Facilities in Total Estimated Asset Value; Total only includes residential structures
Source: Total buildings, exposed buildings and asset values were calculated and compiled from each county's hazard mitigation plan

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Severe Wind are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-77: State CPRI Results for Severe Wind

Risk Due to Severe Wind					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Severe Wind	Likely	Critical	>24hours	< 24 hours	**2.6**
	3	2	3	2	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-78: County CPRI Results for Severe Wind

County	CPRI
Apache	3.10
Cochise	2.87
Coconino	2.50
Gila	2.05
Graham	2.85
Greenlee	No Data
La Paz	2.68
Maricopa	2.99
Mohave	3.17
Navajo	2.93
Pima	2.89
Pinal	3.09
Santa Cruz	2.28
Yavapai	2.86
Yuma	2.86
Average	**2.79**

Source: AZ county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Severe Wind are shown below.

Table RA-79: State Environmental CPRI Results for Severe Wind

Environmental Risk Due to Severe Wind				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Negligible	< 1 month	**.90**
Soil	Possibly	Limited	< 1 month	**1.5**
Average CPRI Environmental Risk Rating: 1.1 (max 3.6)				

Consequences / Impacts

- **Public**
  The past Tornado events illustrated in the "History" of this section details the impact to the citizens of Arizona. With one death and over a hundred injuries historically, tornadoes continue to pose a significant safety risk. The cause of related injuries has and will generally continue to be from falling trees, poles, debris or collapsing structures. In some cases, injuries and/or deaths may be caused by the loss of power that is so often the result of damaged powerlines.

Hospitalized, convalescent and citizens dependent on home medical equipment or oxygen, may be significantly impacted as well.

- **Responders to the Incident**
  As is almost always the case, incident responders face the same threats the general public does, but on a more significant and probable level. The chance for injury, illness and/or death due to the effects of tornado events is high for responders as they must put themselves in harm's way to perform their duties and rescues. As always, exhaustion should be considered as an impact responders are prone to as they may work extended shifts, performing various and strenuous emergency and rescue duties.
- **Continuity of Operations / Delivery of Services**
  Maricopa County, home of the State Capitol and most main state agency buildings/facilities, has a history of F2 event occurrences, resulting in risk of damage due to the hazard. Even with certain critical facilities remaining operational, the performance and delivery of services may easily be hindered during an event due to damaged, closed and impassable roads. Travel may be affected by obstructed transportation routes and no traffic control resulting from power loss.
- **Environment**
  Severe wind can also produce results detrimental to our environment. Winds may damage residential and commercial structures, releasing hazardous materials or damaging natural gas lines, possibly leading to fire. Winds can result in damaged or the loss of trees and in some areas, crops and vegetation.
- **Economic / Financial Condition of Jurisdiction**
  Wind is a very damaging component of thunderstorm events. Arizona has suffered costly wind related damages such as downed trees and utility poles, utility interruption and damaged structures, etc. Damage due to Tornadoes/Dust Devils in Arizona is estimated to be approximately $48 million. When it comes to structures, both residential and commercial are exposed to wind damage. Both are costly, but businesses may suffer additional costs due to lost business during recovery or loss of inventory. For small business owners, the impacts can be devastating and result in complete loss or possibly relocating their business out of the area. Loss of businesses further affects the jurisdictions by loss of tax revenue as well as local employment. The unemployed working age public put a further burden on the jurisdiction by requiring taxpayer paid assistance. Larger scale business loss can result in less development/growth or tourism for some jurisdictions.
- **Public Confidence in Jurisdiction's Governance**
  Arizona's emergency response agencies will continue to respond to severe wind events as promptly and efficiently as possible. Emergency operations centers will be activated as needed to coordinate response, rescue and recovery operations. Most wind events are of short duration and in most cases the community will be restored to pre-event status within hours.

Resources

Sources:
National Climate Data Center, Storm Event Database. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms#NOTICE

NOAA Storm Prediction Center Events Archive: http://www.spc.noaa.gov/wcm/index.html#data

Spatial Hazard Events and Losses Database for the United States (SHELDUS), 2011. http://webra.cas.sc.edu/hvri/products/sheldus.aspx

References:
American Society of Civil Engineers, 1999, *ASCE 7-98: Minimum Design Loads for Buildings and Other Structures*.

Federal Emergency Management Agency, July 2000, *Design and Construction Guidance for Community Shelters* (FEMA 361)
http://www.fema.gov/fima/fema361.shtm

Federal Emergency Management Agency, August 2009, *Multi-Hazard Loss Estimation Methodology, Hurricane Model, HAZUS MH-MR4, User Manual.*

Subsidence

Introduction/History

Subsidence occurs when the established land surface elevation recedes due to changes in the subsurface. Causes of subsidence include, but are not limited to, removal or reduction of fluids (water, oil, gas, etc.), mine subsidence, and hydro compaction. Of these causes, hydro compaction and mine subsidence tend to be localized events, while fluid removal may occur either locally or regionally. The main cause for subsidence in Arizona is excessive groundwater withdrawal (i.e., discharge exceeds recharge). Once an area has subsided, the ground elevation will not rise again, even if the removed fluid, or earth is replaced.

In the United States, more than 80% of the identified areas of subsidence are a result of our exploitation of underground water. The affects are compounded by the increasing draw of land and water resources which threatens to exacerbate existing land subsidence problems and initiate new ones. In many areas of the Southwest, and in more humid areas underlain by soluble rocks such as limestone, gypsum, or salt, land subsidence is an often-overlooked consequence of our land and water-use practices. Some subsidence is an often-overlooked consequence of our land and water-use practices.

Subsidence can cause regional drainage patterns to change, which effects flooding, backs up storm drains, and damages infrastructure both in the subsurface (water and electric lines, well casings, etc.) and surface (roads, canals, drainages, surveyed benchmarks, etc.). It aggravates riverine flooding, alters topographic gradients, and ruptures the land surface in addition to causing other hazards related to deterioration of land and water resources. Subsidence also causes fissures, which are discussed in this section as well.

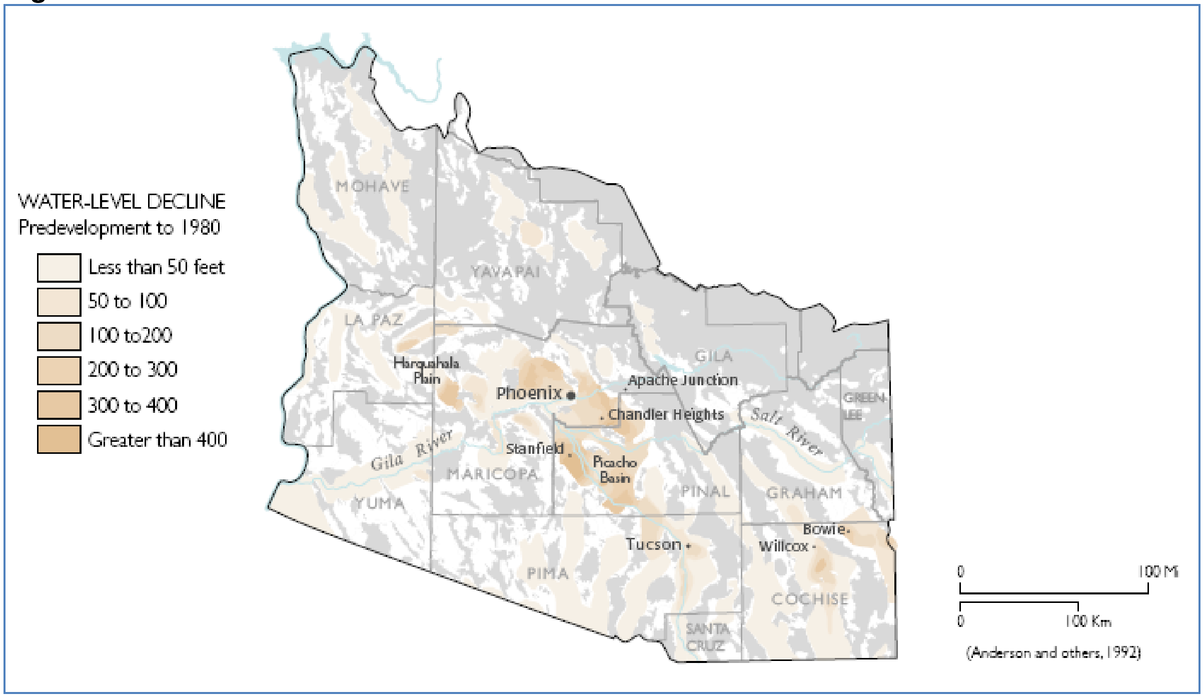
Land-use areas that are predominantly agricultural are at risk to experience the most intense subsidence because of irrigation. However, subsidence is not restricted to rural areas—exponential population growth also places great demands on groundwater.

The land subsidence areas in Arizona are the result of substantial groundwater withdrawal from aquifers in sedimentary basins. Subsidence normally results in bowl-shaped depressions, with loss of elevation greatest in the center and decreasing towards the circumference.

Since 1900, the south-central Arizona's groundwater pumping for irrigation, mining, and municipal use has outpaced the recharge, in some areas by 500 times more than the recharge. (Schumann and Cripe, 1986). Over 3,000 square miles is affected by subsidence, including the surrounding and expanding areas of Tucson and Phoenix and rapidly growing northern Pinal County. Before many communities became established, agriculture was the driving force for groundwater pumping. In Arizona, groundwater accounts for 40% of all water use (Arizona Land Subsidence Group, 2007). Prior to 1980, water levels have declined up to 400 feet in some areas of southern Arizona, as illustrated below.

Since the 1950s, the development of subsidence related earth fissures has greatly increased in Arizona, with hundreds now identified in the alluvial basin of southern Maricopa, western Pinal, eastern Pima and northern Cochise Counties. The majority of these fissures are forming in Pinal and Maricopa Counties.

Figure RA-13: Areas of Water Level Decline in Southern Arizona in 1980



Arizona Department of Water Resources (ADWR) has been analyzing and monitoring land subsidence across the State of Arizona since 2005 using Interferometric Synthetic Aperture Radar (InSAR) data. This geodetic method uses two or more synthetic aperture radar (SAR) images to generate maps of surface deformation or digital elevation using differences in the phase of the waves returning to the satellite, or aircraft. Sources for the SAR data include the ENVISAT, RADARSAT, and ERS-2 platforms. The technique can potentially measure centimeter-scale changes in deformation over time-spans of days to years. Areas currently being monitored by ADWR are shown above. Some of the more active areas of known subsidence include:

- Pinal County
  - Eloy—625 square miles subsided 15 feet between 1948 and 1985
  - Stanfield—425 subsided 12 feet by 1977
  - Apache Junction/Queen Creek—230 square miles subsided 3 feet by 1977
  - Ak-Chin Indian Community – 1998 through 2008, caused damages to sewer line which required jetting at a cost of $25,000. Repair of affected pipe cost $200,000.
- Maricopa County
  - Luke Air Force Base – by 1992, ground-water level declines of more than 300 feet generated land subsidence of as much as 18 feet about 20 miles west of Phoenix on and near Luke Air Force Base (Carpenter, 1999).
  - Queen Creek – by 1977, an area of almost 230 square miles had subsided more than three (3) feet (Carpenter, 1999).
  - Harquahala Plain – subsidence of about 0.6 feet occurred in response to about 300 feet of water-level decline (Carpenter, 1999).
  - East Mesa/Apache Junction – a total of 5.2 feet of subsidence was measured along the CAP near the Superstition Freeway, for the period of 1971 to 2001 (AMEC, 2006).
  - Paradise Valley – between 1965 and 1982, over five (5) feet subsidence occurred (Carpenter, 1999).

- Scottsdale/CAP
  - Canal subsided about 1 foot since construction (Carpenter, 1999).
  - Sections of the CAP canal in Scottsdale traverse an area that has subsided up to 1.5 feet over a 20-year period, threatening the canal's maximum flow capacity. In response, CAP raised the canal lining 3 feet over a one-mile segment of affected area at a cost of $350,000. A second and much larger subsidence area was later identified near the Scottsdale Airpark. Plans for raising the canal lining will cost an estimated $820,000. Recently, a third subsidence area has been identified east of the Scottsdale Airpark in the Scottsdale West World area. This happened in spite of the fact that during the original design phase, CAP Engineers showed considerable foresight in mapping a route to minimize the likelihood of encountering zones of subsidence (Gelt, 1992).
- Cochise County
  - Willcox—areas to the northwest and southeast
  - Bowie
  - San Simon
  - Tombstone
- Pima County
  - Avra Valley—northeast of Tucson[7]
- La Paz County
  - Harquahala Plain

An example of the damage potential at least partly attributable to subsidence occurred on September 20, 1992, when a storm that generated four inches of surface runoff occurred north of Luke Air Force Base. Subsidence in the area caused a flow-reversal in the Dysart Drain, which instead of conveying flows away from the base as designed, actually directed flows onto the base forcing a three (3) day closure. Damages included flooding of the runways and 100 homes and were estimated to total over $3 million.

Potential Secondary/Cascading Effects

Basin subsidence, the slow but persistent sinking of the basin floor, is heterogeneous, expressed over a large area and capable of effecting small but critical changes in the gradient. Rapid subsidence, associated with sinkhole development in the substratum evaporates (gypsum, salt, anhydrite) or carbonates (limestone or dolostone). – Carbonates are not considered here, but is a concern in parts of central and north-central Arizona, where carbonates either crop out or occur in the shallow subsurface to depths of several hundred feet. The sedimentary rocks surrounding Sedona, as one example, are dotted with at least seven sinkholes, two of which actively failed since 1989. Sinkhole formation near Sedona is attributed to collapse in the Redwall Limestone (Lindberg, 2009), nearly 500-feet below the ground surface.

Secondary or cascading events associated with basin subsidence, include:

- gradient changes in drainage leading to localized flooding and ponding of flood waters;
- gradient changes leading to negative effects on water and sewer systems;
- tilting of agricultural fields – which could requiring expensive re-leveling of fields;

[7] USGS Circular No. 1182, South-Central Arizona

- reduced freeboard of levees leading to exceeded design limits, such as overtopping, and localized flooding;
- formation of earth fissures;
- Infrastructure damage – notably to roads, railroads, earthen dams, and water and sewer systems;
- damaged water casing and disrupted well heads – which could result in broken piping impacting water delivery and quality.

Probability and Magnitude

The complexity of the factors associated with subsidence areas make it difficult to recommended procedures that quantifiably determine the probability and magnitude of future subsidence. It is reasonable, however, to anticipate that currently active subsidence areas are also considered susceptible to future subsidence. As long as groundwater discharge continues to exceed recharge, subsidence will occur. Even once water table equilibrium is reached, a period of 5-10 years will pass before the ground finishes subsiding. Accordingly, areas defined by ADWR as active subsidence areas were mapped as “High” hazard zones and all other areas were assigned a “Low” hazard. The high hazard subsidence zones for the State are presented on the following map.

The Arizona Department of Water Resources has been monitoring land subsidence throughout Arizona since 2002 using NASA’s satellite and aerial synthetic aperature radar data (InSAR and UAVSAR). The Department has identified land subsidence features that cover more than 1,100 square miles.

Vulnerability

Most of the significant damages associated with subsidence are typically related to the causal effects of subsidence as it relates to flooding events and fissure development. Other attributable costs and damages include:

- Uneven or differential subsidence across agricultural fields requiring expensive re-leveling efforts. Agricultural fields in the western Salt River Valley, lower Santa Cruz basin, and Willcox basin have all required re-leveling.
- Well damage and protruding well casings in both agricultural and urban areas.
- Replacement of gravity based irrigation systems due to flow reversal.

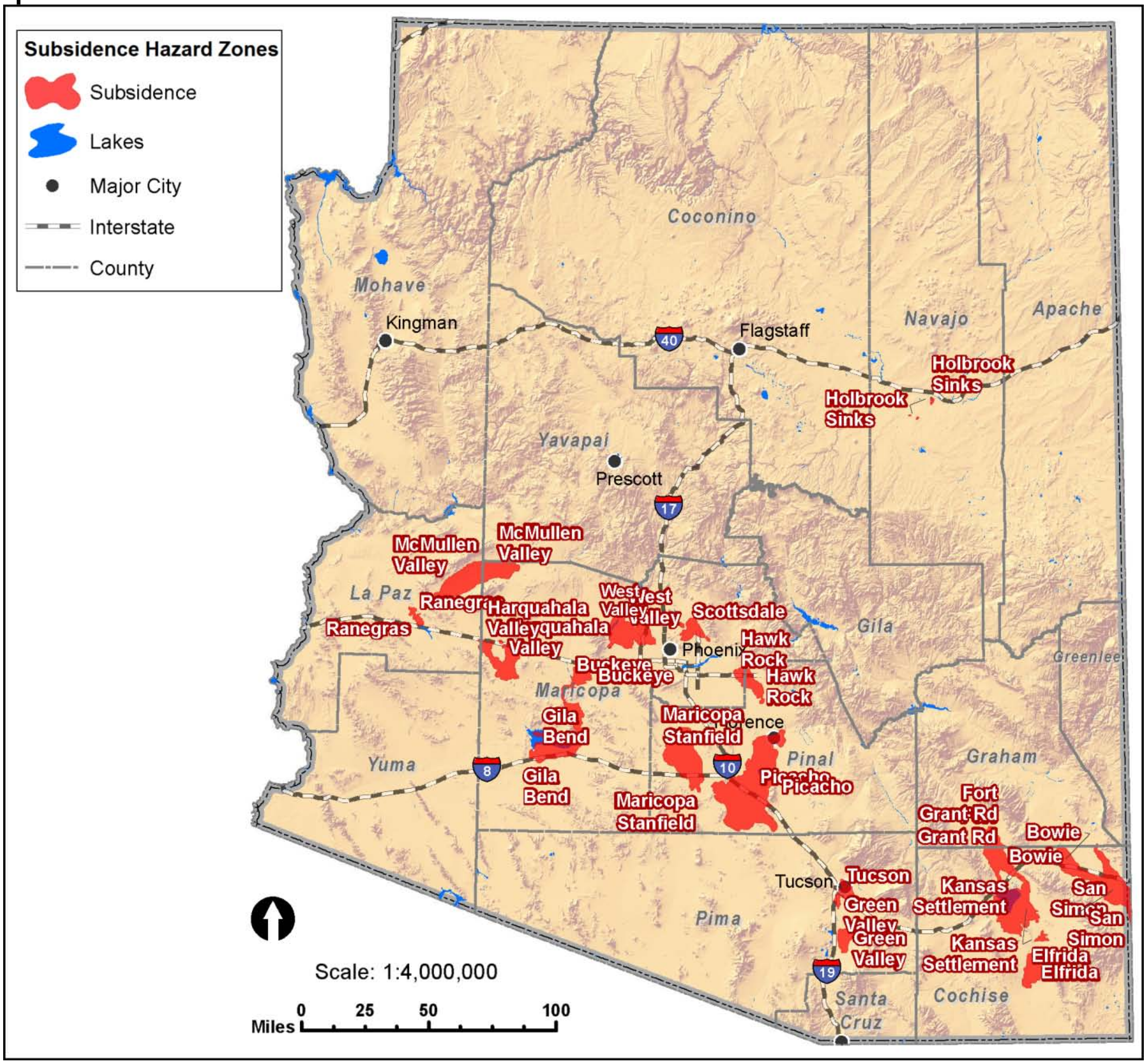
The increased incidence of local riverine flooding caused by reduction of elevation and changes of topographic gradients are the most costly impacts of land subsidence.

No estimates of loss to state-owned critical and non-critical facilities have been estimated. Instead, an estimate of exposure to the subsidence hazard areas is estimated.

In summary, about $1.28 billion in state-owned critical and non-critical facilities are exposed to an active subsidence area. Regarding human vulnerability, approximately 139,588 persons, or about 16% of the total 2010 state population, are potentially exposed to an active subsidence area. The potential for deaths and injuries are negligible as the hazard of subsidence does not pose an extensive direct threat to human life.

The compilation of risk assessment data from local plans indicates that approximately $55.7 billion in locally identified critical and non-critical facilities are exposed to a subsidence hazard area.

Map RA-15: Subsidence Hazard Zones



Areas of Land Subsidence in Arizona Observed as of April, 2013. Source: ADWR
ADWR has been monitoring land subsidence throughout Arizona since 2002 using NASA's satellite and aerial synthetic aperature radar data (InSAR and UAVSAR). The dept has identified land subsidence features that cover more than 1,100 square miles.

Table RA-80: State Owned Asset Inventory Loss Estimates to Subsidence

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost (x 1000)	Estimated Structure Loss
Apache	0	0.00%	0	None Estimated
Cochise	19	2.79%	1,989	None Estimated
Coconino	0	0.00%	0	None Estimated
Gila	0	0.00%	0	None Estimated
Graham	0	0.00%	0	None Estimated
Greenlee	0	0.00%	0	None Estimated
La Paz	5	0.73%	214	None Estimated
Maricopa	41	6.01%	20,234	None Estimated

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost (x 1000)	Estimated Structure Loss
Mohave	0	0.00%	0	None Estimated
Navajo	0	0.00%	0	None Estimated
Pima	189	27.71%	932,683	None Estimated
Pinal	428	62.76%	328,269	None Estimated
Santa Cruz	0	0.00%	0	None Estimated
Yavapai	0	0.00%	0	None Estimated
Yuma	0	0.00%	0	None Estimated
Statewide	**682**	**100.00%**	**1,283,389**	**None Estimated**

Table RA-81: State Facilities Located in the Subsidence "High" Hazard Area

State Facilities in the High Wildfire hazard Area	Apache	Cochise	Coconino	Gila	Graham	Greenlee	La Paz	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma	Total
Critical Facilities																
Banking and Finance Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Communications Infrastructure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Electrical Power Systems	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Emergency Services	0	0	0	0	0	0	0	0	0	0	13	14	0	0	0	**27**
Gas and Oil Facilities	0	2	0	0	0	0	1	3	0	0	1	5	0	0	0	**12**
Government Services	0	10	0	0	0	0	3	25	0	0	27	229	0	0	0	**294**
Transportation Networks	0	6	0	0	0	0	0	1	0	0	0	1	0	0	0	**8**
Water Supply Systems	0	1	0	0	0	0	0	1	0	0	0	22	0	0	0	**24**
Non-Critical Facilities																
Businesses	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	**3**
Cultural	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	**3**
Educational	0	0	0	0	0	0	0	3	0	0	128	38	0	0	0	**169**
Recreational/Leisure	0	0	0	0	0	0	0	0	0	0	9	2	0	0	0	**11**
Residential	0	0	0	0	0	0	1	8	0	0	9	112	0	0	0	**130**
Total	**0**	**19**	**0**	**0**	**0**	**0**	**5**	**41**	**0**	**0**	**189**	**428**	**0**	**0**	**0**	**682**

Table RA-82: County Population Sectors Exposed to Subsidence

County	Total Population	Population Exposed	Percentage Exposed	Over 65	Over 65 Exposed	Percentage Over 65 Exposed
Total Population Exposure to Earthquake						
Apache	71,518	0	0.00%	8,268	0	0.00%
Cochise	131,346	4,798	3.65%	22,688	933	4.11%
Coconino	134,421	0	0.00%	11,924	0	0.00%
Gila	53,597	0	0.00%	12,450	0	0.00%
Graham	37,220	101	0.27%	4,261	15	0.34%
Greenlee	8,437	0	0.00%	1,016	0	0.00%
La Paz	20,489	1,025	5.00%	6,683	182	2.73%
Maricopa	3,817,117	536,433	14.05%	462,641	114,471	24.74%
Mohave	200,186	0	0.00%	46,658	0	0.00%
Navajo	107,449	0	0.00%	14,241	0	0.00%
Pima	980,263	108,138	11.03%	151,293	12,145	8.03%
Pinal	375,770	100,522	26.75%	52,071	11,841	22.74%
Santa Cruz	47,420	0	0.00%	6,224	0	0.00%
Yavapai	211,033	2	0.00%	50,767	0	0.00%
Yuma	195,751	0	0.00%	30,646	0	0.00%
Statewide	**6,392,017**	**751,021**	**11.75%**	**881,831**	**139,588**	15.83%

Population counts based on census 2010

Table RA-83: Local Risk Assessment & Loss Estimates Based on Subsidence

County	Total Estimated Asset Value (x $1,000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $,1000)
Statewide Totals	**$382,041,435**	**$55,722,337**	**$0**
Apache	$11,101,665	No Data	No Data
Cochise	$10,615,770	No Data	No Data
Coconino	$22,517,439	No Data	No Data
Gila	$6,811,526	No Data	No Data
Graham	$2,999,628	No Data	No Data
Greenlee	$6,747,353	No Data	No Data
La Paz	$2,359,292	No Data	No Data
Maricopa	$189,975,238	$28,859,746	No Data
Mohave	$15,521,558	No Data	No Data
Navajo	$11,908,834	No Data	No Data
Pima	$50,584,821	$22,836,910	No Data
Pinal	$14,610,551	$4,025,681	No Data
Santa Cruz	$3,044,947	No Data	No Data
Yavapai	$18,491,858	No Data	No Data
Yuma	$14,750,955	No Data	No Data

NOTE: “*No Data”* denotes lack of available information for assessment.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Subsidence are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-84: State CPRI Results for Subsidence

Risk Due to Subsidence					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max:4)**
Subsidence	Likely	Negligible	>24 Hours	>1 Week	**2.2**
	3	1	1	4	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-85: County CPRI Results for Subsidence

County/Community	CPRI
Maricopa	**1.85**
Avondale	2.50
Buckeye	1.00
Carefree	1.00
Cave Creek	1.00
Chandler	1.00
El Mirage	1.75
Fountain Hills	2.50
Fort McDowell Yavapai Nation	1.30
Gila	1.00
Gilbert	2.85
Glendale	2.05
Goodyear	1.45
Guadalupe	1.45
Litchfield Park	1.45
Unincorporated Maricopa County	2.95
Pima	**2.18**
Marana	2.35
Oro Valley	2.35
Pascua Yaqui Tribe	1.00
Sahuarita	2.30
Tucson	2.80
Unincorporated Pima County	2.30

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Subsidence are shown below.

Table RA-86: State Environmental CPRI Results for Subsidence

Environmental Risk Due to Subsidence				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Limited	6 months+	**2.1**
Soil	Unlikely	Limited	6 months+	**2.1**
Average CPRI Environmental Risk Rating: 1.7 (max 3.6)				

Consequences / Impacts

- **Public**
  There are no obvious direct impacts to public health and safety due to the effects of subsidence conditions. Indirect/secondary impacts are more likely and are typically seen in the form of fissure and flood damage. Inconvenience may result from down utilities during the restoration process.
- **Responders to the Incident**
  Similar to the impact to the public, there should be no threat to responders as this is not considered an 'incident' response type of hazard.
- **Continuity of Operations / Delivery of Services**
  Subsidence is not a threat to the state's ability to continue effectively functioning.
- **Environment**
  Due to the surface elevation drops caused by subsidence, the resulting environmental threat is generally associated with flooding and potential contamination due to entry of floodwaters directly into groundwater through fissures. See the Flooding/Flash Flooding profile in this section for more information on its impacts. Subsidence can also cause fissures which will render the land/area unusable for development and agriculture. The long-term threat is the elevation dropping and reducing or compressing the aquifer holding capacity permanently for the given area. This would impact as a water resource for sustainability of vegetation and wildlife.
- **Economic / Financial Condition of Jurisdiction**
  Subsidence can affect a jurisdiction's economy by causing flood-prone areas, backing up storm drains, infrastructure damage and fissures. Although flooding in this case would be a secondary impact, response and recovery to floods are very costly. Flooding can significantly impact a jurisdiction's economy through residents and businesses. Overall, subsidence alone does not have the potential to cause great economic stress.
- **Public Confidence in Jurisdiction's Governance**
  Although response is not generally an issue directly related to this hazard, taking a proactive approach by addressing subsidence through mitigation/prevention as opposed to only when a critical point is reached should help the public's confidence level. Lack of situation knowledge

will lead to a misunderstanding of the situation and result in frustration and a negative attitude toward those that are perceived as responsible, which in most cases would be the government.

Resources

Definitions:

Sources:
Resources for additional information regarding Arizona subsidence hazards include the following:

- Arizona Geological Survey, Geologic Hazard Center: http://www.azgs.state.az.us/
- U.S Geological Survey, USGS Groundwater Programs: http://water.usgs.gov/ogw/subsidence.html
- The Geological Society of America: http://www.geosociety.org/
- AZ Dept of Water Resources, Interferometric Synthetic Aperture Radar, 2009, www.adwr.state.az.us/azdwr/Hydrology/Geophysics/InSAR.htm (Used in time series monitoring of subsiding basins in south-central Arizona)

References:
Baum, R., "Landslide and Land Subsidence Hazards to Pipelines", Open-File Report 2008-1164, USGS.

Carpenter, M.C., 1987, *Water-level declines, land subsidence, and specific compaction near Apache Junction, south-central Arizona:* U.S. Geological Survey Water-Resources Investigations Report 86-4071, 22 p.

Carpenter, M.C., 1999. *Land subsidence in the United States* [Galloway, D., Jones, D.R., and Ingebritson, S.E., editors], "South-Central Arizona: Earth fissures and subsidence complicate development of desert water resources," USGS Circular 1182.

Conway, B.D., 2006. "What is land subsidence?," presentation to Arizona Planning Association Conference, Arizona Department of Water Resources.

Gelt, J., 1992. "Land subsidence, earth fissures change Arizona's landscape," *Arroyo*, Summer 1992, Vo 6 No. 2, University of Arizona.

Holzer, T.L., 1980, *Research at the U.S. Geological Survey on faults and earth fissures associated with land subsidence*: Engineering Geologist (Newsletter of the Engineering Geology Division, Geological Society of America), v. 15, no. 3, p. 1-3.

Holzer, T.L., 1981, *Preconsolidation stress of aquifer systems in areas of induced land subsidence*: Water Resources Research, v. 17, p. 693-704.

Land Subsidence and Earth Fissures in Arizona, Arizona Geological Survey, Arizona Land Subsidence Group (ALSG), 2007

Leake, S.A., 1997. "Land subsidence from ground-water pumping," Impact of climate change on the southwestern United States workshop, USGS.

Pewe, T.L., 1984, *Land subsidence and earth fissures*, in Pewe, T.L., and Kenny, R., Geologic hazards of Arizona: Tempe, Arizona State University, Department of Geology, p. 4-12.

Pewe, T.L., 1990. "Land subsidence and earth-fissure formation caused by groundwater withdrawal in Arizona; a review," in *Groundwater geomorphology; the role of subsurface water in earth-surface processes and landforms* [Higgins, C.G., and Coates, D.R., eds.], Geological Society of America Special Paper 252, Boulder, CO.

Sandoval, J.P., & Bartlett, S.R., undated. "Land subsidence and earth fissuring on the Central Arizona Project, Arizona," US Bureau of Reclamation, Arizona Projects Office.

Schumann, H.H., & Genauldi, R., 1986. "Land subsidence, earth fissures, and water-level changes in southern Arizona," Arizona Bureau of Geology and Mineral Technology Map 23.

Slaff, S., 1993. "Land subsidence and earth fissures in Arizona," Down-to-Earth Series 3, Arizona Geological Suvey, Tucson, AZ.

US Geological Survey, 1999, *Land Subsidence in the United States*. Circular 1182, P-65-78 (South-Central Arizona).

Terrorism

Introduction & History

Terrorism is a threat everywhere, but there are a number of important considerations in evaluating terrorism hazards, such as the existence of facilities, landmarks, or other buildings of international, national, or regional importance. High-risk targets for acts of terrorism include military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, and corporate centers. Furthermore, terrorists are capable of spreading fear by sending explosives or chemical and biological agents through the mail (FEMA, April 2009). Nonetheless, terrorism can take many forms and terrorists have a wide range of personal, political, or cultural agendas. Therefore, there is no location that is not a potential terrorist target.

Of particular concern to Arizona are the many critical facilities in the State. Police stations, hospitals, military installations, fire stations, schools, wastewater treatment plants, and nuclear power generation stations along with critical infrastructure such as bridges, tunnels, electric generation and distribution facilities, public water supplies, and government buildings may be potential terrorist targets. Damage to these facilities and infrastructure could cripple transportation routes and commerce. Additionally, there are many Title III facilities as well as transportation routes vital to the entire nation traversing Arizona; making intentional hazard material releases a potential threat to citizens and the environment.

The term “terrorism” refers to intentional, criminal, malicious acts, but the functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as “…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives” (28 CFR §0.85). Terrorists use threats to create fear, to try to convince citizens of the powerlessness of their government, and/or to get publicity for their cause.

Terrorist attacks can take many forms, including agriterrorism, arson/incendiary attack, armed attack, assassination, biological agent, chemical agent, cyberterrorism, conventional bomb, hijackings, intentional hazardous material release, kidnapping, nuclear bomb and radiological agent (FEMA April 2009). Explosives have been the traditional method of conducting terrorism, but intelligence suggests that the possibility of biological or chemical terrorism is increasing. The severity of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

Biological agents are organisms or toxins that have illness-producing effects on people, livestock and crops. Some biological agents cannot be easily detected and may take time to develop. Therefore, it can be difficult to know that a biological attack has occurred until victims display symptoms. In other cases, the effects are immediate. Those affected by a biological agent require the immediate attention of professional medical personnel. Some agents are contagious which may result in the need for victims to be quarantined.

In recent years, cyber terrorism has become a larger threat. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure appear to be the main goals at this point in time. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. One of the more prominent groups involved in large-scale hacking events recently is the group "Anonymous." They have been known to overtake websites, and alter the content that is presented to the public. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed and any possible measures taken to harden those resources to attack.

Active shooters, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active shooters include; the Sandy Hook Elementary school shootings in Newtown, Connecticut, the shooting in the Aurora, Colorado movie theater and the shooting in Tucson, Arizona involving U.S. Representative Gabrielle Giffords. Historical active shooter events include the Virginia Tech shootings, the Columbine High School shootings and the University of Texas, Austin shootings. No substantive research has yet been compiled to address the potential vulnerability to an active shooter incident. As a very open, public society, these incidents are easier to accomplish for those bent on doing harm. Some of these incidents have occurred in public places, and some in places that are considered more restricted (like elementary schools and high schools). There is no discernible pattern to the location chosen by the shooter.

Today, terrorism prevention initiatives in Arizona are guided largely through "Securing Arizona, A Roadmap for Arizona Homeland Security", which was finalized in April of 2003. Through this initiative various aggressive action items were proposed which would assist the state in preventing terrorist action and mitigating the impact of such an event. Specifically:

- Establish a statewide integrated justice system that links the information systems used by federal, state, local and tribal criminal justice entities (police, corrections, courts, etc.) in such a way to support the identification of emerging terrorism related trends.
- Establish a 24/7 intelligence information analysis center that will serve as a central hub to facilitate the collection, analysis and dissemination of crime and terrorism related information.
- Establish a statewide disease surveillance system that collects information from emergency rooms, physicians, animal control entities, pharmacies, public safety entities and other public/private sector entities to identify emerging public health problems such as naturally occurring diseases, environmental problems, and biological and chemical weapons attacks.

Supplementing the Securing Arizona initiative is the State Homeland Security Strategy (SHSS), updated in 2007. This document establishes as a goal, "To protect all of Arizona's citizens from potential terrorist attack and enhance the response and recovery capabilities of communities, whether urban or rural." Among the objectives supported through this document are the continued management and support for an anti-terrorism network that ensures that the proper resources, facilities, organization, plans and procedures, and training are all available to those responsible for preventing and responding to terrorist incidents.

Furthermore, the State Homeland Security Strategy provides that the State of Arizona will apply the resources available from the Department of Homeland Security (DHS) through the Office for Domestic Preparedness (ODP) to support planning, equipment, training, and exercise needs of the State in building an enhanced and sustainable capacity to prevent, respond to and recover from threats or acts of terrorism that may involve the use of a weapons of mass destruction. The Strategy also ensures that the State of Arizona will be able to detect, mitigate, prepare for, respond to, and recover from a terrorism incident. Any subsequent plans are intended to utilize an all hazard approach. In addition, Arizona's approach to enhancing regional capability and capacity to prevent and reduce the vulnerability of Arizona from weapons of mass destruction or terrorism incidents will be multidiscipline.

Also, the Arizona Counter Terrorism Information Center (ACTIC) was established. The mission of the ACTIC is to protect the citizens and critical infrastructures of Arizona by enhancing intelligence and domestic preparedness operations for all local, state and federal law enforcement agencies. Mission execution will be guided by the understanding that the key to effectiveness is the development and sharing of information between participants to the fullest extent as is permitted by law or agency policy.

The objective of the ACTIC is to be a "fusion" center by establishing and maintaining an "all-crimes approach" to terrorism prevention. The ACTIC is a true cross-jurisdictional partnership, integrating local, state, and federal law enforcement, as well as first responders, emergency management and, when appropriate, the private sector. The evolution of federal-local collaboration at the ACTIC is accomplished by fully integrating human and technological components. The trend toward examining crime problems multi-dimensionally is a feature of intelligence led policing and relies heavily on the collaboration to access local-federal intelligence.

Among the many agencies involved in this massive mitigation effort will be the Arizona Division of Emergency Management (ADEM) and the Arizona Department of Homeland Security (AZDOHS) which will be responsible for the administration of the State Homeland Security Assessment and Strategy (SHSAS) program. The Governor's Homeland Security Coordinating Council (HSCC) will be responsible for review of these activities before going to the Governor's office for final approval.

The Governors HSCC is a multidiscipline committee developed in order to help guide the strategy development process for equipment allocation and distribution among emergency responders in the state. This committee included representatives from law enforcement, emergency management, fire service, governmental administrative, tribal nations, and private sector and volunteer organizations assisting in disaster recovery.

The worst-case scenario for a terrorism event in Arizona would be if a "dirty bomb" combining radioactive material with conventional explosives were to be detonated in Phoenix at lunchtime on a weekday. At that time of day and location, a significant number of individuals would be exposed to the bomb's radiation both at the time of detonation and after the fact as the radiation spread. The explosive device could damage or even topple buildings, spark utility outages citywide, and/or ignite large-scale urban fires. Prediction of terrorist attacks is almost impossible because terrorism is a result of human factors. As long as fringe groups maintain radically different ideas than that of the government or general population, terrorism is a possibility.

Environmental Impacts

The impacts of terrorism can vary in severity from nominal to catastrophic and are contingent upon the method of the attack, the volume of force applied, and the population density of the attack site. There may be significant loss of life for humans and animals as well as economic losses. Additionally, the impact of the attack itself may be exacerbated by the fact that human services agencies like community support programs, health and medical services, public assistance programs, and social services can experience physical damage to facilities, supplies, and equipment and disruption of emergency communications. There may also be ancillary effects of terrorism such as urban fires or, in the case of a radiological device, radioactive fallout that can multiply the impact of a terrorist event.

Jurisdictional Vulnerability Assessment

All communities in the State are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where the previously mentioned potential targets are located should be considered more vulnerable. Larger cities like Phoenix and Tucson are the most vulnerable to terrorist attacks due to the sheer size of these urban areas, density of the population, and concentration of critical infrastructure located there. Because of its status as the state capital, Phoenix has elevated vulnerability.

State Facility Vulnerability Assessment

Since the probability of terrorism occurring cannot be quantified in the same methodology of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in Arizona, planning efforts can be put in place to reduce the risk of attack. FEMA's Integrating Manmade Hazards into Mitigation Planning (2003) encourages site-specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

- Inherent vulnerability:
  - Visibility – How aware is the public of the existence of the facility?
  - Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
  - Accessibility – How accessible is the place to the public?
  - Asset mobility – is the asset's location fixed or mobile?
  - Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
  - Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
  - Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?
- Tactical vulnerability:
  - Site Perimeter
    - Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
    - Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?
  - Building Envelope
    - Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological and radiological contaminants?
  - Facility Interior
    - Architectural and Interior Space Planning – Does security screening cover all public and private areas?
    - Mechanical Engineering – Are utilities and Heating, Ventilating and Air Conditioning (HVAC) systems protected and/or backed up with redundant systems?
    - Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lightning sufficient?
    - Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
    - Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

Jurisdictional Loss Estimation

Jurisdictional loss estimates can vary greatly in a terrorism event based on the magnitude and type of terrorist action. Catastrophic terrorism events will have proportionally catastrophic losses for the jurisdiction in question. For example, losses may be greater in an event that results in the complete destruction of a high-rise building; in that scenario, losses will stem from loss of life, the actual destruction of the building, and business interruptions. For comparison's sake, the total losses incurred by New York City in the September 11, 2001 attacks are estimated at $83-95 billion. This loss estimate includes lost tax revenue for the city, the cost of response and recovery, business interruptions, deaths, building damage, and infrastructure damage. While Arizona's cities are certainly smaller than New York, losses could still be severe.

State Facility Loss Estimation

All state facilities are vulnerable to terrorism in some way, whether or not the facility itself is the target of an attack. While highly unlikely that all critical facilities would be destroyed in a single event, the total replacement cost of all state critical facilities is unpredictable.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Terrorism are shown below.

Table RA-87: State CPRI Results for Terrorism

Risk Due to Terrorism					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Terrorism	Possible	Critical	< 6 Hours	< 6 Hours	**2.50**
	2	3	4	1	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).
*None of the counties in Arizona profiled terrorism as a hazard, and as such, no CPRI results are available for compilation.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Terrorism are shown below.

Table RA-88: State Environmental CPRI Results for Terrorism

Environmental Risk Due to Terrorism				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Negligible	< 1 month	**.90**
Soil	Unlikely	Negligible	< 1 month	**.90**
Average CPRI Environmental Risk Rating: .90 (max 3.6)				

Consequences / Impacts

Threat is based upon the criticality of a site or event. The threat is collaborated with warning and indicators. This information is sensitive in nature and is maintained at the ACTIC. Personnel responsible to provide indications and warnings will do so at the direction of the Command of the ACTIC.

The Arizona Department of Public Safety (DPS) is mandated by law to coordinate a program that uses state of the art technologies that is implemented based on the statewide assessment of threat and vulnerability by the Arizona Counter Terrorism Information Center.

The Automated Critical Asset Management System (ACAMS) provides the data collection framework that guides the assessment process.

The information that is gathered and evaluated is utilized by the Threat Mitigation Unit using the PACES system at the ACTIC to allocate resources to the areas of greatest need using the management structure established with the GABRIEL project.

- **Public**
  The effects of terrorism include, but are not limited to death, injury and a feeling of fear and helplessness in the general population. It can destroy property, lifelines and the basic social fabric. On a large scale, it destroys major portions of a large city's infrastructure creating physical and economic hardship for some time in addition to the initial death and destruction. Long term psychological damage to a portion of the population is also possible

- **Responders to the Incident**
  Impacts to responding personnel are similar to what can affect the citizens residing or working in the target area. They include medical problems and death from chemical agent exposure, explosion and fire trauma. There may long term hazards such as hazardous chemicals or material (asbestos) that can cause illness, either acute or chronic.

- **Continuity of Operations / Delivery of Services**
  Once again the magnitude and type of event determines the impact on agencies and services. Continuity of operations for agencies that have their main administration or critical components of their operations within the target area could find their operational continuity at risk. If files, paper or electronic, are damaged or destroyed, an organization may not be able to: contact clients; assign work; complete scheduled jobs; meet deadlines; access, track, and pay accounts; or pay staff. Without a Continuity of Operations Plan that takes these issues into account, they may not be able to operate in their normal mode, if at all.

- **Property / Facilities / Infrastructure**
  Arizona has been fortunate in the fact we have not had a terrorist attack other than some "eco-terrorist groups" causing minor disruption to railroad lines and some power lines. Most damage and disruption has been minor. The type and magnitude of the terrorist attack will determine the damage or destruction of a jurisdiction's facilities. Buildings can be destroyed or rendered unsafe, equipment, electronic or mechanical, ruined or in some cases made inaccessible due to damage or contamination. Files, electronic or paper, can be destroyed. Explosions and fire can render infrastructure such as roads, power lines, natural gas, fuel, water pipelines and sewage control facilities inoperable.

- **Environment**
  The impacts to the environment from a terrorist attack can be huge. The infrastructure of a large city if destroyed, can cause lingering problems with contaminates, pollutants, hazardous debris, etc. The effects of attacks on water supplies and food crops can linger for long periods of time rendering the land or water unusable. Radiological damage can close entire geographical areas for years.

- **Economic / Financial Condition of Jurisdiction**
  Economically, the after effects will depend directly on how much damage was done to local businesses, the local tax base, and the local infrastructure, and the type of terrorist activity. An individual home or business damaged by the attack can be devastating to an individual or family, it has very little effect on the overall economic condition of the community. However when a large number of homes, and business, are damaged or destroyed it can negatively alter the tax base decreasing the ability of the local jurisdiction to pay, not just for infrastructure repair and community restoration, but also for the normal day to day programs that make the community a viable area in which to live and work. People and business may need to relocate and in some cases out of the community or State.

  Damage to the business and industry sector does not only affect the tax base, but may also remove jobs from the local economy. The loss of jobs can escalate into other problems. The unemployed may either move away, go on unemployment, or be forced to take a lower paying job, all of which further decreases the financial stability of the community. If the loss of financial stability is not corrected, there are other social problems that arise. Those out of work can develop a loss of self esteem that can lead to an increase in crime, alcohol and drug abuse, psychological problems, spouse abuse and an increase in medical problems

  In summary, the economic viability of the area will depend on not just how much damage was done, but also on how quickly the infrastructure can be repaired; how prepared businesses are to operate in the post disaster environment; how prepared citizens are for the possibility of an attack and its affects; and how well local governments and organizations can respond to the needs of the public for support, cleanup, and if necessary relocation.

- **Public Confidence in Jurisdiction's Governance**
  The reputation of any individual jurisdiction within Arizona or the public's confidence in the jurisdiction is highly dependent on the public's perception on how well response and recovery are handled during and after an event. A response that either shows or gives the impression the jurisdiction is prepared and responsive to the public's needs and that it manages a recovery to gets its services back and damage repaired in a timely manner will maintain or enhance a jurisdictions' reputation. However, if the perception develops, rightly or wrongly, that the jurisdiction is incompetent, slow to react, or ignores the needs of its citizens, the reputation of the jurisdiction and the confidence in its abilities may suffer.

Wildfires

Introduction/History

Wildfires burn thousands of acres in Arizona annually. According to the Southwest Coordination Center Historical Fire Data, during the 21-year period 1990-2011, Arizona had an annual average of 3,068 wildfires affecting an average of 213,302 acres each year. On average, 57% of the wildfires were human caused, while 43% were lightning caused. A combination of extended drought, unhealthy forest conditions, and expanding population centers support the likelihood of increased wildfire occurrence and more severe impacts over the coming years.

Table RA-89: Wildfires in Arizona by Type, 2000-2011

Year	Human Caused		Lightning Caused		Total	
	Fires	Acres Burned	Fires	Acres Burned	Fires	Acres Burned
2000	1,407	45,657	2,172	37,239	3,579	82,896
2001	1,820	12,762	1,347	17,741	3,167	30,503
2002	1,833	599,383	1,385	30,493	3,218	629,876
2003	1,337	118,280	1,594	86,240	2,931	204,520
2004	1,473	49,072	1,409	183,070	2,882	232,142
2005	2,723	197,737	1,196	564,222	3,919	761,959
2006	1,483	36,566	1,597	119,286	3,080	155,852
2007	1,397	22,382	1,057	62,060	2,454	84,442
2008	1,141	52,244	649	49,392	1,790	101,636
2009	1,452	88,772	875	133,857	2,327	222,629
2010	1,014	39,600	493	42,611	1,507	82,211
2011	1,106	898,875	788	82,314	1,894	981,189
Total	**18,186**	**2,161,330**	**14,562**	**1,408,525**	**32,748**	**3,569,855**

Source: Southwest Coordination Center, 2013

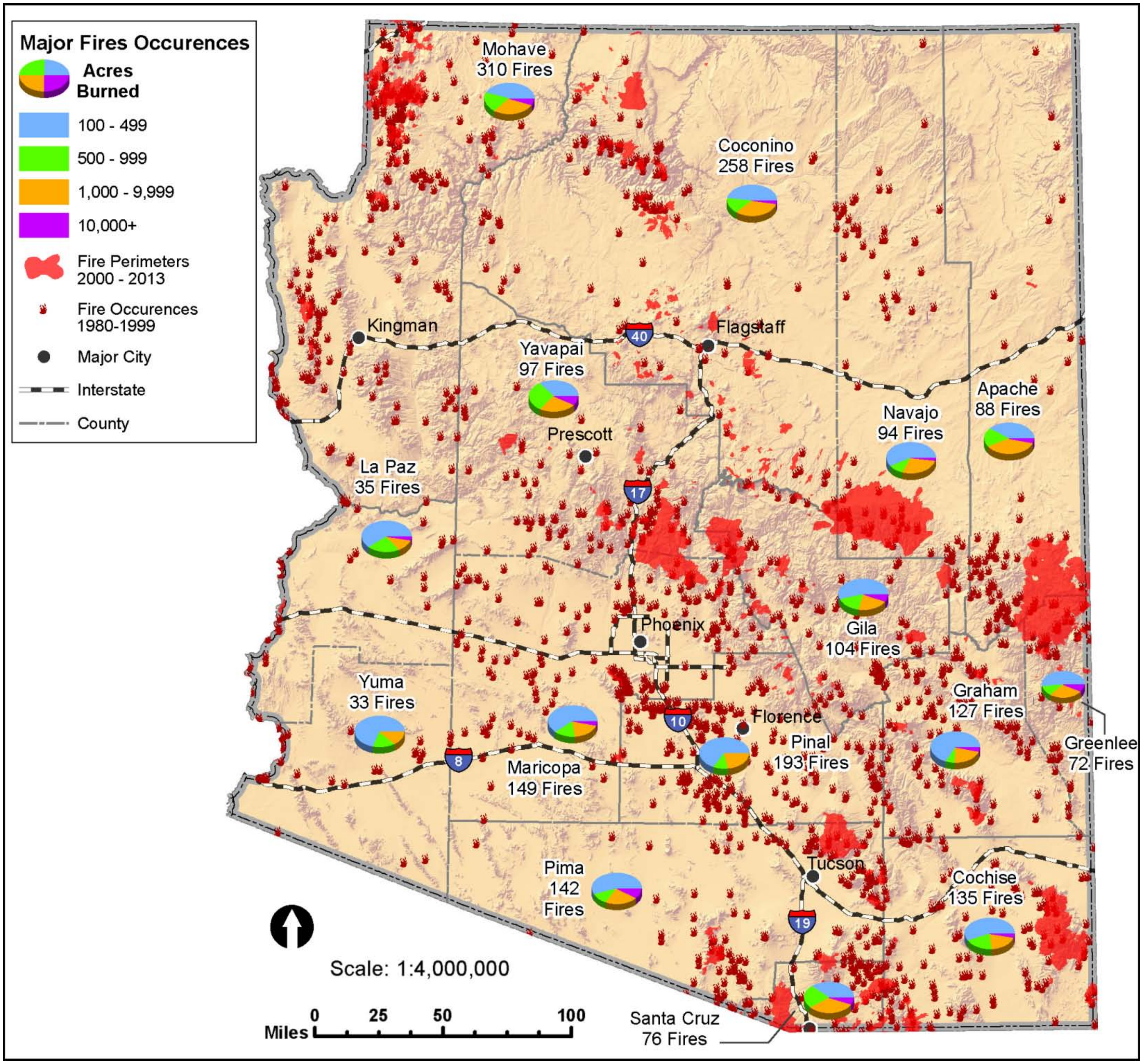
Following are a few of the most significant wildfires in Arizona history:

- June-July 2013. Yarnell Hill Fire, 8,400 acres. A lightning-caused fire that originated 3.5 miles west of the community of Yarnell. On Sunday, June 28th, the fire rapidly grew in size and intensity. Strong erratic winds pushed the fire in several directions at the same time. Nineteen (19) members of the Granite Mountain Hotshot Crew lost their lives battling this fire on June 30, 2013. Residents of the communities of Yarnell and Peeples Valley were forced to evacuate. The Yarnell Hill Fire destroyed 108 homes in Yarnell and damaged an additional 25 others.
- June-July 2013. Dean Peak Fire, approximately 5,400 acres. A lightning-caused fire in the Hualapai Mountains, 10 miles southeast of Kingman. This fire led to the communities of Pine Lake and Pinion Pine Estates being evacuated. No structures were lost.
- June 2013. Doce Fire, 6,732 acres. The Doce Fire began burning in the Prescott National Forest, 8 miles northwest of Prescott and is believed to be human-caused. The fire required 781 personnel to control and residents of Williamson Valley were forced to evacuate 465 homes. Fortunately, no homes were destroyed in this fire.

- June 2011. Wallow Fire, 538,049 acres. The Wallow fire is the largest fire in the history of Arizona wildfires. It was started by two men who didn't properly take care of their campfire. The fire destroyed 32 homes, damaged five (5) others, destroyed five (5) businesses, as well as 36 outbuildings, and involved well over 3,000 personnel to contain it. Alpine, Blue River Greer, Nutrioso, Sunrise, Springerville, and Eagar were evacuated.
- May 2011. Horseshoe Fire, 222,954 acres. This fire was started by human causes and in its first day burned through 9,000 acres. It threatened the Town of Portal and had to be evacuated. There were over 800 personnel and eight (8) helicopters involved in the over month long battle to contain this wildfire.
- June 2005. Cave Creek Complex, 248,310 acres. This was Arizona's second largest wildfire in state history. Caused by lightning from a summer storm, this desert fire burned thousands of acres within the first hour and threatened several communities on the outskirts of metropolitan Phoenix.
- June 2003. Aspen Fire, 84,750 acres. The Aspen fire burned for nearly a month on the slopes of the Santa Catalina Mountains and destroyed 340 homes and business in the community of Summerhaven.
- June 2002. Rodeo/Chediski, 468,638 acres. This fire caused 30,000 people to evacuate, destroyed over 450 homes, and caused an estimated $34 million in damages. The largest fire in Arizona history started when an arsonist set the Rodeo Fire on the Fort Apache Indian Reservation near the Rodeo Fairgrounds. On June 20, a second blaze began near Chediski Peak, 15 miles from the Rodeo fire. The two fires spread quickly northeast and steadily widened toward each other, combining on June 23. On June 25, President Bush declared a national disaster for Apache, Coconino, Gila, Navajo Counties, and the Fort Apache Reservation. An estimated $50 million dollars were spent fighting the fire. 58% of the burned area experienced high intensity burn and extensive smoke damage occurred in Apache County outside the direct burn area. (FEMA, September 2002).
- June 1990. Dude Fire, 24,174 acres. Killed six firefighters, destroyed 63 homes. This fire burned in the Tonto National Forest, northeast of Payson (Arizona Republic, June 30, 2003).

Significant wildfires (100+ acres) in Arizona, shown in the following map, are strongly concentrated in the southeast and across the central and north-central portion of the State. Many Arizona wildfires have occurred near population centers and have been a significant threat to life and property. Arizona's population has continued to grow at one of the highest rates in the nation, with many communities pushing further and further into adjacent wildland areas. Coupled with ongoing drought conditions and decreasing health of Arizona forests and woodlands, these conditions pose an ever-increasing risk of major loss due to wildland fire.

Map RA-16: Significant Wildfires 1980 through 2013



Source: RMGSC 2013; USFS Fire & Aviation Management 2013; ASFD 2013; AGIC 2013; Baker 2013

This map shows large fire locations from 1980 thru 1999, and fire perimeters from 2000 thru May 2013 reported at over 100 acres. Data is from the USGS Rocky Mountain Geographic Science Center (RMGSC), the USFS Fire & Aviation Management and Arizona State Forestry Division. The numerous fires less than 100 acres are not displayed due to limited map size and impacts on readability.

Table RA-90: Major Wildfire Events by County

County	Number of Occurrences for Each Category of Acres Burned				
	100 - 499	500 - 999	1,000 - 9,999	10,000+	Total
Apache	36	14	35	3	88
Cochise	75	29	27	4	135
Coconino	125	35	91	7	258
Gila	56	18	24	6	104
Graham	85	10	28	4	127
Greenlee	37	8	22	5	72
La Paz	21	9	4	1	35
Maricopa	90	25	29	5	149
Mohave	140	54	101	15	310
Navajo	54	10	28	2	94
Pima	78	16	36	12	142
Pinal	127	23	42	1	193
Santa Cruz	30	15	27	4	76
Yavapai	36	26	28	7	97
Yuma	23	6	4	0	33
Total	**1,013**	**298**	**526**	**76**	**1,913**

Based on historical data and spatial analysis - Baker 2013

Wildfire Susceptibility

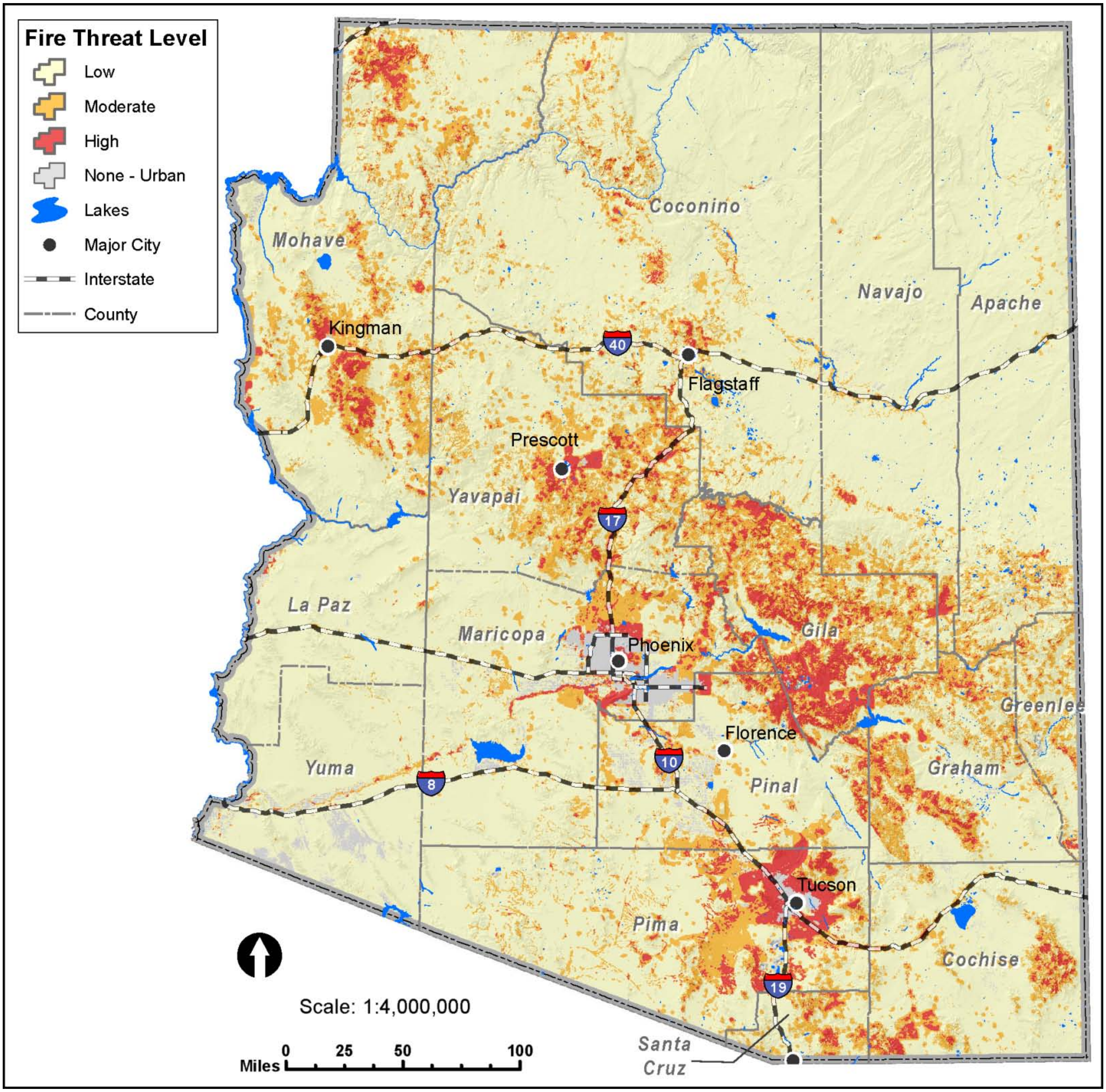
The assessment of the likelihood of wildfire occurrence is depicted in the following Wildfire Hazard Areas map. The Wildfire Hazard Areas is based on Fire Threat Index (FTI) data, one of many key products of the West Wide Wildfire Risk Assessment (WWA) project that define the current fire situation in the western states. The WWA analysis work was completed in October 2012.

The FTI reflects the likelihood of an acre burning. The calculation process integrates the probability of an acre igniting and the expected final fire size into a single measure of wildland fire susceptibility. The assessed fire size is based on the rate of spread in four weather percentile categories.

The key inputs and intermediate data used in the risk model to produce the Wildfire Threat layer are:

- Probability of fire occurrence, derived from:
    - Historic fire locations and fire occurrence areas.
    - Weather influence zones derived from historic weather observations categorized into weather percentile categories
- Fire behavior (rate of spread) derived from:
    - Surface fuels
    - Canopy closure
    - Canopy characteristics
    - Topography
- Fire suppression effectiveness, derived from
- Historic fire sizes
- Historic protection organization

Map RA-17: Wildfire Hazard Areas



Source: West Wide Wildfire Risk Assessment (WWA) 2010; AGIC 2013; Baker 2013

Potential Secondary/Cascading Effects

Indirect effects of wildfire can be catastrophic. Smoke from wildfires often have severe impacts on human health of both firefighters and residents, and wildfires affect critical public infrastructure, have severe business and economic impacts, affect local government budgets, and have many other significant cascading effects. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams thereby enhancing flood potential, a significant issue in Arizona, and harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased landslide hazards.

Probability and Magnitude

Depending upon the needs of the user and the availability of data, there are many different approaches to fire modeling. However, nationally accepted or utilized wildfire models have not been developed for the evaluation of wildfire risk or conducting vulnerability analysis. In addition, most wildfire modeling conducted to date has been focused on wildfire behavior, not true probability and magnitude modeling. This is because the probability of ignition and the probable wildfire size have generally not been considered. In addition, there have been major limitations in terms of software systems, data availability, and data coverage/resolution.

These limitations aside, with improving GIS programs and data availability, there are a growing number of wildfire hazard assessment models. In addition, as a part of the National Fire Plan, communities have also been identified across the US that are at risk to wildfires.

Wildland Urban Interface Communities at Risk Program

Urban wildland interface areas, where development meets wildland vegetation, where both vegetation and the built environment provide fuel for fires, have increased significantly throughout the U.S. Due to this increase, there is risk of major losses from wildfires. Following the severe wildfires during the summer of 2000, the Secretaries of Agriculture and the Interior developed the National Fire Plan, a program to reduce wildland fire risks to communities and the environment, and to save the lives of firefighters and the public. The Plan is a long-term program based on cooperation and communication among federal agencies, state and local governments, tribes, communities and interested publics. The program includes a 10-Year Comprehensive Strategy and an Implementation Plan.

As part of the National Fire Plan, the Wildland Urban Interface Communities at Risk Program was developed in order to reduce the risk of wildland fire in urban interface communities through education, prevention, hazardous fuels reduction, and to increase fire protection capabilities. A key step in realizing this goal was the identification of areas that are at high risk of damage from wildfire. Federal land managers authorized state and tribal authorities to determine which communities were under significant risk from wildland fire on or in the vicinity of Federal lands. In some states, communities that are not on or within the vicinity of federal lands were also included, primarily in eastern states. States and tribes were asked to follow a consistent process established by an interagency group at the national level, or state teams could use existing community assessment systems when those systems met or exceeded the standardized process. The outcome of this process was the *Wildland Urban Interface Communities at Risk*, which was first published in the Federal Register on January 4, 2001 and revised to include additional communities on August 17, 2001. The official list for Arizona is updated and maintained by the Arizona State Forester and the Arizona State Forestry Division. Table 3 shows how many communities are identified in each county.

Table RA-91: Urban Wildland Interface Communities in Arizona

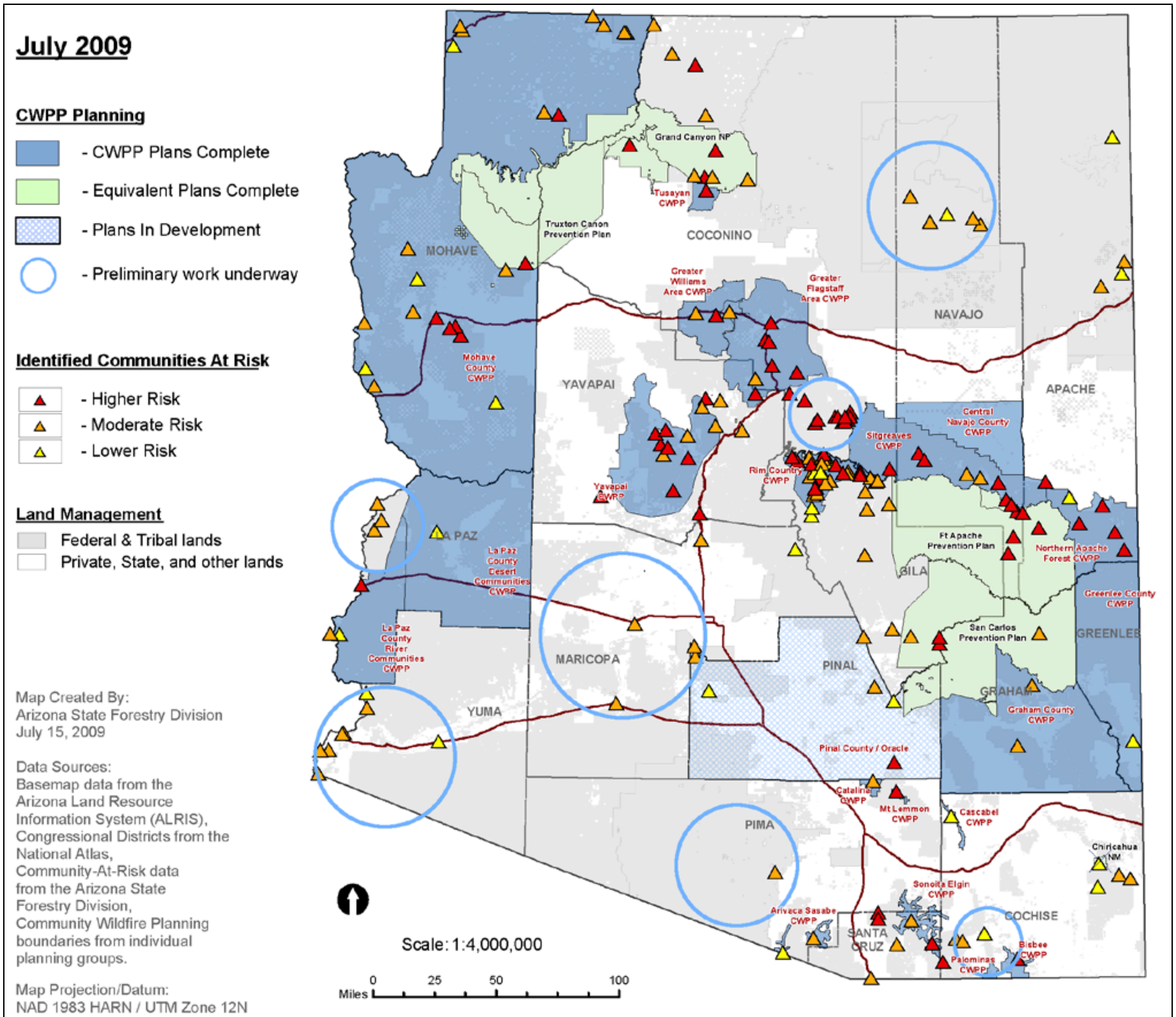
County	# of Communities
Apache	12
Cochise	10
Coconino	37
Gila	40
Graham	3
Greenlee	1
La Paz	7
Maricopa	5
Mohave	22
Navajo	15
Pima	5
Pinal	6
Santa Cruz	6
Yavapai	15
Yuma	8
Total	**192**

Source: Arizona State Forestry Division, 2009

The information contained in the list is used by interagency groups of land managers at the state and/or tribal level to collaboratively identify priority areas benefiting from hazardous fuels reduction and other support. Federal land management agencies and state foresters will focus special attention on these areas in a concerted effort to reduce wildfire hazards.

The map below was produced by Arizona State Forestry Division in July 2009. It identifies 192 Communities-At-Risk from wildfire, with corresponding risk level. Additionally, this map identifies areas that have Community Wildfire Protection Plans (CWPP), or equivalent plans, in place as of 2009. As shown in table below, there are currently a total of 26 completed plans that encompass 65% of the identified communities at risk.

Map RA-18: Community Wildfire Protection Planning and Identified Communities-At-Risk



25 - Arizona CWPP or Equivalent Plans completed to date:

Sitgreaves National Forest	Jul 2004	Palominas	Feb 2005	La Paz River	Aug 2006
Mt Lemmon	Jul 2004	Greater Williams Area	Mar 2005	La Paz Desert	Aug 2006
Northern Apache County	Aug 2004	Tusayan Area	Jul 2005	Cascabel	Sep 2006
Rim Country	Oct 2004	Grand Canyon	Jul 2005	Arivaca Sasabe	Nov 2007
Greater Flagstaff	Oct 2004	Chiricahua NM	Jul 2005	Sonoita / Elgin	Dec 2007
Yavapai Communities	Nov 2004	Greenlee County	Nov 2005	Bisbee	Mar 2008
Fort Apache (BIA)	Dec 2004	Graham County	Nov 2005	Catalina	Sep 2008
San Carlos (BIA)	Dec 2004	Truxton Canon (BIA)	Dec 2005	Mohave County	Jun 2009
				Central Navajo County	Jun 2009

8 - Plans in development:

- Upper San Perdo River (in review)
- Pinal County / Oracle (draft complete)
- Blue Ridge Area
- Yuma
- Western Maricopa County
- Tohono O'Odam (BIA)
- Colorado River (BIA)
- Hopi (BIA)

Identified Communities-At-Risk:

192 - Communities in Arizona identified as at-risk from wildland fire.

119 - (62%) At-risk communities with completed CWPP or equivalent planning.

41 - (21%) At-risk communities included in CWPP planning in development. (Approximate)

This map is for informational purposes only and not intended as an authoritative document.
The Arizona State Forestry Division makes no warranties, implied or expressed, with respect to information shown.

Table RA-92: Completed Arizona Community Wildfire Protection Plans

Community / Area	Date Completed
Sitgreaves National Forest	July 2004
Mt Lemmon	July 2004
Apache National Forest in Apache County	August 2004
Rim Country	October 2004
Greater Flagstaff	October 2004
Yavapai Communities	November 2004
Fort Apache	December 2004
San Carlos	December 2004
Palominas	February 2005
Greater Williams Area	March 2005
Tusayan Area	July 2005
Grand Canyon	July 2005
Chiricahua County	November 2005
Greenlee County	November 2005
Graham County	November 2005
Truxton Canon	December 2005
La Paz River Communities	August 2006
La Paz Desert Communities	August 2006
Cascabel	September 2006
Arivaca Sasabe	November 2007
Sonoita Elgin	December 2007
Bisbee	March 2008
Catalina	September 2008
Mahave County	June 2009
Central Navajo County	June 2009
Blue Ridge Area	January 2010
Southern Gila County	May 2012
Total Arizona CWPP:	**27**

Source: Arizona Forestry Division, 2013

Work continues to encourage implementation of existing community plans and development of additional plans throughout the state. The flowing table lists communities with plans in development. Additional information is available from the Arizona State Forestry Division.

Table RA-93: Arizona Community Wildfire Protection Plans In-Development

Community / Area
Upper San Pedro River
Pinal County/Oracle
Yuma
Western Maricopa County
Tohono O'odham Nation

Colorado River
Hopi
Total Arizona CWPP In Development: 7

Source: Arizona Forestry Division, 2009

Vulnerability

Losses due to wildfire are estimated by intersecting the state-owned critical and non-critical facilities with the wildfire hazard threat zones depicted on Map 33. No standardized loss to ratios exist at this time, so for the purposes of this Plan, the loss to exposure ratio for state-owned critical and non-critical facilities located within "High" wildfire hazard areas are estimated to be 0.20 (20%), and 0.05 (5%) for those located in "Medium" hazard areas. No losses are estimated for low wildfire hazard areas.

As shown in the tables below, there are 412 state own facilities exposed to high wildfire hazard risk which amounts $20.8 million in losses to potentially impacted state-owned critical and non-critical facilities are estimated for the high wildfire hazard areas. This does not account for the additional 559 facilities exposed to a medium wildfire hazard risk that which could reach an additional 10.4 million in losses.

Table RA-94: State-Owned Asset Inventory Loss Estimates Based on Wildfire

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost	Estimated Structure Loss
High Hazard				
Apache	7	1.70%	1,802,198	360,440
Coconino	22	5.34%	4,053,195	810,639
Gila	72	17.48%	18,809,616	3,761,923
Graham	1	0.24%	0	0
La Paz	1	0.24%	38,221	7,644
Maricopa	145	35.19%	37,398,177	7,479,635
Mohave	30	7.28%	5,528,283	1,105,657
Navajo	4	0.97%	1,532,945	306,589
Pima	52	12.62%	24,013,694	4,802,739
Pinal	20	4.85%	1,663,574	332,715
Santa Cruz	7	1.70%	348,315	69,663
Yavapai	50	12.14%	9,242,394	1,848,479
Yuma	1	0.24%	1,406	281
Statewide Total	**412**	**100.00%**	**104,432,017**	**20,886,403**

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost	Estimated Structure Loss
Medium Hazard				
Apache	15	2.68%	1,282,833	64,142
Cochise	9	1.61%	2,991,491	149,575
Coconino	41	7.33%	4,335,484	216,774
Gila	58	10.38%	3,897,590	194,879
La Paz	29	5.19%	2,900,249	145,012
Maricopa	37	6.62%	35,667,611	1,783,381
Mohave	17	3.04%	1,682,469	84,123
Navajo	4	0.72%	1,161,822	58,091
Pima	176	31.48%	94,283,337	4,714,167

County	Facilities Exposed	Percentage of Statewide Exposure	Estimated Replacement Cost	Estimated Structure Loss
Pinal	63	11.27%	44,514,523	2,225,726
Santa Cruz	21	3.76%	3,115,763	155,788
Yavapai	84	15.03%	12,017,962	600,898
Yuma	5	0.89%	770,699	38,535
Statewide Total	**559**	**100.00%**	**208,621,832**	**10,431,092**

Table RA-95: State Facilities Located in the High Wildfire Hazard Area

State Facilities in the High Wildfire hazard Area	Apache	Cochise	Coconino	Gila	Graham	Greenlee	La Paz	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma	Total
Critical Facilities																
Banking and Finance Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Communications Infrastructure	0	0	2	0	0	0	1	3	1	1	1	0	0	2	0	**11**
Electrical Power Systems	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Emergency Services	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Gas and Oil Facilities	0	0	1	2	0	0	0	1	0	0	0	0	0	5	0	**9**
Government Services	0	0	9	34	1	0	0	67	4	3	16	0	0	19	0	**153**
Transportation Networks	0	0	0	3	0	0	0	0	0	0	7	0	0	7	0	**17**
Water Supply Systems	0	0	2	9	0	0	0	4	3	0	3	4	0	2	0	**27**
Non-Critical Facilities																
Businesses	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Cultural	0	0	5	0	0	0	0	0	2	0	0	0	0	0	0	**7**
Educational	0	0	1	5	0	0	0	8	0	0	9	0	0	0	0	**23**
Recreational/ Leisure	7	0	1	5	0	0	0	44	19	0	1	14	7	12	1	**111**
Residential	0	0	1	14	0	0	0	15	1	0	15	2	0	2	0	**50**
Total	**7**	**0**	**22**	**72**	**1**	**0**	**1**	**145**	**30**	**4**	**52**	**20**	**7**	**50**	**1**	**412**

Regarding human vulnerability, a total population of 1,485,027 people, or 23.2% of the total 2010 state population, is potentially exposed to a high wildfire hazard area (as shown in below). Of which 242,633 are over the age of 65, which are especially vulnerable to hazards due to mobility and health restrictions.

Table RA-96: Population Exposure to Wildfire

County	Total	Low	Medium	High	Total Exposure	Percent Exposed
Apache	71,518	48,936	9,516	1,720	60,172	84.1%
Cochise	131,346	39,515	24,198	9,238	72,951	55.5%
Coconino	134,421	44,860	20,156	3,488	68,504	51.0%
Gila	53,597	2,575	15,920	17,436	35,931	67.0%
Graham	37,220	17,320	909	3,594	21,823	58.6%
Greenlee	8,437	4,286	318	24	4,628	54.9%
La Paz	20,489	8,470	1,180	567	10,217	49.9%
Maricopa	3,817,117	198,074	163,582	80,960	442,616	11.6%
Mohave	200,186	41,692	40,796	8,273	90,761	45.3%
Navajo	107,449	57,125	9,215	9,978	76,318	71.0%
Pima	980,263	39,289	49,694	180,844	269,827	27.5%
Pinal	375,770	77,948	38,717	18,293	134,958	35.9%
Santa Cruz	47,420	25,559	5,547	728	31,834	67.1%
Yavapai	211,033	36,977	52,808	31,467	121,252	57.5%
Yuma	195,751	36,145	6,176	914	43,235	22.1%
Statewide Total	**6,392,017**	**678,771**	**438,732**	**367,524**	**1,485,027**	**23.2%**

Table RA-97: Over 65 Population Exposed to Wildfire

County	Total	Over 65	Over 65 Exposed	Over 65 Exposed
Apache	71,518	8,268	7,136	86.3%
Cochise	131,346	22,688	13,394	59.0%
Coconino	134,421	11,924	7,182	60.2%
Gila	53,597	12,450	8,636	69.4%
Graham	37,220	4,261	2,360	55.4%
Greenlee	8,437	1,016	742	73.0%
La Paz	20,489	6,683	3,953	59.1%
Maricopa	3,817,117	462,641	56,170	12.1%
Mohave	200,186	46,658	21,776	46.7%
Navajo	107,449	14,241	10,557	74.1%
Pima	980,263	151,293	49,308	32.6%
Pinal	375,770	52,071	20,061	38.5%
Santa Cruz	47,420	6,224	4,016	64.5%
Yavapai	211,033	50,767	31,283	61.6%
Yuma	195,751	30,646	6,060	19.8%
Statewide Total	**6,392,017**	**881,831**	**242,633**	**27.5%**

Based on the historic record, there is a distinct possibility for either deaths or injuries, although typically, most wildfire related deaths and injuries are associated with the fire-fight. There is also a high probability of population displacement for most of the inhabitants within the wildfire area during an event.

The compilation of risk assessment data from local plans, as shown below, indicates that approximately $48.2 billion in locally identified critical and non-critical facilities are exposed to wildfire hazard, with approximately $5.04 billion in potential losses estimated.

Table RA-98: Local Risk Assessment & Loss Estimates Based on Wildfire

County/ Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Apache	36,818	27,418	$4,353,765	$3,320,611	$350,389
Cochise**	59,633	3,927	$11,794,138	$773,618	$82,392
Coconino**	53,466	28,066	11823344	5568627	806554
Gila	29,170	10,718	4854321	1,649,551	$252,512
Graham	13,130	834	1935759	118,213	$9,308
Greenlee	4,078	302	$510,861	$27,951	$2,823
La Paz	16,200	1,111	$2,888,808	$734,321	$118,471
Maricopa	541,259	386	$164,894,580	$72,881	$10,844
Mohave	86,841	40,583	$14,065,296	$7,460,080	$492,466
Navajo	53,472	41,440	$7,668,023	$6,056,887	$890,391
Pima**	440,794	57,467	$96,840,841	$15,461,422	$1,269,697
Pinal	11,785	5,932	$13,472,739	$1,008,006	$72,656
Santa Cruz	14,217	747	$3,098,495	$158,910	$20,213
Yavapai	87,895	24,104	$16,149,585	$4,193,422	$504,202
Yuma	68,384	11,483	$12,584,649	$1,630,983	$160,269
Statewide Total	**1,517,142**	**254,518**	**$366,935,204**	**$48,235,483**	**$5,043,187**

Sources: Individual County plans fire vulnerability tables.

For a detailed vulnerability break down of exposure and potential losses by community see Community Vulnerability to Wildfire Loss (By County) in this Plan's Appendices.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Wildfire are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-99: State CPRI Results for Wildfire

Risk Due to Wildfire					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Wildfire	Highly Likely	Limited	< 12 hours	< One Week	**3.15**
	4	2	3	3	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30)+(Warning Time x .15)+(Duration x .10).

Table RA-100: County CPRI Results for Wildfire

County	CPRI
Apache	2.68

Cochise	2.55
Coconino	3.23
Gila	3.17
Graham	2.63
Greenlee	2.93
La Paz	2.80
Maricopa	2.43
Mohave	2.94
Navajo	2.53
Pima	2.58
Pinal	2.72
Santa Cruz	3.50
Yavapai	3.10
Yuma	2.43
Average	**2.84**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Wildfire are shown below.

Table RA-101: State Environmental CPRI Results for Wildfire

Environmental Risk Due to Wildfire				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Limited	6 months+	**2.1**
Soil	Unlikely	Limited	6 months+	**2.1**
Average CPRI Environmental Risk Rating: 1.7 (max 3.6)				

Consequences / Impacts

- **Public**
  The impact to the general public from wildfire is typically injuries (burns), illness (smoke inhalation & psychological) and even death. During fires that threaten populated areas, evacuation plans are exercised. Over the years, Arizona has evacuated thousands of residences, providing sheltering for the citizens as well as pets and livestock.
- **Responders to the Incident**
  Incident responders face the same threats the general public does, but on a more significant and probable level. In addition, responders can be hurt accessing fires in areas that have rough or steep terrain. The chance for injury, illness and/or death is very high for responders. The Dude Fire of 1990, sadly demonstrated the most severe threat to wildfire incident responders. This fire destroyed 63 homes and burned over 24,000 acres in the Tonto National Forest and killed six firefighters. Other threats to responders may include exhaustion, usually experienced

in very large fires that continue for extended periods of time and long term effects of environmentally caused diseases.

- **Continuity of Operations / Delivery of Services**
  As is discussed in other hazard sections of this Plan, the level of effectiveness of a specific facility/service would be dependent on the severity of the hazard and how much damage the facility and its equipment and files, etc. sustain. Even with certain critical facilities remaining operational, the performance and delivery of services may easily be hindered during an event due to damaged, closed and impassable roads. In the case of wildfire, travel may be affected by damaged transportation routes, no traffic control resulting from power outages and blocked routes due to downed trees and/or power poles. Smaller jurisdictions with little or no wildfire experience may have limited staff and resources which may inhibit their ability to continue operations/services. Arizona has several small, somewhat isolated communities in wildfire prone areas. These jurisdictions are less likely to have the ability to remain operational and self-sustaining during and after an event. Larger jurisdictions typically have more facilities, infrastructure, equipment and staff and are usually more spread out over multiple areas. This leaves these operations less vulnerable, especially when they can operate out of a variety of locations.

- **Environment**
  As experienced in 1992, the Rodeo Chediski Fire, the largest fire in Arizona history, significant damage to the land was sustained. Fifty-eight (58%) of the burned area experienced high intensity burn and extensive smoke damage occurred outside the direct burn area. As a result, the critical Little Colorado River, and Salt River watersheds are subject to increased erosion and siltation for years to come. The indirect effects of wildfire can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams thereby enhancing flood potential, which is a significant issue in Arizona and harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased landslide hazards.

- **Economic / Financial Condition of Jurisdiction**
  The Rodeo Chediski fire of 1992 caused an estimated $34 million in damages. More than 30,000 people evacuated and over 450 homes were destroyed. Additionally, an estimated $50 million dollars were spent fighting the fire. Neither of these estimates take into account the costs for post-fire assessments or rehabilitation, the economic impact/revenue loss to the recreation areas burned and loss of revenue and inventory destruction experienced by an Indian tribe’s timber company, just to mention a few.

- **Public Confidence in Jurisdiction’s Governance**
  As is typical of most natural hazards, swiftness of response is critical. The effects of fire have been, and continue to be, very destructive and disruptive to the jurisdiction, and the effects can extend well past the event period.

  Power outages are likely and travel may be hindered due to flood waters, debris and blocked roads. These issues further support the need for quick response and emergency work. In most events, it is almost inevitable that there will be some decrease in confidence in the jurisdiction’s capabilities. In the case of power outages, the cause may be damaged or complete loss of equipment as opposed to a simple repair. When major damage is done, it can take what appears to the consumer to be an excessive amount of time to restore all power. When damages are to this level, it is in the best interest of everyone involved to keep the public well informed of the damage extent, status of repairs and provide realistic expectations. Doing so may have a positive impact on the public’s confidence level by letting them know the situation is being resolved and is under control. Lack of communication can be mistaken for lack of action, resulting in frustration, anger, negativity, etc.

Resources

Definitions

Sources

Arizona Geological Survey, Online at: http://www.azgs.az.gov/

Arizona State Land Department, Division of Forestry. Online at: http://www.azsf.az.gov/

Southwest Coordination Center. Online at: http://gacc.nifc.gov/swcc/

U.S. Forest Service, Fire and Aviation Management. Online at: http://www.fs.fed.us/fire/

U.S. Dept of Interior, Bureau of Land Management, Fire and Aviation. Online at: http://www.blm.gov/nifc/st/en/prog/fire.1.html \

Western Forestry Leadership Coalition, West Wide Wildfire Risk Assessment (WWA), Online at: http://www.westwideriskassessment.com

References:

Arizona Republic, The, June 30, 2003, *Past Wildfires at a Glance*, http://www.azcentral.com/news/specials/wildfires/0630fireglance.html

Arizona Republic, The, June 20, 2003, *Largest Wildfires in Arizona History*, http://www.azstarnet.com/wildfire/30620WILD2fFIRESLIST2.html

FEMA, Interagency/Intergovernmental Watershed Task Force. September 2002. *Rodeo-Chediski Fire Watershed Recovery* Report, FEMA-DR-1422-AZ.

Federal Register. August 17, 2001. U*rban Wildland Interface Communities Within the Vicinity of Federal Lands That Area at High Risk From Wildfire; Notice*. Vol. 66, No. 160.http://www.fireplan.gov/reports/351-358-en.pdf

International Fire Code Institute.2000. U*rban-Wildland Interface Code*.

Southwest Coordination Center, 2009. *Southwest Area Fires and Acres by State,* http://gacc.nifc.gov/swcc/predictive/intelligence/ytd_historical_data/historical/wf/average/average_per_year_suppression.pdf

Arizona Emergency Information Network. *Emergency Bulletin* dated 6/1/2011, http://www.azein.gov/azein/Lists/Announcements/DispForm.aspx?ID=1583

InciWeb Incident Information System, News Release dated 7/21/2011, http://www.inciweb.org/incident/2262/

Winter Storms

Introduction/History

Winter storms in Arizona include heavy snowfall, freezing rain and sleet. Heavy precipitation associated with winter storms has the potential to collapse roofs, topple trees and power poles, and cause road closures due to rapid accumulation of ice or snow. Winter highway closures can be deadly as travelers may be stranded in freezing temperatures, or injured in collisions as drivers lose control on slippery roads. Since 2000, at least 81 winter storms were identified in Arizona, of which 13 fatalities, 20 injuries, and approximately $120,000 in damages were reported (NCDC Storm Event Database). The following are some of the largest winter storms in Arizona's history:

- January 18-21, 2010. Heavy snow fell across much of the northern areas of the state and the higher elevation southern areas and mountains, closing roadways and causing numerous traffic problems and stranded vehicles. DPS responded to over 150 requests for help, 14 non-injury collisions, and four injury collisions. The Flagstaff Police department responded to 50 slide-offs and 21 requests for help. There were 16 non-injury collisions and 2 injury collisions in the Flagstaff city limits. There was one fatal crash about 6 miles east of Flagstaff (NCDC Storm Event Database). The winter storm impacts, combined with heavy flooding at lower elevations, prompted a federal disaster declaration (FEMA-1888-DR).
- November 28, 2009. The early stages of an approaching winter storm caused a bridge to ice up on I-17 near Munds Park. A semi slid on the ice, crossed a median and struck an officer investigating a van rollover. The officer was pinned under a third vehicle, other drivers were able to lift the vehicle off the officer, free him, and call for help. He was taken to a local hospital where he was in critical but stable condition. Property damages were estimated to exceed $100,000 (NCDC Storm Event Database).
- October 28, 2009. A departing low pressure center brought snow showers and cold conditions to the Flagstaff area during the afternoon and early evening which lead to icy roads and few dozen car wrecks. The Department of Public Safety reported 11 collisions, Coconino Co Sheriff's Office reported 7 traffic accidents with injuries, and the Flagstaff Police Dept reported 14 traffic accidents. A parked DPS patrol car was hit and totaled by a truck that slid on the ice on I-40 just west of Flagstaff. The officer was out of his vehicle investigating a single vehicle roll over and was not hurt. Property damages were estimated to exceed $400,000 (NCDC Storm Event Database).
- December 15-18, 2008. A winter storm in northern Arizona dropped 24 inches of snow at 7,000 ft, and nearly 48" at 9,000 ft. resulting in hazardous road conditions with the Department of Public Safety reporting 188 cars sliding off the highway in northern Arizona, and 65 collisions, 12 with injuries (NCDC Storm Event Database).
- March 16, 2008. An intense winter snow shower reduced visibility to zero on Interstate 40 near Flagstaff, leading to a 139 vehicle pile-up covering 4 miles on both sides of the highway. Eastbound lanes were closed for 14 hours, westbound for 16 hours. Two deaths were reported, along with 10 people hospitalized with serious injuries and another 35 people treated and released NCDC Storm Event Database).
- November 2001. The first storm of the season with measurable snow caused dozens of rush-hour traffic accidents along the Mogollon Rim, resulting in 1 fatality and 5 injuries. Most of the accidents occurred on Flagstaff City streets as the roads became snow packed and icy. City police handled more than 40 accident calls. County officials reported less than ten accidents. Jack-knifed semis caused east bound traffic on I-40 to come to a standstill 5 miles east of Williams. There was a fatal crash on I-40 three miles east of Seligman (NCDC Storm Event Database).

- March 2000. A winter storm dropped between 1 and 1 1/2 inches of rain in the Tucson area, with nearby mountains receiving about 24 inches of snow. Temperatures hovered around freezing and approximately 500 illegal aliens surrendered themselves to nearby homes or passing motorists. Wearing only t-shirts and using plastics bags as rain gear they were treated for various stages of hypothermia and injuries they received while walking through the desert. Two fatalities and ten injuries from exposure were reported in an area 50 miles southwest of Tucson (NCDC Storm Event Database).
- January 1997. A winter storm created snowfall at unusually low elevations across southern Arizona. A trace of snow was recorded at Tucson, and 4 to 10 inches at elevations between 4,000 and 6,000 feet. The storm closed schools, stranded many motorists, caused broken water pipes, and caused the fatality of many ostriches at commercial farms, resulting in an estimated $100,000 in damages (NCDC Storm Event Database).

Potential Secondary/Cascading Effects

Secondary effects of winter storms can include erosion of hillsides due to loss of trees from avalanches, springtime flooding from large winter snow events, and the potential for hypothermia from power outages.

Probability and Magnitude

Snow level measurements are recorded daily across the United States and can be used to estimate the probability and frequency of severe winter storms. In Arizona, there is a 5% annual chance that snow depths between zero and 9.8 inches will be exceeded, a snowfall probability that is among the lowest in the nation (FEMA, 1997). However, snowfall extremes can occur in Arizona and have serious effects. The table below summarizes the snowfall records for Arizona since 1950.

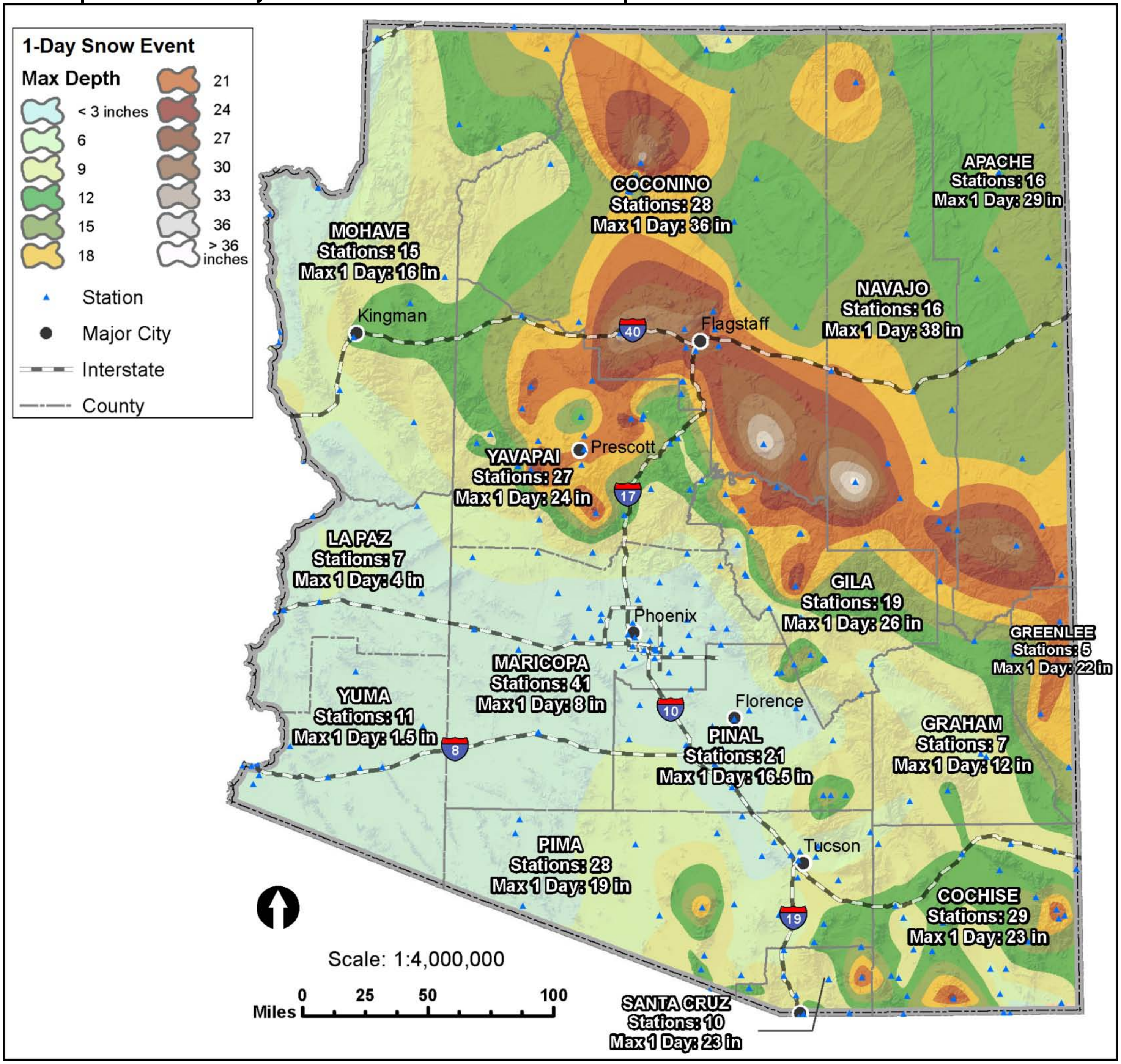
Table RA-102: Snowfall Records in Arizona

Event	Amount	Date	Location
Record Maximum Winter Snowfall	400.9”	1972-73	Sunrise Mountain
Record Maximum 1-Day Snowfall	38.0”	14 December 1967	Heber Ranger Station
Highest Average Annual Snowfall	243.0”	--	Sunrise Mountain

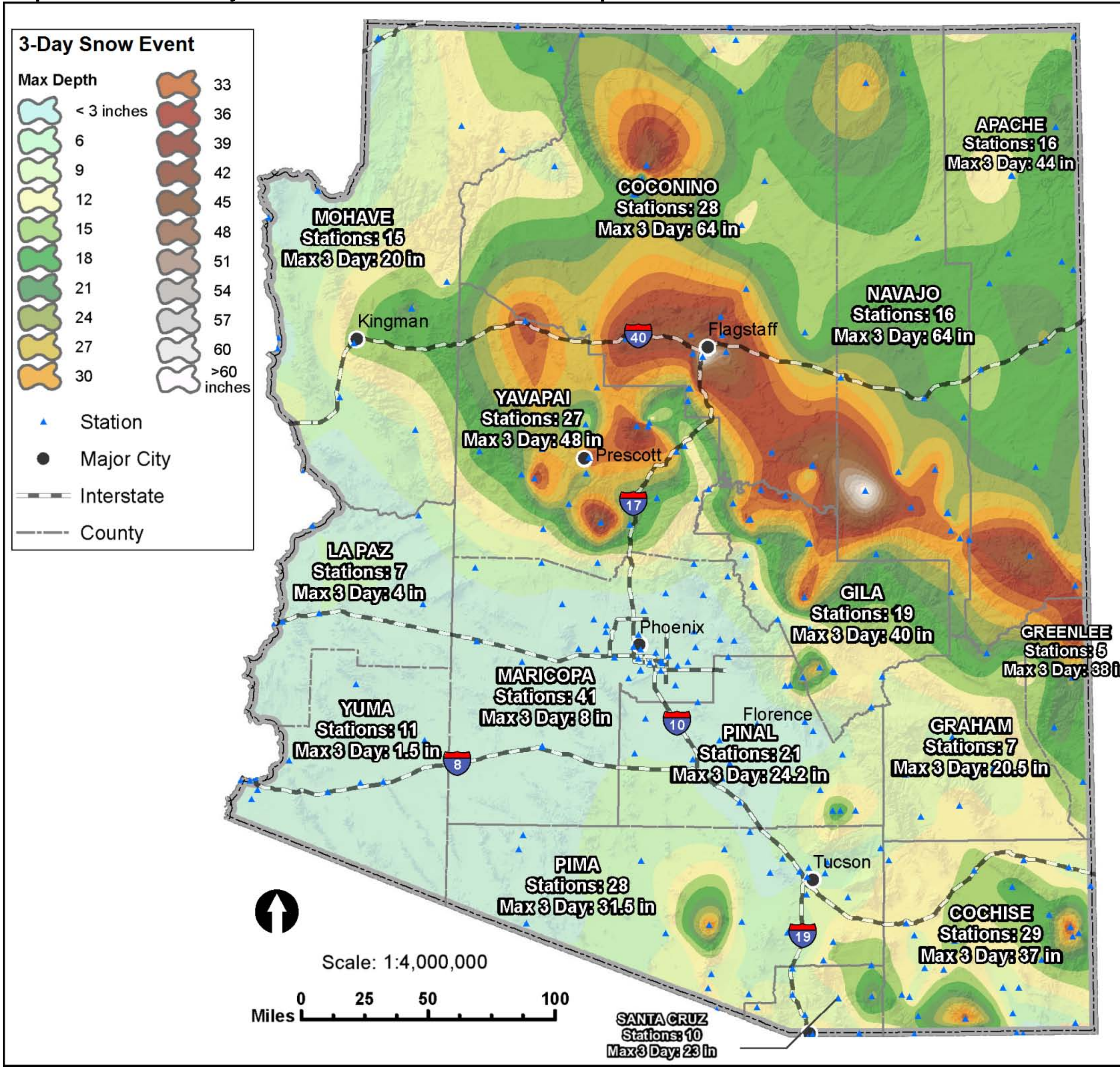
Source: Office of the State Climatologist for Arizona, 2009.

The NCDC maintains a snow climatology data set that contains maximum 1-day, 2-day, and 3-day duration snow depths at various weather stations across the nation. The data reflects the maximum depth of snowfall recorded as of 2006. Maps 34 and 35 represent a graphical depiction of zones of historically maximum snow depths for the 1- and 3-day durations for the state. Bordering gage stations in California, Nevada, Utah, Colorado, and New Mexico were also used to ensure that no boundary effects were created. See following maps for location based analysis results.

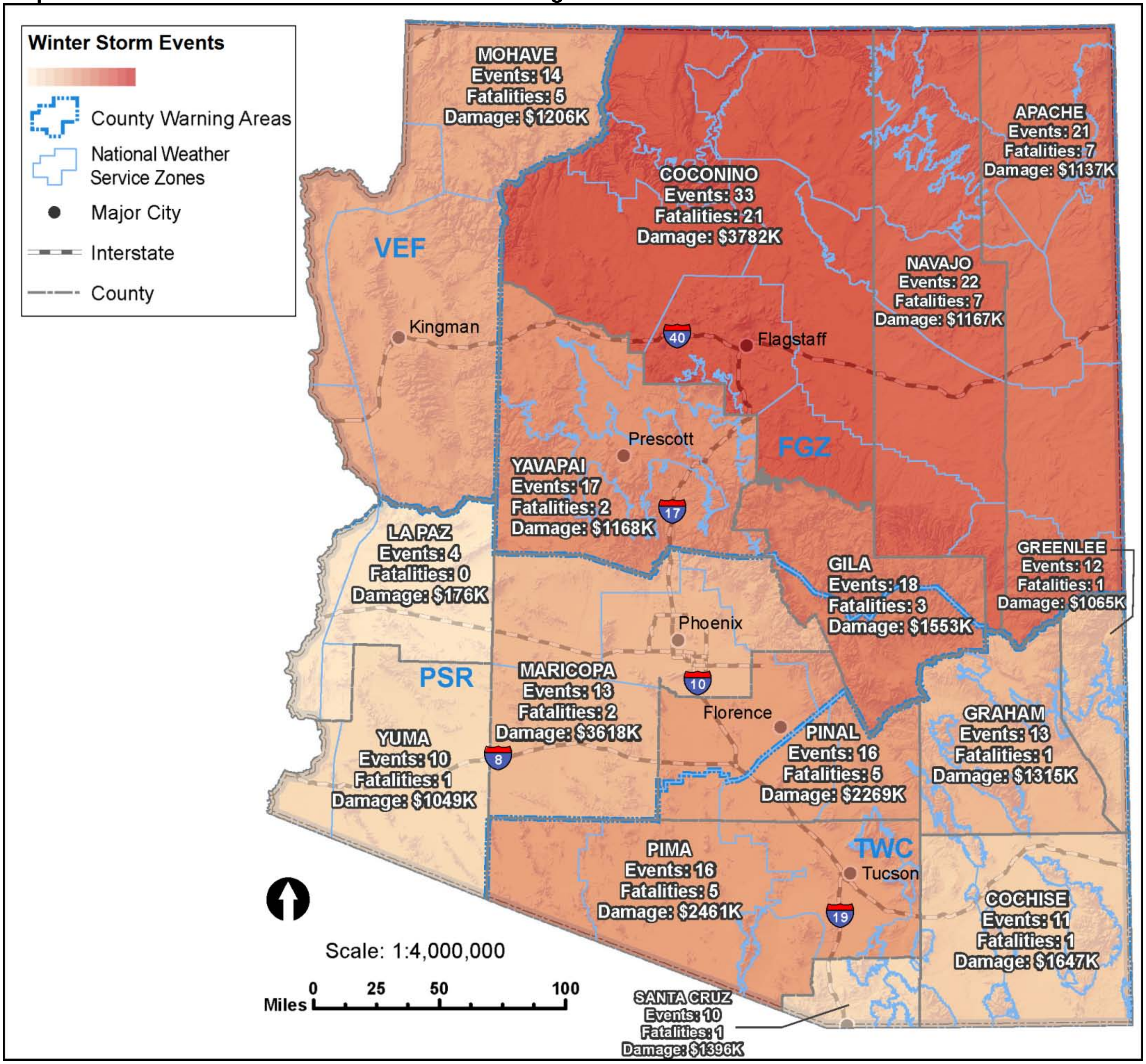
Map RA-19: One Day Maximum Winter Storm Snow Depth



Map RA-20: Three Day Maximum Winter Storm Snow Depth



Map RA-21: Severe Events of Winter Storm Damage



Vulnerability

The National Weather Service in Flagstaff uses the following criteria for issuing warnings about winter storm weather:

Blizzard Warning: Sustained winds or frequent gusts of 35 mph or more, AND visibility frequently below 1/4 mile in considerable snow and/or blowing snow, AND above conditions are expected to prevail for 3 hours or longer.

Winter Storm Warning: Issued when more than one winter hazard is involved producing life threatening conditions, such as a combination of heavy snow, strong winds producing widespread blowing and drifting snow, freezing rain, or wind chill. The tables below provide Snow warning and Snow Advisory Criteria.

Blowing Snow Advisory Criteria: Visibility frequently at or below 1/4 mile.

Wind Chill: Issued for a wind chill factor of minus 20 degrees Fahrenheit or colder.

Freezing Rain/Drizzle, or Sleet: widespread, dangerous, and damaging accumulations of ice or sleet.

Frost or Freeze Warning: Issued when temperatures are critical for crops and sensitive plants. Criteria is season dependent, but usually a freeze warning is appropriate when temperatures are expected to fall below freezing for at least 2 hours.

Table RA-103: Heavy Snow Warning Criteria

Elevation	Inches / 12 HR	Inches / 24 HR
Above 8500 ft	12 inches/12 hrs	18 inches/24 hrs
7000 to 8500 ft	8 inches/12 hrs*	12 inches/24 hrs*
5000 to 7000 ft	6 inches/12 hrs	10 inches/24 hrs
Below 5000 ft	2 inches/12 hrs	4 inches/24 hrs

*(Flagstaff is located in this elevation criteria)

Table RA-104: Snow Advisory Criteria

Elevation	Inches / 12 HR	Inches / 24 HR
Above 8500 ft	6 to 12 inches/12hrs	12 to 18 inches/24 hrs
7000 to 8500 ft	4 to 8 inches/12 hrs*	8 to 12 inches/24 hrs*
5000-7000 ft	3 to 6 inches/12 hrs	6 to 10 inches/24 hrs
Below 5000 ft	1 to 2 inches/12 hrs	2 inches/24 hrs**

*(Flagstaff is located in this elevation criteria) **or snow accumulation in any location where it is a rare event.

Though winter snows are the lifeblood of water supplies for a large part of northern Arizona, snow and freezing rain due to winter storms are the second most costly and deadly natural hazard to the area. Severe winter storms affect many aspects of life in the County, including; transportation, emergency services, utilities, agriculture and the supply of basic subsistence to isolated communities. Interstates 40 and 17 have produced numerous fatal multi-car accidents due to heavy winter snowfall and icy road conditions. Heavy snowfalls can also leave motorists stranded in their vehicles with potentially disastrous results like hypothermia and carbon-monoxide poisoning. Significant snowstorms can also hinder both ground and air emergency services vehicles from responding to accidents or other emergencies. Remote areas and communities can be easily cut-off from basic resources such as food, water, electricity, and fuel for extended periods during a heavy storm. Extremely heavy snowstorms can produce excessive snowloads that can cause structural damage to poorly-designed buildings. Agricultural livestock can also be vulnerable to exposure and starvation during heavy snowstorms.

Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Winter Storms are shown below. County CPRI average values are also given below. These figures are based on information provided in their current respective mitigation plans.

Table RA-105: State CPRI Results for Winter Storms

Risk Due to Winter Storms					
Hazard	**Probability**	**Magnitude/ Severity**	**Warning Time**	**Duration**	**CPRI Score (max: 4)**
Winter Storms	Likely	Critical	>24hours	< 24 hours	**2.45**
	3	3	1	2	

CPRI Score = (Probability x .45)+(Magnitude/Severity x .30) +(Warning Time x .15)+(Duration x .10).

Table RA-106: County CPRI Results for Winter Storms

County	CPRI
Apache	2.59
Cochise	No Data
Coconino	3.15
Gila	2.39
Graham	No Data
Greenlee	No Data
La Paz	No Data
Maricopa	No Data
Mohave	No Data
Navajo	2.67
Pima	2.06
Pinal	No Data
Santa Cruz	No Data
Yavapai	2.64
Yuma	No Data
Average	**2.58**

Source: Arizona county hazard mitigation plans.

Environmental Risk & Vulnerability

Based on the *Index Values* and *Assigned Weighting Factors* determined in the Environmental Risk CPRI table discussed at the beginning of this section and updated by the Planning Team, the results based on Winter Storms are shown below.

Table RA-107: State Environmental CPRI Results for Winter Storms

Environmental Risk Due to Winter Storms				
Component	**Probability of an Impact**	**Magnitude/ Severity**	**Duration of Impact/Damage**	**CPRI Score (max: 3.6)**
Air	Unlikely	Negligible	< 1 month	**.90**
Water	Unlikely	Negligible	< 1 month	**2.1**
Soil	Unlikely	Negligible	6 months+	**1.8**
Average CPRI Environmental Risk Rating: 1.6 (max 3.6)				

Consequences/Impacts

- **Public**
  For the purpose of this Plan, winter storms are characterized by cold wind accompanied by blowing snow, freezing rain or sleet and cold temperatures. Heavy snowfalls can leave residents and travelers stranded in their homes or vehicles with potentially disastrous results like exposure, hypothermia and carbon-monoxide poisoning. Our interstates have produced numerous fatal car accidents due to heavy winter snowfall and icy road conditions. In Arizona, since 2009, there have been 3 fatalities and 19 injuries due to winter storm activity. The highest threat to public health and safety are in the northern part of the State.
- **Responders to the Incident**
  Incident responders face the same threats as the general public, but on a more significant and probable level. Responders can be hurt while attending to vehicle accidents by other drivers on the road who are unaware of the crash due to low visibility. Responders also face injury when accessing victims in vehicles that may have driven off the roadway into areas that have rough or steep terrain. The chance for injury, illness and/or death is very high for responders. Other threats to responders may include exhaustion and injuries due to temperature extremes. Additionally, significant snow storms can hinder both ground and air emergency service vehicles from responding to accidents or other emergencies.
- **Continuity of Operations / Delivery of Services**
  The performance and delivery of services may easily be hindered during a winter storm event due to damaged, closed and impassable roads. In the case of winter storms, travel may be affected by loss of traffic control resulting from power outages and blocked routes due to downed trees and/or power poles. Northern Arizona has several small, somewhat isolated communities that are prone to winter storms. These jurisdictions are less likely to have the ability to remain operational and self-sustaining during and after an event. Larger jurisdictions typically have more facilities, infrastructure, equipment and staff and are usually spread out over multiple areas. Having a larger framework of infrastructure and equipment reduces the vulnerability of the jurisdictions' continuity of operations, especially when they operate out of a variety of locations.
- **Environment**
  Typically, there is not a significant risk posed to the environment from the effects of winter storms.
- **Economic / Financial Condition of Jurisdiction**
  According to the NCDC and SHELDUS databases for northern Arizona, especially for Coconino County, winter storms are second most costly and deadly natural hazard to that area. Severe winter storms affect transportation, utilities, agriculture and the supply of basic subsistence. Significant damage to these areas can cause economic hardship through loss of

revenue, business and increased costs of basic supplies to shortage of supply. Damage and/or loss of crops and livestock can also result in revenue and supply losses.

- **Public Confidence in Jurisdiction's Governance**
  As with all disaster events, swiftness of response and recovery to the effects of winter storms is critical. Winter storms have and can continue to be disruptive to, mainly the northern portion of the State. Power outages are likely and travel may be hindered due to blocked roads. These issues further support the need for quick response and emergency work. As with any event, quick response is imperative, but it is almost inevitable that there will be some decrease in confidence in the jurisdiction's capabilities. In the case of power outages, the cause may be damaged or complete loss of equipment as opposed to a simple repair. When major damage is done, it can take what appears to the consumer to be an excessive amount of time to restore all power. During all disaster events and especially when it reaches points like this, it is in the best interest of the jurisdiction to keep the public well informed of the damage extent, status of repairs and provide realistic expectations. Doing so may have a positive impact on the public's confidence level.

Resources

Sources:

AZ Department of Emergency Management Reports

National Weather Service Winter Storm Warnings.

National Climatic Data Center. Various years.
Storm Events Database – online: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

NOAA Storm Prediction Center Warnings Archive: http://www.spc.noaa.gov/wcm/index.html#data

Spatial Hazard Events and Losses Database for the United States (SHELDUS), 2011.
http://webra.cas.sc.edu/hvri/products/sheldus.aspx

References:

Federal Emergency Management Agency, 1997, *Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy.*

U.S. Dept of Commerce, National Climatic Data Center, 2006, *Snow Climatology and Extremes*, accessed online at: http://www.ncdc.noaa.gov/ussc/USSCAppController?action=map

5. Mitigation Strategy

Section Changes

Mitigation Actions & Funding Sources – These topics have been updated accordingly to include information on the hazards added to this Plan revision: Disease, Hazardous Materials Incidents and Terrorism.

Hazard Mitigation Activity in Arizona – Includes a more comprehensive table of recent mitigation projects as well as two new and much more recent mitigation project stories.

Hazard Mitigation Goals

Requirement: §201.4(c)(3)(i): [The mitigation strategy shall include a] description of State goals to guide the selection of activities to mitigate and reduce potential losses.

The State's mitigation mission is "Reduce the risk to people and property from natural and human-caused hazards." Because we feel our mission is all encompassing, we adopted it as our one and only goal for this Plan. The goal was assessed by the Planning Team and determined that it will remain as it provides a foundation for clear objectives that result in actions that are clear and concise, without a complex and confusing structure as was seen in the original plan. The actions are discussed later in this section. The goal supporting objectives are:

1. Reduce or eliminate risks that threaten Arizona's citizens.
2. Reduce risk to critical facilities and infrastructure from natural and human-caused hazards.
3. Promote hazard mitigation throughout the State.
4. Assist local jurisdictions in implementing/sustaining their mitigation programs.
5. Increase public awareness of Arizona's hazards and risks.
6. Pursue hazard mitigation project funding sources.

This simplified goal/objective structure is presented to our local jurisdictions as an option for use in their plans. The structure, slightly changed by the jurisdictions, has been adopted as part of several of our county multi-jurisdictional plans' Mitigation Strategy.

State Capability Assessment

Requirement: *§201.4(c)(3) (ii):* [The State mitigation strategy shall include] a discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: An evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; [and] A discussion of State funding capabilities for hazard mitigation projects.

An overview of our hazard mitigation capabilities is provided below and addresses the way the State's existing capabilities can aid the mitigation effort, as well as areas needing strengthening.

Areas of discussion regarding the State Capability Assessment include:

- State Laws, Regulations, Policies, and Programs
- State Funding Capabilities
- Current/Potential Funding Sources
- Hazard Mitigation Activity in Arizona

State Hazard Mitigation Laws, Regulations, Policies, and Programs

Arizona has a long history of hazard mitigation. Beginning in 1978, the State began a program to acquire or relocate hundreds of homes out of the floodplains and Arizona passed legislation requiring each county to have a flood control district and also created a professional organization for floodplain managers.

The Governor, executive leadership, and the State Legislature are keenly aware and supportive of the State's emergency management laws, regulations, policies and programs. The Governor has instituted councils, committees and a task force which address many of the pre-hazard, post-hazard and development issues facing Arizona communities.

The following information provides program data regarding the state's pre- and post-hazard management policies, programs and capabilities along with global summary evaluation at the end.

PRE & POST-HAZARD

Arizona Div of Emergency Management (ADEM)

Arizona Revised Statutes (ARS), Title 26, establishes the ADEM under the DEMA. Title 26 states the Division shall prepare for and coordinate those emergency management activities that may be required to reduce the impact of disaster on persons or property. ADEM is organized into four operational sections: Logistics, Preparedness, Operations, and Recovery. ADEM is also responsible for the administrative oversight of the Arizona Emergency Response Commission. The Mitigation Office falls under the Operations Section.

<u>The Mitigation Group</u> is staffed by four employees, including the State Hazard Mitigation Officer, Grant Program Manager, State and Local Hazard Mitigation Planning Program Manager and an Administrative Assistant.

The Operations Section coordinates emergency response and conducts hazard mitigation planning through the coordination and application of federal and state resources. It liaises with federal, state and local agencies to conduct a daily all-hazard threat assessment to ensure the emergency management community is not caught unaware.

<u>The Recovery Section</u> manages the Public Assistance Program (406 Mitigation). The Recovery Section is extremely proactive in regards to 406 Mitigation on federal as well as state disasters. Each Disaster Recovery Coordinator has received training on hazard mitigation and works with the subgrantees to include any and all potential 406 Mitigation measures in the project worksheets. The Arizona Administrative Code (R8-2-314) states, "The applicant shall comply with any mitigation requirements specified by the Director for repair or replacement projects subject to repeated damage from flooding or other threats to life or property", which advocates for mitigation on Public Assistance projects. The Mitigation Office and the Recovery Section coordinate very closely before, during and following disasters.

<u>The Governors Emergency Fund (GEF)</u> receives $4,000,000 annually from the State's General Fund to assist government agencies, local governments, and political subdivisions of the State of Arizona respond to and recover from state declared emergencies. This fund is also used on federal disaster declarations for the state's cost share. If there are funds available at the end of the state fiscal year, those monies may be used for mitigation projects that substantially lower the risk to people and property from natural and human-caused hazards. The Governor has the authority to declare an emergency within the state and allocate up to $200,000 per declaration. The State Emergency Council (SEC) allocates from the GEF once the Governor's authorization level is maximized.

<u>The Preparedness Section</u> is responsible for the State of Arizona Emergency Response and Recovery Plan (SERPP) which addresses the consequences of any emergency, disaster or incident in which there is a need for state resources in providing prevention, preparedness, response and/or recovery assistance activities. It is applicable to natural hazards and human-caused incidents. The Recovery and Mitigation Annex within the SERPP was consolidated and has been completely revised in mid-2007 as part of ESF #14.

The Arizona State Emergency Response Commission (AZSERC) oversees 15 Local Emergency Planning Committees and supports community, industry and government and academia in: planning, release and incident reporting, data management guidance for inventory reporting, public disclosure about hazardous chemicals and development of training and outreach programs. Also provides consultative services, workshops and coordinates development and review of plans and programs for local planning committees.

Arizona Dept of Water Resources (ADWR)

The Director of the ADWR has a vested authority in administering of surface water, its appropriation and distribution, and of groundwater to the extent provided by this Title 26 of the Arizona Revised Statutes, except distribution of water reserved to decreed rights.

The Engineering Section of ADWR's Surface Water Division performs Dam Safety and Flood Mitigation activities.

The Engineering Section's objectives are to maximize the protection of the public against loss of life and property by reducing the likelihood of catastrophic failure of jurisdictional dams and to assist communities, counties and local jurisdictions that participate in the National Flood Insurance Program (NFIP). The section administers the Community Assistance Program; the RiskMAP program to assist in delineation of floodplains; establishes State Standards for floodplain management; and coordinates the planning, design, and construction of flood warning systems to reduce the likelihood of loss of life by providing real-time flood information to the National Weather Service and other entities through the Arizona Flood Warning System. The section also coordinates with local, state, and federal entities during post-disaster flood and wildland fire emergencies. Additionally, the section is responsible for statewide NFIP coordination regarding repetitive loss (RL) and server repetitive loss (SRL) properties. Coordination includes but is not limited to collection and distribution of the most current RL/SRL property list from FEMA. ADEM uses both FEMA and ADWR as a resource for these properties. ADWR coordinates education for officials of jurisdictions with RL & potential SRL properties during their scheduled Community Assistance Visits (CAV).

ADWR's Drought Program coordinates drought preparedness and response activities through monitoring, state agency coordination and facilitation of local-level planning. The following activities include:

- New Arizona Revised Statutes, established in 2005 require drinking water providers to develop water supply, conservation and drought plans. The requirements also expand annual water use reporting to the entire state (for community water systems).
- The State Drought Monitoring Technical Committee gathers and evaluates drought, climate and weather data and distributes that information to land managers, policy-makers and the public. An important goal of the committee is to provide early warning of changes in drought severity. Drought status maps and drought status updates are provided on a monthly basis.
- ADWR is working with local leaders around the state to establish county-level drought impact groups. The goals of these groups are to monitor drought status and impacts in their area, increase drought public awareness and develop local mitigation and response options.
- The Governor's Drought Interagency Coordination Group is comprised of state, federal, tribal and non-governmental organizations. Biannually, this group meets and advises the governor on drought status, impacts and any necessary preparedness and response actions.

Governor Napolitano established the Governor's Drought Task Force to address drought issues facing Arizonans. In October 2004, the Task Force finalized the Arizona Drought Preparedness Plan. The goals of the Plan were to identify the impacts of drought to the various sectors of water users, define sources of drought vulnerability, outline monitoring programs, and prepare response options and mitigation strategies to reduce drought impacts

Arizona Dept of Administration (ADOA) Risk Management Section

The focus of the ADOA, Risk Management Section as it relates to mitigation is to protect the State's assets from loss. Risk Management was established in 1976 to provide insurance coverage to state agencies and employees for property, liability and workers' compensation losses in accordance with the statutory provisions found in A.R.S Section 41-621through Section 41-625.

Risk Management has the responsibility for making and carrying out decisions that will minimize the adverse effects of accidental losses that involve state government assets. In order for Risk Management to fulfill the responsibility of preventing or reducing the potential severity of losses, it is essential to identify the type of assets exposed to loss; the perils or hazards that could cause loss; the state agency that could suffer the loss; and the potential financial consequence of the loss on the agency's operations.

Insurance: A.R.S. Section 41-621 through Section 41-625 provide for insurance or self-insurance of the following: all state-owned buildings, including those of the three state universities; all property owned by the state; all officers, agents and employees of the State against liability for acts or omissions of any nature while acting in authorized governmental or proprietary capacities, except as prescribed by statute; workers' compensation injuries of state employees; and environmental damage and health threats associated with state-owned/operated property and facilities.

A.A.C., Title 2, Chapter 10 of the Administrative Code supplements the statutes and provides guidelines for coverage and claims procedures, loss prevention programs, purchase of insurance, environmental losses, and the Provider Indemnity Program.

Risk Managements responsibilities for insurance and self insurance include: evaluation of risk financing alternatives; procurement of commercial insurance when appropriate; and allocation of costs for property, liability and worker's compensation among agencies.

Arizona Dept of Fire, Building & Life Safety/State Fire Marshal

This office was established within the Department of Building and Fire Safety to promote public health and safety and to reduce hazards to life and property. The State Fire Marshall's Office performs its duties by performing inspections, fire investigations, providing public education by conducting workshops and by adopting fire protection codes.

Arizona State Land Dept (ASLD)

The ASLD was established to manage state trust lands and resources while enhancing the value and optimizing the economic return. The ASLD also manages and provides support for resource conservation programs for the well-being of the public and the state's natural environment.

The ASLD has several Divisions that have some type of mitigation responsibilities.

The Natural Resources Division administers all natural resource-related leases, Natural Resource Conservation Districts and any natural resource issue affecting state trust land.

Real Estate Division provides support for state lands in sales, commercial leasing and rights of way. The Real Estate Division offers for lease and sale properties within the growth path of major metropolitan areas. In addition, they also prepares for state land disposition through planning and engineering studies.

The Forestry Division provides for the prevention and suppression of wildfires on state and private lands, located outside incorporated municipalities, through the use of various cooperative agreements. The Forestry Division also maintains in-house overhead and firefighting capabilities through the qualifications of its own employees. They provide technical, educational, and financial assistance to rural communities and private land owners in management of their forested lands. The Forestry Division also manages the Firewise Program which promotes fire-safe landscaping and construction practices to help reduce the loss of property from wildfire. The Firewise Program minimizes the negative effects of wildfire on public life, safety, and property by promoting fire-safe landscaping and construction practices to help reduce the loss of property from wildfire.

The Fire Management Assistance Program (FMAG) was authorized by the Disaster Mitigation Act of 2000 and provides for the mitigation, management and control of fires that threaten such destruction as would constitute a major disaster and is administered by the ASFD.

Within the authority of the ASLD Forest Stewardship Plans are written and implemented by natural resource professionals to guide landowners in reducing the risk of wildfire, insects and disease, protecting soil and water quality, providing timber and other forest products, improving fish and wildlife habitat, and maintaining the landscape's natural beauty.

PRE-HAZARD

Arizona Floodplain Manager's Association
Promotes the common interest in flood hazard mitigation, enhance cooperation between private, local, state and federal agencies and encourage and ensure new approaches to managing the State's floodplains.

Arizona Geological Survey (AZGS)
AZGS conducts geological hazard mapping of floods, earth fissures, landslides, earthquakes, and post-fire effects. They are charged with constructing and disseminating geological hazard information, and with providing technical expertise to state and local jurisdictions regarding hazards, hazard assessments, and mitigation plans.

Arizona Water Banking Authority (AWBA)
Stores unused Arizona Colorado River water to meet future needs for: Assuring adequate supply to municipal and industrial users in times of shortages or disruptions of the CAP system; Meeting the management plan objectives of the Arizona Groundwater Code; Assisting in the settlement of Indian water rights claims; and Exchanging water to assist Colorado River communities.

Governor's Forest Health Councils
The mission of the *Forest Health Advisory Council* is to develop guiding principles for the design and implementation of restoration-based fire fuels reduction and forest health restoration projects based on the best available science; to monitor and evaluate results of existing restoration projects in Arizona, to identify new strategies and opportunities for demonstrating restoration-based hazardous fuels reduction and other forest health restoration techniques; to identify the resources to fund demonstration projects; and to evaluate existing and potential sustainable economic uses for small diameter trees that are compatible with long-term protection of forest health and economic development goals.

Emergency Preparedness Oversight Committee (EPOC)
The EPOC serves to oversee and ensure coordination of the numerous federal, state and local homeland security and emergency management initiatives, programs and resources. The EPOC meets bi-monthly, is co-chaired by the Governor's Chief of Staff and the Director of the Arizona Department of Homeland Security. Membership includes key cabinet officials, local government and private sector stakeholders.

POST HAZARD

Arizona Fire Chiefs Association
The AFCA, through cooperation with the ADEM, ASLD, the Arizona Fire District Association, and the professional fire Fighters of Arizona developed the Arizona Fire Service Mutual Aid Plan to provide immediate response resources for all-risk emergencies. The purpose of the plan is, in the absence of, or in support of a declaration of emergency, provide for the systematic mobilization, organization, and operation of necessary fire and rescue resources within the state and its political sub-divisions in mitigating the effects of disasters, whether natural or human-caused. The Arizona Fire Service Mutual Aid Plan is also included in the Arizona's State Emergency Response and Recovery Plan.

DEVELOPMENT

Greater Arizona Development Authority (GADA)
Assists Arizona communities and tribal governments with the development of public infrastructure projects that enhance community and economic development.

Evaluation Assessment for Various State Capabilities

A challenge the Mitigation Office has had over the years is not being able to provide enough education and outreach regarding the definition of mitigation along with grant program information. However, in 2008 we developed a brochure which contains information on the grant programs, potential mitigation actions for Arizona's top hazards, and also includes information for pets and special needs populations. We have made the same brochure, with different inserts focusing on mitigation grant programs, available for our local governments. Our website was re-designed to be more comprehensive and contains grant program information, downloadable forms, mitigation tips, and much more valuable information. We anticipate our outreach benefiting emergency management agencies, potential applicants, local governments and citizens of Arizona due to the variety of information on Arizona's risks, grant programs and potential mitigation measures. The Mitigation Office will continue to apply for grants to assist us with future outreach and mitigation projects.

The Governor's Drought Task Force task force has determined that one of their challenges is a need for drought planning in fast-growing rural communities where water supplies are very limited and where the economic pillars of recreation, ranching, forestry and tourism are extremely sensitive to drought. This seems to be a sensitive issue and there needs to be flexibility to avoid a cookie-cutter approach statewide. The goal is to have a conservation plan that is tailored to each individual community.

The various councils and committees that have been instituted by Governor Napolitano focus on developing strategies to overcoming the challenges Arizona faces. The councils and committees bring local, state and federal stakeholders together to develop a unified approach to resolve forest health, drought and growth related issues, plus much more. It is very positive step in the right direction for Arizona.

Although the Arizona Revised Statutes, Title 26, gives the Director of the Arizona Department of Water Resources the authority to fund flood control projects and flood warning projects, but both are currently unfunded. These funding shortcomings could be avoided if there was a specific revenue source instead of legislative appropriations.

Many of the agencies and programs are challenged and/or threatened due to lack of funding and are possibly relying on external sources to fund their activities.

Local Capability Assessment

Requirement: §201.4(c)(3) (ii): [The State mitigation strategy shall include]: a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

There are numerous programs and policies that originate at the State level and are implemented on the local level. In addition, each County has developed its own specific requirements and capabilities in response to their own particular context and needs. This section discusses some of those policies and programs and broadly describes how they translate into capabilities at the local level.

During this Plan update, we reached out to each County Emergency Manager in the State to participate on the Planning and/or Resource Teams. Unfortunately, we were not as successful with that effort as we hoped to be. In the future, we plan to reach out to each County individually to encourage exchange of knowledge and experiences as it relates to the information in this and other sections of this Plan. We intend to make this outreach continual, rather than during just the update period of this Plan.

Further, including the county emergency managers on the Planning and/or Resource Team(s) may provide a forum for the capability information of each county to be shared and better understood and possibly improved upon or used in other areas of the State. This may result in the promotion of implementation and use of new and existing policies and programs, furthering implementation of Mitigation Measures. ADEM intends to make this outreach continual rather than just during the update period of this Plan and will support these efforts by encouraging information sharing and notifying the counties of new State/Federal developments that may be helpful in their efforts.

Code/Plan	Purpose	Impact on Mitigation	Mitigation Opportunities
Building Codes	To ensure quality design and construction of buildings that meet safety requirements.	Most jurisdictions adopt the Uniform & Int'l Building Codes with amendments to mitigate the impact of their specific hazards; flooding, wildfire, etc.	Support those communities that have not yet adopted the latest IBC or IRC. Promote the adoption of higher standards for natural hazards where appropriate.
Capital Improvement	To identify and prioritize future capital needs of the community which are to be constructed from public sources.	Capital improvement projects are often a key mechanism for achieving mitigation that is aligned with other community priorities.	Identify and promote opportunities to integrate mitigation into capital improvement plans and projects.
Community Wildfire Protection Plan	To identify, guide and prioritize wildfire safety projects. .	Has a mitigation section of the plan, which is one more tool to use in implementing wildfire mitigation activities.	Include the lead for the program on the State Mitigation Planning team to integrate outreach, education and mitigation efforts.
Floodplain Management	Regulations designed to promote public health and safety and minimize losses due to flood conditions in specific areas.	State Legislature delegates the responsibility of adopting regulations to each county flood control district and the respective floodplain manager. The floodplain manager is responsible for corrective and preventative measures for reducing flood damage to include zoning, subdivision or building, and special –purpose floodplain ordinances.	Include the State Floodplain Manager on the State Mitigation Planning team to integrate outreach, education and mitigation efforts.
Comprehensive Planning	Provide for the health, safety and general welfare of the citizens through orderly development and land use.	Serves as the foundation for other planning documents and ordinances that provide for the future growth and improvement of the respective area of jurisdictions. This is a State Requirement for all Counties.	Ensure that comprehensive planners i.e. Municipal Planning Area authorities are part of the State Mitigation Planning team and identify opportunities for integrating mitigation into all appropriate areas of the comprehensive plans; land use; circulation; water resources; energy use; open space; growth; environmental and economic feasibility in line with ARS 11-804.
Growth Management	Regulate growth and development that preserves, promotes and protects the health, safety and general welfare of the public while conforming with the intent of the Comprehensive Plan.	The purpose is to bring about coordinated physical development in accordance with the present & future needs of the county. Focus is to conserve the natural resources of the County, to insure efficient expenditure of public funds and to promote the health, safety and general welfare of the public while conforming to the intent of the Comprehensive Plan. Growth element is included in the Comprehensive Plans for most	

Code/Plan	Purpose	Impact on Mitigation	Mitigation Opportunities
		Counties.	
Real Estate Disclosure	Sellers are required to disclose all known (important) facts about the property, including but not limited to: building and safety, utilities & environmental (soil erosion, expansion, drainage).	State requires disclosure notice addressing safety and environmental concerns.	The AZ Hazard Viewer would be a great source of information to new home buyers. Sharing the hazard data with companies like Tulia could be beneficial.
Subdivision	Provide for the orderly growth and development to secure adequate provisions for water supply, drainage, protection against flood, storm water detention, sanitary sewerage and other health and safety requirements; to insure consideration for adequate sites for schools, recreation areas, and other public facilities.	State requires Counties to identify land that is to be subdivided or proposed to be for the purpose of sale or lease, whether immediate or future, into six or more lots or parcels.	
Zoning	Set forth land use classifications, divides the county into land use zones as delineated on the official zoning maps and sets regulations for the promotion of the health, safety, morals, convenience and welfare of the citizens.	The State requires Counties to adopt ordinances identifying zones for a particular purpose or residential area.	Identify mitigation opportunities for improved zoning or set back ordinances, particularly related to multi-objective projects (i.e. recreation, flood control and habitat restoration).

Mitigation Actions

Update Requirement §201.4(d): [The] plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities.

The process used to develop this section was to evaluate the progress on the previous Plan's Mitigation Strategy, determine which Mitigation Measures should be eliminated, revised, remain or added to the Plan.

Planning Team members representing agencies listed as the Responsible/Lead Agency were provided with a list of their A/Ps from the previous Plan. They were asked to provide information on progress made (documented under the action description), provide missing implementation details if needed, determine overall feasibility of their Mitigation Measures and determine if they should be deleted or remain in the Plan. Brief descriptions were also provided to support the determination (see list of Measures eliminated or revised in the table below):

The Mitigation Measures included in this Plan update were once again prioritized based on the criteria used in the previous Plans:

- Direct Impact on Life and/or Property
- Long-Term Solution
- Benefit vs Cost

The current Mitigation Measures are listed and in high, medium and low priority order. The list was reviewed and approved by the Planning Team, which can be found in the second table below.

We have made every effort to ensure this Plan's Mitigation Measures contribute to the State's overall goal to "Reduce or eliminate the risk to people and property from natural and human-caused hazards" by taking the steps outlined above and by providing as much detail as possible. We intend to perform continuous evaluations of the actions/projects with every review, update and/or enhancement of this Plan in an effort to obtain more specific activities and time frames on listed actions. We believe this will result in a higher rate of progress and completion of strategy actions. Only actions/projects that appear to be environmentally sound and technically feasible are considered.

Past Mitigation Measures now Eliminated or Revised							
New or Existing	**Hazard Mitigated**	**Action/Project Description**	**Lead Agency**	**Est Cost**	**Est Completion**	**Potential Funding**
E	Flood	Develop and implement public awareness and education programs involving land use planning, design and flood hazard curricula, flood hazard safety programs and community risk education.	AZGS, ADEM	$100k	2012	FEMA HMGP
Disposition		**DELETE** – The actual mitigation measure is not clear.				
E	Wildfire	Arizona Statewide forest Resource Assessment & Strategy: The State Forestry Division is working closely with our partner organizations and stakeholder groups as well as landowners and interested parties for input. When completed, the Arizona Resource Assessment & Strategy will address national private forest conservation priorities; be a useful tool to a wide range of individuals, agencies and organizations and provide the basis of future work in Arizona to address our forest resource issues.	State Forestry	N/A	Phase 1: June 2010	N/A
Disposition		**Complete**d and published as of June 2010.				
E	Wildfire	Develop/maintain GIS wildfire incident database. Share data with local jurisdictions and other that may benefit from it. GIS has proven to be an important tool for managers in identifying areas at risk and to prioritize project areas based on present fuels, threat to the public, threat to natural resources and to track the location and progress of ongoing projects.	State Forestry	N/A	Nov 2010	N/A
Disposition		Database is complete. Information is collected and updated on a yearly basis. This action is **revised** and in the current Mitigation Strategy of this Plan.				
E	Dam	Identify areas of encroachment below Arizona unsafe dams and notify local entities.	ADWR	N/A	July 2008	N/A
Disposition		ADWR maintains a listing of unsafe dams and requires updated Emergency Action Plans from all owners of high and significant hazard potential dams. This Action/Project is **revised** and in the current Mitigation Strategy of this Plan.				
E	Dam	Monitor encroachment below dams in the floodplain that could result in a change to the hazard classification.	ADWR	N/A	Annually	N/A
Disposition		ADWR regularly inspects all jurisdictional dams. This Action/Project is **revised** and in the current Mitigation Strategy of this Plan.				
E	All	Perform full update/upgrade to the State Hazard Mitigation Plan.	ADEM Mit Office	$173, 250k	Sept 2010	PDM
Disposition		This project will be complete upon receiving FEMA approval for this Plan. Project is **complete**.				
E	All	Develop and implement a program to enable jurisdictions statewide to track the progress of the actions/projects from their Plan's mitigation strategy. This could improve the % of action completed.	ADEM Mit Office	N/A	Dec 2010	N/A

Disposition	**DELETE –** A couple systems have been considered only to find they may making the process more complex and the effort to develop and maintain may not be worth the effort. For now, we will perform status updates in a simple spreadsheet format.

GOAL: REDUCE OR ELIMINATE THE RISK TO PEOPLE AND PROPERTY FROM NATURAL AND HUMAN-CAUSED HAZARDS						
	Objective 1	**Reduce or eliminate risks that threaten Arizona's citizens.**				
	2	**Reduce risk to critical facilities and infrastructure from natural and human caused hazards.**				
	3	**Promote hazard mitigation throughout the State.**				
	4	**Assist local jurisdictions in implementing/sustaining their mitigation programs.**				
	5	**Increase public awareness of Arizona's hazards and risks.**				
	6	**Pursue hazard mitigation project funding sources.**				
New or Existing	**Hazard Mitigated**	**Mitigation Measure Description (In order of High, Medium, Low Priority)** **Status**	**Lead Agency**	**Est Cost**	**Est Comp**	**Pot Funding Source**
N	Terrorism	Administer "Partners for Arizona's Safety & Security" (PASS) by providing terrorism subject bulletins to public and private partners. PASS is a program based on terrorism awareness with such partners as USDHS, FBI, AZDOHS, ADEM, and AZDHS acting as the steering committee.	ADEM	N/A	Ongoing	N/A
In progress		Bulletins are disseminated on an as available and as needed basis.				
N	Terrorism	Perform duties as liaison to the Arizona Counter Terrorism Information Center (ACTIC) and coordinate the dissemination of terrorism related information to appropriate parties as needed.	ADEM	N/A	Ongoing	N/A
In progress		Activity is already ongoing and will continue as described.				
E	Flood	Assist local jurisdictions in acquiring, or otherwise mitigating property located in the 100-year floodplain, beginning with repetitive loss properties.	ADWR, ADEM, Flood Cont Dists	N/A	Annually	N/A
In progress		Some local jurisdictions have acquired homes in the floodplain that was converted to open space. ADWR investigates NFIP compliance of repetitive loss properties and discusses mitigation opportunities with local jurisdictions. ADEM continues to work with local jurisdictions and solicit grant applications in order to acquire eligible repetitive loss properties.				
E	Flood	Investigate areas with the potential for debris flows and flooding in the post-fire environment & identify high-risk areas for incorporation into mitigation plans and to target areas for mitigation activities.	AZGS	$200k	Ongoing multi-year project	FEMA 5% Initiative Study
In progress		Recent mapping in Gila County. Released report evaluating debris flow potential in the post-wildfire environment in Gila County. Research into post-fire debris flows is ongoing. Funds for dedicated studies are lacking. AZGS recently published the *Southwest Wildfire Hydrology & Hazard Workshop Proceedings*, summarizing the state of knowledge of post-wildfire debris flows in the Southwest.				
N	HazMat	Manage an online database for Hazardous Materials and Extremely Hazardous Chemicals in which facilities in Arizona upload Tier II information for viewing by Fire Depts and Local Emergency Planning Committees for response and planning activities to mitigate against HazMat incidents.	AZ State Emerg Response Commission (AZSERC)	$20k/ year	Annual Ongoing	ADEM
In progress		By the end of this year's reporting cycle (March 1, 2013) 4,100+ Arizona facilities have entered their Tier II information into the database.				

N	HazMat	Distribute funds to the Local Emergency Planning Committees (LEPCs) to support hazmat planning, training and equipment. The LEPCs have Response Plans in the event of a hazmat incident. The hazmat training is for first responders and the equipment enhances the County HazMat Teams.	AZ State Emerg Response Commission (AZSERC)			
In progress		Already being implemented.				
E	Wildfire	Continue to complete wildland fuels reduction projects as appropriate and renew/revise agreements as necessary. Necessary for those living in or owning property in the WUI or Communities At Risk to manage the fuels on their properties to reduce their risk from wildland fires. It is also equally important that agencies reduce the fuel loading on public lands in order to further reduce the risk of destructive wildfires.	State Forestry, DOC	N/A	Ongoing	N/A
In progress		Actively prioritizing projects as federal grant funding is awarded.				
E	Multi	Add requirements to building codes for fire resistive materials for new construction and additions to existing construction. One element of Statewide Strategy for Restoring Arizona's Forests: encourage community leaders to take steps to mitigate against wildfire by encouraging local implementation of WUI codes.	State Forestry	N/A	Ongoing	N/A
In progress		Governor's Forest Health Council workplan includes outreach to communities regarding WUI codes and Firewise practices. Provides public forums for community leaders; six communities have adopted codes.				
N	Earthquake, Fissure, Flood, Wildfire	Enhance hazards viewer which contains hazard specific information to increase public awareness for citizens and local emergency managers.	AZGS, ADEM	$100K (initial phase)	2014	FEMA
In progress		AZGS in coordination with ADEM are in the process of developing this hazards viewer which not only contain four different hazard layers, but will also incorporate mitigation actions for each hazard and be linked to AzEIN for additional information. The project is expected to expand to include additional wildfire information if funding becomes available from Arizona Forestry.				
E	Dam	Coordinate with county and community emergency management and floodplain management officials and provide information regarding the status, potential hazards and risks associated with deficient dams so that those communities can make better informed decisions regarding planning and development.	ADWR	N/A	Annually	N/A
In progress		ADWR maintains a listing of deficient dams and requires updated Emergency Action Plans from all owners of high and significant hazard potential dams. Specifically, ADWR and the dam owners have made local entities potentially affected by Magma Dam in Pinal County (repairs underway and expected to be completed in 2013), Fredonia Dam in Coconino County, Powerline Dam in Pinal County (repairs underway and expected to be completed in 2013), and Cook Reservoir Dam in Graham County are each made aware of potentially elevated risks due to deficiencies.				
E	Wildfire	Maintain up to date list of Arizona Communities at Risk (of wildfire) and share with agencies or individuals who can use the information to benefit their respective communities. This will provide a benefit to State Forestry and communities in identifying priority areas for wildfire mitigation work and is required by the National Fire Plan as well.	State Forestry	N/A	Ongoing	N/A
In progress		This information has been updated in conjunction with GIS mapping updates and routine Forestry Division district interaction with communities and fire districts and the information is now posted on our agency website.				

E	Dam	Identify adequate funding sources of the dam repair program, which is designed to assist the state and the owners in the protection of life and property. Report to the Director of ADWR.	ADWR	N/A	Annually	N/A
In progress		ADWR manages Dam Repair Funds and routinely makes grants to owners of unsafe dams. Two grants provided in 2009. Funding was provided and work has been completed on the engineering design and plans for rehabilitation of Millet Swale Dam in Navajo County and for removal of Cook Reservoir Dam in Graham County. Both projects currently seek funding for construction costs. Due to the economic recession and legislative sweeps of the Dam Repair Fund, no additional dam projects have been funded since 2009. Recent increases to ADWR's Dam Safety permit and inspection fees may make funding for additional projects in the near future.				
E	Flood	Continue to encourage homeowners and renters who live in areas that are flood prone to acquire flood insurance through the NFIP.	ADWR, Flood Cont Dists	N/A	Ongoing	N/A
In progress		ADWR promotes flood safety and awareness through the Community Assistance, National Flood Insurance and Risk MAP Programs. Staff created two outreach brochures for distribution to communities and residents: "Manufactured Homes, Recreational Vehicles, Park Trailers and Floodplains" and Wildfire and Flood Risks".				
E	Wildfire	Encourage cities, communities and other municipalities to specify landscaping requirements based upon Firewise principles. Necessary for those living in or owning property in the WUI or Communities at Risk to manage the fuels on their properties to reduce their risk from wildland fires.	State Forestry	N/A	Ongoing	N/A
In progress		Forestry Division staff conduct outreach, especially the District Forestry staff in our three districts -Tucson, So Arizona, Phoenix District in Central AZ, Flagstaff District in No Arizona. This outreach has resulted in Arizona holding one of the highest community certification rates in the nation at 45.				
E	Wildfire	Maintain GIS wildfire incident database. Share data with local jurisdictions and others that may benefit from it by using it to identifying areas at risk and prioritize project areas based on present fuels, threat to the public and natural resources and to track the location and progress of ongoing projects.	State Forestry	N/A	Ongoing	N/A
In progress		With database complete, the information is collected and updated on a yearly basis.				
E	Severe Weather	Add information on the dangers of severe weather to the State Climatology website and continue weather presentations to K-12 students and community groups. The state Climatology Office engages in both, applied research and outreach, making presentations to both k-12 and community groups on various weather and climate topics. The webpage also provides weather and climate information to the general public. As internet accessibility expands, websites are becoming a primary source of information. Providing severe weather hazard information on the State Climate website will help educate the public and potentially reduce injuries or damage due to severe weather. Severe weather presentations are always favorites with K-12 students and community groups and they are very useful for correcting misinformation about hazards.	State Climate Office	N/A	Initial phase done, now ongoing.	N/A
In progress		Educational visits to K-12 and community groups continue. Currently in planning stage to add severe weather preparedness to the website, in accordance w/ the NWS guidelines.				
E	Wildfire	Distribute wildfire mitigation information to those applying for building permits and those communities seeking Firewise Communities recognition. It has been repeatedly demonstrated that education is a key component in convincing the public to endorse and adopt wildland prevention and Firewise principles and activities.	State Forestry	N/A	Ongoing	N/A

In progress		The growing list of Firewise Communities in Arizona at 45 is a significant indicator of mitigation work accomplished to prevent or reduce wildfire risk.				
E	Flood	Continue monitoring and coordinating with State NFIP Coordinator & FEMA to identify properties that meet Repetitive Loss or Severe Repetitive Loss criteria.	ADEM Mit Office	N/A	Ongoing	N/A
In progress		ADEM receives listings of RL/SRL properties and will continue to notify the appropriate County Emergency Managers to make them aware of these properties. ADEM will also continue to make them aware of funding sources to mitigate these properties.				
E	All	Continue to provide local jurisdictions with technical assistance in developing their future hazard mitigation plan updates.	ADEM Mit Office	N/A	Ongoing	N/A
In progress		ADEM has provided planning assistance to all 15 counties on their original plans and first updates. The County plans are all now multi-jurisdictional, so in assisting them, we are also assisting their respective incorporated jurisdictions. We have also offered assistance to all tribes and actually assistance approximately 15 of them in their plan development. We intend to continue the same level of assistance in the development of the second plan updates.				
E	Floods	Conduct surficial geologic mapping to evaluate piedmont areas that may be prone flooding.	AZGS	N/A	2008-2011	N/A
In progress		Several reports and maps published. Released numerous geologic quadrangle maps showing extent of young deposits, interpretations of flood hazards. As part of the StateMap program, we continue to map and evaluate flood hazards on piedmonts. The resulting maps and reports, including several Contributed Reports are available at no charge at the AZGS online document repository (repository.azgs.az).				
E	All	Continue to distribute mitigation brochures to the public.	ADEM Mit Office		Ongoing	
In progress		Brochures have been distributed through meetings. Workshops, conference and Individual Assistance Service Centers set up in areas affected by disasters such as the Yarnell Hill Fire. We have also made the brochure available in ready to print and printer ready artwork formats via ADEM's website. Our brochures include "Wildfire and Flood Risks", "Mitigation for Citizens", and "Arizona Shake – Seismic Hazard Awareness".				
E	Fissure	Conduct earth fissure planning map briefings for state and local agencies whose responsibilities are affected by fissures.	AZGS	$25k	Ongoing	FEMA HMGP
In progress		Briefings for agencies associated with initial releases of earth fissure maps; continued interaction with local and state agencies. AZGS continues to communicate with local and state authorities about earth fissures. Civil authorities are notified upon the release of new earth fissure maps. At the onset of each monsoon season, we issue a reminder to county authorities regarding earth fissures and request information on any new or ongoing development.				
N	HazMat	Provide consultative services, conduct and participate in workshops and coordinate development and review of plans and programs for 15 Local Emergency Planning Committees (LEPC).	AZ State Emerg Response Commission (AZSERC)	$20k/ year	Annual Ongoing	ADEM
In progress		Already in progress.				
E	Multi	Increase public awareness of geologic hazards - earth fissures, landslides, debris flows and flash floods via workshops, online resources, media and other outreach avenues through AZGS Geologic Extension Service.	AZGS	$80k annua lly	Ongoing	FEMA HMGP
In progress		Fissure and earthquake outreach programs are active. AZGS continues to develop print and web outreach products describing geologic hazards in Arizona. In 2012, and in partnership with ADEM, we hosted the Great Arizona ShakeOut with 62,500 Arizonans participating. Our Arizona Shakes Earthquake Outreach program is our most successful hazard awareness program due to annual funding from the National Earthquake Hazard Reduction Program.				

		Funding for other geologic hazard awareness programs are wholly lacking.				
E	Earthquake	Obtain seismic stations and monitor and analyze activity to re-assess the seismic hazard (which is underestimated) for the state and identify areas that are particularly vulnerable. Release the information via public outreach to allow jurisdictions to determine appropriate mitigation measures and establish appropriate seismic building codes.	AZGS	$50k	2008-2011	N/A
In progress		Collaborative monitoring effort with ASU, NAU and UofA. Acquired and are operating 8 modern seismometers arrayed across the state; conducting research in cooperation with state universities to use data in updated seismic hazard assessments. AZGS continues to operate the Arizona Broadband Seismic Network. Vandalism has reduced the number of operational seismometers from 8 to 7. We continue to search for funding sources to assure sustainability of the network.				
E	All	Develop and maintain a database of past/current funded mitigation projects to track progress and publish project/success stories.	ADEM Mit Office	N/A	2008 and & ongoing	N/A
In progress		Database has been populated with grant award information and work continues on documenting project details. This database will help ensure historical mitigation project information is not lost.				
E	Flood	Encourage communities to begin or continue participation in the Community Rating System (CRS) program to ensure credit for various activities that assist property owners in receiving reduced insurance premiums and to reduce flood damages.	ADWR	N/A	Ongoing	N/A
In progress		ADWR discusses the benefits of the CRS program and encourages participation during Community Assistance Program meetings with NFIP communities. Currently, 25 communities participate in the CRS program and two more are considering joining.				
E	Earthquake	Distribute earthquake hazard information via hard copy and internet (including posters and presentations, monitoring and activity updates, etc).	AZGS	$50k/yr	2010 & ongoing	FEMA NERHP
In progress		Working on web and print materials. AZGS continues to aggressively pursue an earthquake hazard outreach program. Recent outreach publications include: earthquake preparedness brochures, Arizona is Earthquake Country Down-to-Earth text, and videos exploring Quaternary faults in Arizona. With ADEM we hosted the Great Arizona ShakeOut in October 2012. The second Great Arizona ShakeOut is scheduled for October 2013; as of May 26, 2013, nearly 10,000 Arizonans are enrolled in the program. NEHRP funding in 2014 is at risk. The loss of funding will adversely impact AZGS efforts to alert the Arizona public to earthquake hazards.				
E	Landslide	Map and identify active and paleolandslides in order to identify areas susceptible to landslide occurrence.	AZGS	$200k	Ongoing	FEMA HMGP
In progress		Some action along Beeline Hwy near Payson. Several landslides identified as part of StateMap mapping program. Where encountered as part of AZGS's StateMap program, paleolandslide masses are mapped. Funding for systematic statewide study of landslide hazards has not been procured.				
E	Wildfire	Ensure Arizona Firewise Communities program and fire prevention information is distributed statewide. It has been repeatedly demonstrated that education is a key component in convincing the public to endorse and adopt wildland fire prevention and Firewise principles and activities.	State Forestry	N/A	Ongoing	N/A

In progress		All three field districts for State Forestry Divisions meet with Fire Chiefs in their respective districts monthly, quarterly and annual meetings, conference and training sessions and advocate wildland urban interface and Firewise models.				
E	Earthquake	Investigate quaternary (young) faults to estimate the time since the most recent event, average recurrence intervals or slip rates and to estimate paleoeathquake magnitudes. This information can be used for seismic hazard assessments, including probabilistic earthquake hazard maps, which in turn can be used to plan mitigation projects.	AZGS	$50k per fault	Ongoing	USGS State Map Prog & ADOT as potential secondary source
In progress		Some mapping complete. Investigated one quaternary fault zone in western Arizona in 2007-08 as part of mapping project for ADOT; discovered on quaternary fault zone north of Prescott and team is mapping two other as part of Statemap program. AZGS monitors seismic activity in Arizona with the Arizona Broadband Seismic Network. Where encountered as part of AZGS's StateMap program, faults are mapped and characterized. A new Quaternary fault map is in a preliminary state of construction. Funding for detailed characterization of Quaternary faults has not been procured.				
E	Landslide	Coordinate research priorities to develop a predictive understanding of landslide processes & triggering mechanisms.	AZGS	$200k	2008 & ongoing	USGS
In progress		Some debris flow mapping in place. Mapped young debris flow deposits in Tucson area with funding from local flood control district and AZGS; investigations of triggering mechanisms underway. As part of the FEMA-funded Arizona Hazards Viewer, AZGS is making some progress on understanding were slope and geologic conditions are conducive to landslides in Arizona. But much more needs to be done and dedicated funding stream identified for additional study.				
E	Dam	Coordinate with county and community emergency management and floodplain management officials and provide information regarding the locations and potential hazards existing dams so that those communities can make better informed local development decisions.	ADWR	N/A	Annually	N/A
In progress		ADWR regularly inspects all jurisdictional dams. ADWR will in the near future begin a project of low-cost flood inundation mapping using the DSAT/DSS-WISE software developed by the US Department of Homeland Security. This work will greatly increase the number of dams, including those not without development downstream currently, having identified flood inundation limits in the event of dam failure and thereby provide information for informed decision-making which does not currently exist.				
E	Fissure	Identify and map known fissures across the state.	AZGS	$65k/ year	Sept 2006 & ongoing	State budget
In progress		Completed earth fissure mapping in Maricopa and Pinal Counties, made maps available to public. Seventeen (17) maps published since 2007. Mapping of earth fissures is ongoing. Twenty-two of the original earth fissure study areas have been mapped and the maps are published. All published earth fissure maps are available at AZGS's Earth Fissure Viewer. Over the next several years, the earth fissure program will transform from mapping fissures to monitoring fissure development.				
N	Disease	Encourage local jurisdictions to consider including Disease and/or Health Issues to their hazard mitigation plans in the future. Disease is now profiled in the State of Arizona Hazard Mitigation Plan in an effort to stay consistent with all other statewide planning mechanisms and for the purpose of THIRA. This will begin when locals begin work on their next hazard mitigation plan updates.	ADEM	N/A	Ongoing	N/A
Progress						

N	All	Establish a State Mitigation Committee to further the Goals and Objectives of the State mitigation plan through increased integration of State agencies. Identify members from agencies and communities with similar hazard mitigation missions to integrate programs and leverage opportunities. (For local capacity building, reference ideas included in the Local Capability Assessment table earlier in this section.)	ADEM	N/A	Ongoing	N/A
Progress						
N	Climate Change	Collaborate with the State Climatologist, ASU and other agencies/organizations to discuss and analyze the potential impacts to Arizona from future climate change. The goal is to utilize the findings to provide outreach to the local jurisdictions to assist them in future mitigation activity.	ADEM	N/A	Ongoing	N/A
Progress						
N	Multi	Assist local jurisdictions in identifying and promoting model ordinances for development in high hazard areas and in adopting the latest building codes such as the International Building Code (IBC) and the International Residential Code (IRC).	ADEM	N/A	Ongoing	N/A
Progress						
N	Climate Change	Incorporate Climate Change and its' potential impacts on the hazards identified in this Plan and other planning mechanisms, as appropriate. Require local jurisdictions to include at least a discussion on Climate Change in their future hazard mitigation plans.	ADEM	N/A	Ongoing	N/A
Progress						
N	All	Promote integration of hazard mitigation into Building Codes, Capital Improvement and Comprehensive Plans. The ideal time for this is as we are assisting the local jurisdictions with their future hazard mitigation plan update process.	ADEM	N/A	Ongoing	N/A
Progress						

Funding Sources

Requirement: §201.4(c)(3)(iv): [The State mitigation strategy shall include an] identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.

The State of Arizona and local jurisdictions rely on various local, state and federal programs to implement and fund mitigation projects throughout the state. As demonstrated in this section's "Hazard Mitigation Activity in Arizona" and the "Funded Projects" table, the State depends on the local, state and federal resources to fund mitigation projects. Below is an updated summary of programs currently available and available in the future:

FUNDING - CURRENT	
FEMA (Federal) Hazard Mitigation Grant Program (HMGP)	Provides funding to implement long-term hazard mitigation measures after a major disaster declaration. The State, through ADEM administers this federal program and takes a proactive approach to assisting local jurisdictions take advantage of this program.
FEMA (Federal) Flood Mitigation Assistance (FMA)	Provides funding to assist in the implementation of measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP).
FEMA (Federal) Pre-Disaster Mitigation Program (PDM)	Provides funding for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.
FEMA (Federal) Repetitive Loss	Provides funding to assist States and communities reduce flood damages to insured properties that have had 1 or more claims to the NFIP.
FEMA (Federal) Severe Repetitive Loss	Provides funding for flood damage to severe repetitive loss structures insured under the NFIP.
State Governor's Emergency Fund	The Governors Emergency Fund (GEF) receives $4,000,000 annually from the State's General Fund to assist government agencies, local governments, and political subdivisions of the State respond to and recover from state declared emergencies. This fund is also used on federal disaster declarations for the state's cost share. If there are funds available at the end of the state fiscal year, those monies may be used for mitigation projects that substantially lower the risk to people and property from natural and human-caused hazards. The Governor has the authority to declare an emergency within the state and allocate up to $200,000 per declaration. The State Emergency Council (SEC) allocates from the GEF once the Governor's authorization level is maximized.
State State Public Assistance Program	Provides an organizational structure for the administration of state and federal funding provided to eligible public entities for the repair and restoration of damaged public facilities within a declared disaster area.
U.S. Department of Housing & Urban Development (Federal) Disaster Recovery Assistance	Provides critical housing and community development resources to aid disaster recovery. HUD's Disaster Recovery Teams are located in offices throughout the country.

FUNDING - CURRENT	
U.S. Department of Housing & Urban Development (Federal) Community Development Block Grants (CDBG)	Provides funding to carry out a wide range of community development activities directed toward revitalizing neighborhoods, economic development, and providing improved community facilities and services.
Dept of Health & Human Services (HHS), Centers for Disease Control (CDC) Public Health Emergency Preparedness (PHEP)	PHEP Cooperative Agreement funds are intended to upgrade state and local public health jurisdictions' preparedness and response to bioterrorism, outbreaks of infectious diseases and other public health threats and emergencies.
U.S. Army Corps of Engineers (Federal) P.L. 84-99 Rehabilitation Program	Authorized assistance includes emergency repair or rehabilitation of flood control works damaged by flood, and restoration of federally authorized coastal protection structures damaged by extraordinary wind, wave, or water action. Assistance does not extend to major improvements of flood control or federally authorized coastal protection structures, nor to reimbursement of individuals or communities for funds expended in repair or rehabilitation efforts.
Natural Resource Conservation Service (Federal) Emergency Watershed Protection Program	Undertakes emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.
Natural Resource Conservation Service (Federal) Watershed Rehabilitation Amendments (PL 106-472)	Authorizes the NRCS to work with watershed project sponsors to address critical public health and safety concerns and environmental impacts of aging NRCS program dams. NRCS assists sponsors by providing technical and financial assistance for the assessment, planning, design and installation of improvements necessary to extend the service life of dams and meet applicable safety and performance standards.
Natural Resource Conservation Service (Federal) Snow Survey & Water Supply Forecasting	Provides western states with information on future water supplies. NRCS field staff collect and analyze data on depth and water equivalent of the snowpack at more than 1,200 mountain sites and estimate annual water availability, spring runoff and summer streamflows. Individuals, organizations and state and federal agencies use these forecasts for decisions relating to agricultural production, fish and wildlife management, municipal and industrial water supply, urban development, flood control, recreation, power generation and water quality management.
Natural Resource Conservation Service (Federal) Rapid Watershed Assessments	Provides initial estimates of where conservation investments, including flooding and sediment control would best address the concerns of landowners, conservation districts and other community organizations and stakeholders. These assessments help landowners and local leaders set priorities and determine the best actions to achieve their goals.
Natural Resource Conservation Service (Federal) Watershed Surveys & Planning	The program is to assist Federal, State, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources. Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal

FUNDING - CURRENT	
	and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries.
Natural Resource Conservation Service (Federal) Watershed Operations	Provides assistance to sponsoring local organizations of authorized watershed projects, planned and approved under the authority of PL 78-534 and PL 83-566. NRCS provides technical and financial assistance to States, local governments and Tribes to implement authorized watershed project plans for the purpose of watershed protection; flood mitigation; water quality improvements; soil erosion reduction; rural, municipal and industrial water supply; irrigation water management; sediment control; fish and wildlife enhancement and wetlands and wetland function creation and restoration.
Small Business Administration (Federal) Pre-Disaster Mitigation Loan Program	Provides low interest, fixed rate loans to small businesses for the purpose of implementing mitigation measures to protect their property from future disaster related damages.
Arizona State Land Department (Federal) Fire Management Assistance Grant	Provides funding to states, local and tribal governments, for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster.
Arizona State Land Department, State Forestry Division (State) Community Challenge Grants	Provides funding to be used to promote and enhance the quality of Arizona's urban and community forests. The program is primarily directed toward projects that might not otherwise be funded through existing budgets. Projects should be directed at improving the long-term health and care of the urban forest, or at initiating new urban forestry projects in Arizona.
Arizona Lottery (State) Heritage Fund	Arizona voters created the Heritage Fund in 1990, designating up to $10 million a year from lottery ticket sales for the conservation and protection of the state's wildlife and natural areas. The Arizona Game & Fish Dept spends its Heritage Fund dollars to recover threatened and endangered species, to help urban residents appreciate and coexist with our unique wildlife, to educate citizens about the environment, and to create new opportunities for outdoor recreation. This fund is critical to recovering and sustaining Arizona's unique native wildlife and to managing more 800 native species.
Local Funding Readiness and Emergency Management for Schools (REMS) Grant Program	Provides funding for local education agencies or school districts to improve and strengthen their emergency management plans. The program also enables school districts to develop improved plans that address all four phases of emergency management: Prevention-Mitigation, Preparedness, Response and Recovery. School districts also must commit to developing written plans that are coordinated with state Homeland Security plans, support the implementation of the National Incident Management System (NIMS) and are designed to prepare for a possible infectious disease outbreak, such as influenza pandemic. Funds can also be used to train school personnel and students in emergency management; communicate emergency management policies and reunification procedures to parents and guardians; coordinate with local emergency responders, including fire and police; purchase equipment; and coordinate with groups and organizations responsible for recovery issues, such as health and mental health agencies.

FUNDING - CURRENT	
U.S. Department of Homeland Security (Federal) Homeland Security Grant Program	Funds intended to enhance the protection of Arizona's residents and critical infrastructure from potential terrorist attacks and other significant hazards. Although the primary focus of federal homeland security dollars continues to be terrorism prevention and response, these funds may be used to prepare for and respond to all emergency and disaster situations, whether terrorist incidents or natural disasters such as floods and wildfires.
FEMA (Federal) National Earthquake Hazard Reduction Program	Provides funding to the Arizona Geological Survey to conduct an earthquake hazard awareness program – Arizona SHAKES. Funds are used to design and develop web-based and printed materials for informing and educating the Arizona public of the nature, scope, and distribution of earthquake hazards and associated cascading events.
US Dept of Transportation, Pipeline & Hazardous Materials Safety Administration Hazard Materials Emergency Preparedness Grant (HMEP)	The HMEP program is intended to provide financial and technical assistance as well as national direction and guidance to enhance state, tribal and local hazardous materials emergency planning and training. The HMEP grant program distributes fees collected from shippers and carriers of hazardous materials to emergency responders for hazmat training and to Local Emergency Planning Committees (LEPCs) for hazmat planning.

Hazard Mitigation Activity in Arizona

In 2010, Arizona received three Presidential Disaster Declarations for severe storms and flooding, making available $1,064,478 in HMGP grant funds. This total does not include the amount made available to the Havasupai Tribe for FEMA Disaster #1950, because they are a sovereign nation.

Since the 2010 Plan approval, funding for the Pre-Disaster Mitigation Grant Program was limited due to the lack of Congressional appropriation. Funding for the FMA Program was also limited due to the availability of funding to states. Funding information is included below for projects approved after the approval of the *2010 State of Arizona Multi-Hazard Mitigation Plan*:

Funding Source	Year Funded	Federal Share	Project Name	Subgrantee	Project Purpose
PDM	2012	$2,554,183	Wildfire Risk Mitigation Project	Pima County	The goal of this project is to eradicate buffelgrass which is a non-native perennial grass that can cause severe wildfire issues.
PDM	2012	$63,750	State Plan Update	ADEM	These funds will provide funding to update the State's Hazard Mitigation Plan.
FMA	2012	$1,584,055	Reaches 2-3 Flood Mitigation Project	Town of Snowflake	This project will alleviate the flood hazard to a residential subdivision and an industrial park.
HMGP 1888	2012	$22,500	Cibola Secondary Wash, Phase 1 H & H Study	La Paz County	This study will provide specific information regarding the flood risk to the area and may result in additional mitigation funding for the area.
HMGP 1888	2012	$703,288	Sunset Crater Estates Flood Mitigation Project	Coconino County	This project would provide a release and flow path for floodwaters in the Sunset Crater Estates subdivision.
HMGP 1940	2012	$53,200	Topographical Risk Assessment	Coconino County	This project includes using Light Detection and Ranging (LIDAR) to gather critical data from the project site to utilize in their future planning and mitigation efforts.
HMGP 1940	2012	$1,011,278	Upper Campbell Stabilization	Coconino County	The funds will be used to mitigate a residential area around Upper Campbell which has been repetitively flooded. This area is adjacent to the San Francisco Peaks which was burned by the 15,000 acre Schultz Fire in 2010.
PDM	2011	$132,023	LeSueur Flood Mitigation Project	Town of Eagar	This project will alleviate the flood hazard to homes and infrastructure which was made worse by the Wallow Fire.
HMGP 1888	2011	$12,218	Community Outreach & Preparedness Program	Coconino County	This project will assist in educating the community on how to mitigate and prepare against various hazards.
HMGP 1888	2011	$9,750	Schultz Flood Aftermath Project	Coconino County	This project will assist in educating the community regarding flood insurance, developing evacuation routes, how to correctly use sandbags and other flood related information.
HMGP 1888	2011	$10,020	Multi-Hazard Mitigation Brochures	Coconino County	This project will also assist in educating the community on how to mitigate and prepare against various hazards.
RFC	2011	$176,924	Acquisition Project of the Pool Property	Gila County	This project provides funds for the acquisition and demolition of a home that had been repetitively flooded and was uninhabitable.
HMGP 1660	2010	$956,188	Southern Solution Flood Control Project	Town of Snowflake	This project will alleviate the flood hazard to homes, businesses and infrastructure.

Here is a sampling of past mitigation activity:

Town of Snowflake Regional Flood Control Project

Mitigation Grant Funding

In 2003-2004, the Town of Snowflake was presented with serious challenges in its Regional Industrial Park and surrounding areas. Extensive flooding in the area led to closures of two major highways, the threat of washouts to major infrastructure, and a flood damage lawsuit, noted as being among the top most expensive civil suits in Arizona's history. Town staff, together with Navajo County Flood control, began the work in 2005 of assembling solutions to resolve the flood hazard issues. When the planning was complete, a partnership of over 14 federal, state, local, and private partners was assembled. Despite technical and policy support, funding was lacking to accomplish the tasks.

With the assistance of the Arizona Division of Emergency Management (ADEM), the Town identified a critical upstream component of the project, a series of retention/detention basins that would attenuate the damaging peak flows. Through a Hazard Mitigation Grant Program (HMGP) award, ADEM provided 75% funding, or $956,188 to cover the costs of the upstream basins. The HMGP award also included extensive Environmental and Historic Preservation (EHP) studies for the entire flood hazard area, to comply with NEPA requirements. In September, 2012, the basins were completed, providing upstream protection as a stand-alone project.

In 2011, a second project which took the outfall from the basins through the industrial park was awarded FMA funds. The project cost is estimated at $2.4M, with $1.584M funded by FEMA and the remaining $849K the responsibility of the Town of Snowflake and its other partners. The FMA project consists of over a mile of gunite lined channel, several road and railroad crossings, two state highway crossings, and a smaller retention basin, blended into the existing municipal golf course.

"Experts with experience in such regional projects were doubtful the project would ever be built, because of the unique and sometimes divergent objectives of the individual partners." said Project Manager Robert Toy. "The Mitigation Grant program's requirements for extensive documentation--which on the surface could appear to add a layer of bureaucracy--actually were a benefit to this project. The grant criteria created a foundation for consensus, and a template with its timelines to keep the project moving forward."

"Without the help of ADEM and FEMA, this project would simply not have been possible." said Toy. "The impact of this project, which provides protection of property, lives and vital infrastructure, affects the entire region. With the ultimate goal of removing the Industrial Park from the floodplain, it also opens the way for economic expansion."

“The Town had to demonstrate viability of the HMGP project, and compete on a national basis for the FMA grant. Since their applications were comprehensive and the protection provided to homes and infrastructure was clearly articulated, FEMA funded the project. Snowflake has taken the time to work closely with our office through the planning and construction phases, which has been critical to their success,” said Darlene Trammell, State Hazard Mitigation Officer.

Final construction is expected through calendar years 2013 and 2014, with the application for a Letter of Map Revision to follow.

Town of Eagar LeSueur Flood Control Project

Pre-Disaster Mitigation Grant Funding

Flooding has been an issue over the past decade in the Town of Eagar. Last year, using county flood control funds to provide the engineering documents, and with the assistance of the Arizona Division of Emergency Management (ADEM), the Town of Eagar applied for federal Pre-Disaster Mitigation (PDM) Competitive Grant funds from the Federal Emergency Management Agency (FEMA).

The Town of Eagar's "LeSueur Flood Control Project" is the culmination of two years of study and design in a project which will mitigate flood hazards to homes and infrastructure. The drainage area in the vicinity of LeSueur Drive is one of five major watercourses coming off the National Forest into Eagar, and made significantly worse by the recent Wallow Fire which was Arizona's largest wildfire and burned over 538,000 acres.

In August 2011, the project was awarded PDM funds. The total project cost is $180,876, with $132,023 funded by FEMA and the remaining $48,853 the responsibility of the Town of Eagar.

The project consists of inlet works upstream of the LeSueur neighborhood, and carries the stormwater through a pair of 36-inch underground pipe, to open fields on the east side of Amity Lane.

The LeSueur Flood Control Project will provide long-term mitigation measures and dovetails nicely into the emergency protective measures that were provided by the Town, County, Natural Resource Conservation Service (NRCS) and others.

"The NRCS work has done its job, and will be replaced by permanent mitigation structures," said County Engineer Ferrin Crosby. "The time between emergency measures and mitigation is usually several years. We're hopeful that this replacement of the concrete barriers with an underground system will be a model we can follow in the years ahead."

"The Town had to compete on a national basis for this PDM grant, but since their applications are comprehensive and the protection provided to homes and infrastructure is clearly articulated, FEMA funded the project. After the Wallow Fire, the community had to deal with post-fire flooding concerns, so the funding came at a critical time," said Darlene Trammell, State Hazard Mitigation Officer.

A celebratory groundbreaking to mark the beginning of construction on the project was held in Eagar, Arizona on Thursday, September 22, 2012 with local, state, and federal participation.

6. Coordination of Local Mitigation Planning

Section Changes

Prioritizing Local Assistance – This discussion has been updated according to the Arizona Hazard Mitigation Grant Program State Administrative (404) Plan, July 2013 (DRAFT).

Local Funding and Technical Assistance

Requirement: §201.4(c)(4)(i): [The section on the Coordination of Local Mitigation Planning must include a] description of the State process to support, through funding and technical assistance, the development of local mitigation plans.

The Arizona Division of Emergency Management (ADEM) has and continues to take a proactive approach to assisting our counties, local jurisdictions and tribal governments in the development of their hazard mitigation plans and plan updates. From the beginning of the DMA2K requirement, ADEM has applied for and been awarded PDM grant funding on behalf of the local participants, to assist in developing and updating local and tribal plans. The required matching amounts are also provided by ADEM. There has also been technical assistance provided by ADEM to jurisdictions and tribes who obtained their own planning funds or developing their plan(s) in-house.

ADEM prioritizes coordination and assistance primarily according to Plan expiration dates. However, should the issue arise, there may be consideration given based on new hazard development and/or major changes needing to be incorporated into Plan(s).

ADEM hired a contractor to facilitate the planning process, perform research, create maps and assess vulnerability. The contractor works with the participating jurisdictions under the direction of the Planning Program Manager in the Mitigation Office. Meetings are facilitated by ADEM's Planning Program Manager and the contractor's representative.

As of August 2013, these efforts have resulted in approved original plans and first plan updates for all 15 counties, 86 of our 91 local jurisdictions and 15 of 20 Indian tribes with land/infrastructure, requiring a plan.

Despite dwindling PDM program amounts, ADEM is committed to continuing a high level of technical assistance and coordination with our local jurisdictions during the upcoming second round of updates.

The benefits of our planning coordination strategy include:

- ADEM applying for the grants on behalf of the local jurisdictions and tribal governments. Many jurisdictions do not have the resources to focus their attention to applying for grants;
- ADEM meeting the match requirements. Many jurisdictions do not have the financial resources to meet the 25% match requirement.
- Ensuring the counties included the communities within the county. By including the communities within the county, ADEM was able to assist more communities and get a "bigger bang for our buck."

The Mitigation Office keeps track of approval dates of all mitigation plans within the state in a table which is located in a Mitigation common drive. This will assist anyone who comes into the mitigation office with the plan status statewide. Detailed documentation is also kept for each county, community and tribal government so anyone coming into the office can immediately know what has been happening.

To provide further local planning assistance, The Mitigation Section previously delivered FEMA course *G318: Mitigation Planning Workshop for Local Governments* and currently, *G393: Mitigation* *for Emergency Managers* at various locations throughout the State. The class has resulted in an increases awareness of planning processes and excellent class evaluations. Since the last update of this Plan, the classes have been delivered at least five (5) times in three (3) different regions within the State.

Local Non-Planning Funding & Technical Assistance

Since the approval of our previous Plan, there has been one federally declared disaster in Arizona; #1940 declared in October 2010. The classes and briefings listed below were primarily in response to the HMGP program initiated by that disaster and are typically conducted after all disasters.

- **Benefit Cost Analysis Classes**
  - July 2011 and July 2012
- **Application Development Classes**
  - Aug 2011 and June 2012
- **HMGP Briefings (Disaster 1940, 2010)**
  - HMGP program open to eligible jurisdictions statewide
  - Briefings conducted to inform potential applicants of funding and program requirements
- **Project Site Visits**
  - Aug 2010 Town of Eagar
  - Aug 2010 Town of Snowflake
  - Aug 2011 Town of Eagar
  - Sept 2011 Town of Eagar
  - Sept 2011 Town of Clifton
  - January 2012 La Paz County
  - March 2012 Coconino County
  - April 2012 Town of Eagar
  - April 2012 Town of Snowflake
  - August 2012 Town of Eagar
  - September 2012 Coconino County
  - February 2013 La Paz County
  - February 2013 Coconino County

Upon a federal disaster declaration; ADEM intends to:

- Contact jurisdictions and other potential applicants and solicit desired project summaries or “Notices of Intent” to submit an application;
- Visit specific counties affected by the disaster to observe and advise regarding possible mitigation projects;
- Conduct workshops throughout the State to assist applicants in the preparation of their applications and the Benefit Cost Analysis process;
- Meet individually with potential applicants that are unable to attend the scheduled workshops to assist in application development and completion;
- Review, prioritize and submit applications;
- Maintain ongoing monitoring and contact with successful sub-grantees in the management of their projects and completion of required reports;
- When possible, coordinate project site visits to monitor progress and photograph the work as it is accomplished.

Local Plan Integration

Requirement: §201.4(c)(4)(ii): The section must include a] description of the State process and timeframe by which the local plans will be reviewed, coordinated, and linked to the State Mitigation Plan.

Update Requirement §201.4(d): Plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts and changes in priorities…

As of August 2013, ADEM's coordination of the local plans has resulted in approved plans for all 15 counties, 86 of our 91 incorporated local jurisdictions and 15 of 20 Indian tribes with land/infrastructure, requiring a plan. During the first round of updates, ADEM assisted the local jurisdictions to develop their plans according to the multi-jurisdictional framework. We believe this method is more cost and time effective and encourages partnerships and connectivity between the counties, local jurisdictions and Indian Tribes within the county boundaries.

It is our goal and directed by the DMA2K, to ensure that the State's local hazard mitigation plans reflect the priorities in this Plan. We have made every effort to integrate and link the State hazard mitigation plan with that of the local jurisdictions. We have also reached out to the counties for more detailed community descriptions and maps for inclusion in this Plan. It is our intention to continue refining those and include them in their future respective county multi-jurisdictional plan updates.

To ensure future success in this area, we intend to:

- Link pertinent information to this Plan as new information is available or new plans are approved;
- Urge the local jurisdictions and counties to develop effective future multi-jurisdictional mitigation plan updates by;
  - Notification/education of the benefits through the mitigation newsletter and other outreach activities.
  - Use the quarterly county emergency managers meetings to provide the latest requirements, guidance publications and lessons learned by ADEM and offer plan coordination and technical assistance to local jurisdictions;
- Distribute the State Plan to all county emergency managers and make available to all local jurisdictions immediately following approval from FEMA; and
- Encourage use of the framework used for this Plan to allow smooth integration with the State Plan.

Local Plan Review

The local plan review process will be performed using the most recent FEMA crosswalk. All Plan sections will be reviewed to ensure requirements are met as well as its consistency with the State Plan. The linking with the State Plan will occur during the update process. The ADEM Mitigation Office will be responsible for these tasks.

For the purpose of this update, the following steps were taken to integrate information from local plans:

The local mitigation plans were reviewed and provided information documented in the Community Descriptions and Risk Assessment sections of this Plan, which may but not limited to:

- History/Geography/Geology/Climate
- Population/Economy/Land Ownership
- Historic Disaster Events

- Local Jurisdiction Vulnerability
- Calculated Priority Risk Index (CPRI)
- Local Risk Assessment and Loss Estimations

As plans continue to get submitted for approval and as we continue to learn from the update process, we plan to continue to review local mitigation plans for the following information (just to mention a few):

- to ensure hazards and risks are evaluated in a manner similar to that used to develop the State Plan;
- to ensure State Plan information is used, where appropriate, during the development of local plans;
- continue to utilize the local Risk Assessment and Mitigation Strategy information to shape the State Plan to more accurately reflect the State's current situation;
- Mitigation Strategy progress to determine jurisdictions that may need assistance from the State.

Prioritizing Local Assistance

Requirement: §201.4(c)(4)(iii): The section shall include] criteria for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs which should include: consideration for communities with the highest risks, repetitive loss properties, and most intense development pressures. [For] non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs.

Update Requirement §201.4(d): [The] plan must be reviewed and revised to reflect changed in development, progress in statewide mitigation efforts and changes in priorities.

The State's mitigation goal is to "reduce risk to people and property from natural and human-caused hazards." All projects will be reviewed and approved based on this goal. Projects that best demonstrate the ability to protect the lives and property of the citizens of Arizona will be considered a high priority.

Projects will be selected and prioritized with the overall goal of reducing or eliminating the risk to people, property and critical infrastructure from natural hazards. Projects which are undergoing a secondary review will be given a higher priority, in order of significance include:

- Projects located in a declared county;
- Projects that pose a risk to public health and/or safety if left unresolved;
- Projects which protect homes and/or businesses;
- Projects which protect critical facilities and/or critical infrastructure; and
- Acquisitions or buy-outs, especially for properties which have been designated repetitive or severe repetitive loss structures. These are the only projects which completely eliminate the risk to people and property.

As part of the prioritization instructions, each panelist will be advised to prioritize each project from one through the number of applications submitted. For instance, if there are ten applications, projects would be prioritized from one through ten. If there are four applications, they would be prioritized from one through four. All prioritization numbers will be added for each project and totaled. The project application that has the lowest number will be project number one and so forth, see example below:

	Project A	**Project B**	**Project C**	**Project D**
Panelist 1	3	4	2	1
Panelist 2	2	3	4	1
Panelist 3	2	1	3	3
Panelist 4	1	2	3	4
Totals	8	10	12	9
Prioritization	**1**	**3**	**4**	**2**

Project A would be the State's priority #1 since the total of "8" is a lower number than the rest of the application totals. Project B would be the State's priority #3 with a total of "10"; Project C would be the State's priority #4 with a total of "12"; and lastly, Project D would be the State's priority #2 with a total of "9."

In the event of a tie, the project with the highest BCA will be ranked higher in priority.

7. Plan Maintenance Procedures

Section Changes

Monitoring Progress of Mitigation Activities – This discussion has been updated according to the Arizona Hazard Mitigation Grant Program State Administrative (404) Plan, July 2013 (DRAFT).

Plan Monitoring & Evaluation

Requirement: §201.4(c)(5)(i): [The Standard State plan must include an] established method and schedule for monitoring, evaluating, and updating the plan.

This Plan update was prepared in coordination with Team Members from ADEM and other state agencies and county emergency managers and their staff. In order to keep the Plan current and build upon previous hazard mitigation planning efforts and success, the State intends to utilize the Planning Team to monitor, evaluate, and update the Plan on an ongoing basis.

Due to the briefness of the state plan valid period and what is reasonable, we will evaluate our Plan one year after its FEMA approval date. What would normally be the next annual monitoring/evaluation, will be done during the update planning process as we begin that process one year prior the Plan's expiration date. Additional reviews may occur when required/needed due to changes in federal/state regulations and/or legislation that have an impact on the hazard mitigation program.

The Planning Team will provide an evaluation of the Plan by focusing on the following:

- Appropriateness of Goals/Objectives and Actions/Projects;
- Notable changes in the State's risk to natural hazards;
- Impacts of land development activities and related programs on hazard mitigation;
- Progress on implementation of the Plan. This may include identification of problems and suggested improvements;
- The adequacy of resources for implementation of the Plan;
- Participants in the planning process and how to increase and improve participation among State agencies and others in future planning efforts.

The Planning Team will be responsible for summarizing the information gathered during the annual review and reporting this information to the Director of the Division of Emergency Management within 3 months. The summary report may include recommended revisions to the Risk Assessment, the State's goal and objectives, projects and timelines and may reflect major changes in policies, programs, and funding.

During the last Plan cycle, the Plan was evaluated on an ongoing process as changes were instituted to integrate new human-caused hazards to make it more cohesive with FEMA's *Threat and Hazard Identification and Risk Assessment (THIRA)*. We were also continually evaluating the Plan as we were assisting the local jurisdictions in developing their plan updates. Since the beginning of our DMA2K planning, much has been learned and many ways of making our plans more meaningful and effective have been developed. In developing these ideas into changes in our Plans, we must consider both the State and all our local plans, as we believe in a standard plan format and flow, enabling smoother integration. The information in this Plan is referred to and/or used for inclusion in other agency activities and in our brochures.

Plan Updating

The *Disaster Mitigation Act of 2000 (DMA2K)* requires the updating of state level hazard mitigation plans every three years. To ensure this occurs, approximately one year prior to the update due date, the Planning Team will undertake the following activities:

- Analyze the State's risk to natural and man-made hazards, and updates as necessary;
- Perform the Plan review and review the previous evaluation;
- Review and revision of the Mitigation Strategy, including goal, objectives & potential actions;
- Prepare a new Action Plan with prioritized actions, responsible parties, and resources;
- Prepare a new draft *State of Arizona Multi- Hazard Mitigation Plan* for adoption;
- Submit an updated Plan to FEMA for approval;
- Consideration of annual reviews and project monitoring since last Plan approval

Each three year update will be developed using information according to a specific cut-off date. The cut-off date used for this update due is on or around March 2013.

This Plan is a living document and, as discussed above, will be reviewed, updated, adopted and submitted to FEMA for approval every three years. The annual progress review will include key members of the Planning Team, to be determined by the SHMO and/or the Hazard Mitigation Planning Program Manager.

We will ensure monitoring and reviewing activities are performed as schedule by:

- Storing all Plan documents on the Mitigation Office's shared main computer network drive;
- Ensure network system is backed up every night;
- Post scheduled dates on the Mitigation Office staff calendar, paper and shared through computer.

Monitoring Progress of Mitigation Activities

Requirement: §201.4(c)(5)(ii) and (iii): The Standard State plan maintenance process must include: A system for monitoring implementation of mitigation measures and project closeouts, [and] A system for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.

Monitoring Progress of Funded Mitigation Projects

This section reflects the processes used by ADEM, according to Section V: Project Management of the *Arizona Hazard Mitigation Grant Program State Administrative (404) Plan, July 2013 (DRAFT)*:

Accountability of Funds

ADEM, serving as grantee, has primary responsibility for project management and accountability of funds as indicated in 44 CFR, Part 13. ADEM is responsible for ensuring that subgrantees meet all program and administrative requirements***.***

The MGPM, under the direction of the SHMO, will be responsible for monitoring mitigation projects in accordance with 44 CFR, Part 13.

Cost Sharing

Under the HMA programs, the total cost to implement approved mitigation activities is generally funded by a combination of Federal and non-Federal sources. The non–Federal share must be an eligible cost used in direct support of the approved activities under the HMA guidance and the specific grant award. Contributions of cash, in-kind services or materials, or any combination thereof, may be accepted as part of the non-Federal cost share.

The state and subapplicants will identify the source of their cost share requirement as part of the application procedure. Commitment letters will be submitted as part of the actual application documenting where the actual non-Federal cost share will be obtained or provided.

Duplication of Programs/Benefits

HMGP funds cannot be used to provide assistance for activities for which it determines the primary or more specific authority lies with another Federal agency or program. HMGP funds are not intended to be used as a substitute for other available program authorities.

HMGP funds cannot duplicate funds received by or available to applicants or subapplicants from other sources for the same purpose. Examples of other sources include insurance claims, other assistance programs, legal awards, or other benefits associated with properties or damage that are subject of litigation.

Packaging of Programs

HMGP funds may be packaged or used in combination with other Federal, State, local or private funding sources when appropriate to develop a comprehensive mitigation solution; however, HMGP funds cannot be used as a match for other Federal funds.

Projects identified for packaged programs must demonstrate that the portion funded by the HMGP solves a problem independently or constitutes a functional portion of a solution. Projects that are dependent on another phase of a project(s) in order to be effective and/or feasible are ineligible activities.

Reimbursements to Subgrantees

Subgrantees shall be paid on a reimbursement basis. The subgrantee request for reimbursement shall include:

- Letter requesting reimbursement
- Summary invoice

- All supporting documentation

Subgrantees will be reimbursed upon review of the requested amount and supporting documentation, also, a site visit may be conducted. If all appropriate documentation is in order, the subgrantee will be reimbursed. If there are questions or concerns, the State will work with the subgrantee to ensure everything is in order before the reimbursement is made. The final Federal 10% of the subgrant will be paid upon final review of the project and if the project is in compliance with the grant requirements.

Cost Underruns

A cost underrun occurs when the subgrantee spends less on the project than the amount of the grant. Cost underruns may be used to offset overruns for other HMGP activities within the same disaster. However, cost underruns will not be applied to new activities if the application period has expired.

Cost Overruns

Projects within a specific disaster that are completed under estimated costs (underrun) may have the remaining funds applied to projects within the same disaster that experienced an overrun. ADEM may request this transfer of funds if all criteria have been met. FEMA must approve requested cost overruns prior to implementation and the subgrantee must continue to meet programmatic eligibility requirements including cost effectiveness and cost share. Cost overrun notifications may need to be accompanied by a new BCA if requested by FEMA; if the results of this analysis do not result in a BCR equal or greater than one, Federal funds will not be allowed to meet the cost overrun. In no case, shall the cost overrun exceed the amount available in HMGP from the disaster.

Acquisitions/Relocations/Elevations

The grantee and subgrantees must comply with additional requirements when using HMGP funding for open-space acquisition and/or relocation projects in 44 CFR, Part 80. Link to GPO Access to review or print necessary information: http://www.gpo.gov/nara/cfr/cfr-table-search.html.

Subgrantees receiving assistance for real property acquisition or relocation projects will enter into an agreement with the State, subject to FEMA concurrence. The agreement will provide assurances that:

- The subgrantee will inform the prospective participants in writing that it will not use its eminent domain authority to acquire their property should negotiations fail and property owners must voluntarily elect to participate in the program. The community may include an expiration date for this limitation in the letter (44 CFR, Part 209);
- With stated exceptions, the property will be used in perpetuity for open space without future construction and in compliance with conservation requirements;
- The agreement should include the requirement that warranty deed restrictions will be attached to each individual deed; and
- The agreement should include provisions for the State to monitor and inspect the property every two years and certify that the owner continues to use the inspected property for open space or agricultural purposes.

Elevation projects in areas of Special Flood Hazard Areas will adhere to the conditions noted in FEMA guidance entitled: *Conditions for Mitigation of Property in a Special Flood Hazard Area with FEMA Grant Funds* (D. Maurstad, Memorandum, March 20, 2006).

Monitoring Projects

The MGPM is responsible for monitoring and evaluating the progress and completion of each project. The amount of monitoring that must be done depends on the complexities of the project and the sophistication of the subgrantees. This can be accomplished by:

- Recognizing danger signals and providing technical assistance early on in the project. Danger signals might be: failure to file quarterly reports on time or quarterly reports that show lack of progress; expenditures that do not match with the percentage of the project that is completed (e.g., 60% of the eligible costs have been requested, but quarterly reports show only 10% of the project is complete); or a change in project manager;
- Meeting with the subgrantee and ensuring they are aware of the requirements imposed on them by Federal regulations and by the regulations of the HMGP;
- If a project is not completed and there is not adequate justification for non-completion of the project, no Federal funding will be provided for that project. If a project is not completed and partial reimbursements have been paid to the subgrantee, the subgrantee may be expected to pay back the partial reimbursements if there is not adequate justification why the project was not completed.

ADEM will use the required Quarterly Progress Report to monitor projects (see Quarterly Progress Reports).

Period of Performance

The Period of Performance (POP) is the period of time during which ADEM is expected to complete all grant activities and to incur and expend approved funds. The POP begins when the first project is awarded and ends no later than 36 months from the close of the application period.

Extensions

Extensions to a subgrantee's project or activity will not be approved automatically. All extension requests must be submitted to ADEM at least 90 days prior to the expiration of the approved project/activity date and must be submitted in writing. The extension justification must demonstrate that work is in progress and will be completed according to the project scope as stated in the original application. The extension justification must address:

- Verification that progress has been made as described in quarterly reports;
- Reason(s) for delay;
- Current status of the project/activity/activities;
- Current POP termination date and new projected completion date;
- Remaining available funds, both Federal and non-Federal;
- Budget outlining how remaining Federal and non-Federal funds will be expended; and
- Plan for completion, including updated schedule.

Any extension request for a subgrantee's project or activity completion date that will cause the POP for the grant to be extended will need to be sent to FEMA for approval. All requests will need to include the required documentation listed above.

Appeals

An eligible applicant, subgrantee, or grantee may appeal any FEMA determination previously made related to an application for, or the provision of Federal assistance according to the following procedures:

- All appeals must be in writing and go through the State to FEMA. The grantee shall review and evaluate all subgrantee appeals before submitting them to the FEMA.
- Each appeal shall contain documented justification supporting the appellant's position, specifying the monetary figure in dispute and the provisions in Federal law, regulation, or policy with which the appellant believes the initial action was inconsistent.

All appeals will follow the procedures and time limits as listed in 44 CFR, Part 206.440.

Levels of Appeals

- FEMA will consider the first appeals for HMGP decisions with respect to Subparts M and N of 44 CFR, Part 206.440.
- The submission of a second appeal will follow the same protocol as a first appeal. The second appeal and supporting documentation will be forwarded to FEMA HQ by the Regional Administrator.

Time Limits

- Appeals must be made to the grantee within 60 days of the receipt of the notice of the action that is being appealed. However, there are extenuating circumstances that preclude requesting an appeal within the given time frame, and these must be justified.
- The grantee will review and forward these appeals from an applicant or subgrantee with written recommendations to the Regional Administrator within 60 days of receipt.
- Within 90 days of the receipt of an appeal, the Regional Administrator (for first appeals) or the Associate Director (for second appeals) shall review the material submitted and notify the grantee, in writing, as to the disposition of the appeal. If the decision is to grant the appeal, the Regional Administrator will implement the appropriate action.

In some cases, additional information may be required before a decision can be made. The decision must be made within 90 days of the receipt of the additional information.

In the case of highly technical appeals, the Regional Administrator or the Associate Director may choose to submit the appeal information to an independent scientific or technical person or group. The 90-day time limit begins when the Regional Administrator or Associate Director receives the report from the technical expert(s).

Quarterly Performance Reports

All subgrantees will be required to submit a progress report to ADEM on a quarterly basis. Quarterly reports from subgrantees are due each January 15th, April 15th, July 15th, and October 15th. An electronic notification will be sent two weeks before the quarterly report is due to all subgrantees. The MGPM will compile the quarterly reports and submit them to FEMA in a timely manner.

All official financial reports for each project will be submitted by the Arizona Department of Emergency and Military Affairs (DEMA) Finance Office to FEMA.

Subgrantee Record Keeping Requirements

Federal regulations (44 CFR, Parts 13.20 and 206.205) require each subgrantee to maintain a system that accounts for FEMA funds on a project-by-project basis. The system must disclose the financial results for all FEMA-funded activities accurately, currently and completely. It must identify funds received and disbursed and reference source documentation. The SF 425 is also utilized for this process

Federal regulations (OMB Circular A-87 and 44 CFR, Part 13.20) require that costs claimed under Federal programs must be adequately supported by source documentation such as cancelled checks, invoices, payroll, time and attendance records, contracts, etc.

Each subgrantee must maintain full documentation in order to receive payment. The MGPM will require submission of all documentation before any reimbursement is made.

The subgrantee will be required to document all expenditures and implement monitoring procedures for review by the MGPM. Quarterly reports will be submitted to ADEM on the status of completion dates, any changes in the scope of work, and project costs to date. Non-Federal cost share will be documented utilizing the same procedures outlined in OMB Circular A-87 and 44 CFR 13.20 and 44 CFR 13.24. All cost must also be supported by source documentation such as cancelled checks, invoices, payroll, time and attendance records, contracts, etc.

Audit Requirements

The Audit Section of the DEMA will conduct audits following State accounting procedures. (See http://www.gao.state.az.us/Manuals and Publications.) FEMA may also elect to conduct a Federal audit on the HMGP grants. (44 CFR, Parts 13.22 and 14)

- The grantee and all subgrantees shall have audits made in accordance with 44 CFR, Part 14, *Uniform Audit Requirements* for all grants $100,000 or more a year in Federal financial assistance. The SHMO will schedule audits with the DEMA Audit Department based on the level of audit that is needed. If the project was clear cut, no changes were made to the budget or scope of work and the reimbursement process was straightforward, than one of the lesser audits will suffice. If the project was difficult and there were amendments to the initial approved application, then a general audit should be conducted. Audit descriptions are as follows:
    - LIMITED AUDIT – The DEMA Audit Department will conduct an audit limited to a high level review of the documentation as a whole. If warranted, the audit may be upgraded to a "desk review" audit or a "general" audit.
    - DESK REVIEW AUDIT – The DEMA Audit Department will conduct an audit limited to a high level review of each project and applicable components (labor, equipment and material expenditures). If warranted, the audit may be upgraded to a "general" audit.
    - GENERAL AUDIT – The DEMA Audit Department will conduct a detailed audit of each HMGP project and applicable components (labor, equipment and material expenditures).

If adverse findings are reported, the SHMO will report to the GAR to ensure that appropriate action is taken and reports that action to FEMA.

Closeout Procedures

Subgrant Closeout: Before final closeout of a subgrant, the MGPM or SHMO's designee will inspect all projects for completion and compliance. If documentation, inspections, and other reviews done by the MGPM reveal problems in performance of work or the documentation, the MGPM will work with the subgrantee's applicant agent to correct the deficiencies before closeout. Items required to be submitted with the subgrant closeout request are:

- Final invoice along with supporting documentation
- Final quarterly report
- Letter requesting final reimbursement
- Project photographs
- List of planned maintenance

Elevation projects also will require:

- Before and after photos
- Copies of pre and post construction elevation certificates
- Signed, recorded deed notices
- Acquisition projects will also require:
- List of all properties acquired to include address, parcel number, longitude and latitude
- Copies of signed recorded deeds

The SHMO will submit the final closeout request to FEMA containing the same documents listed above submitted by the subgrantee.

The SHMO will submit a final project closure package to terminate the FEMA-State Agreement when all subgrants have been closed. The package will include the following:

- A listing of all projects with the eligible expenditures.
- Certification that all funds have been expended in accordance with the FEMA-State Agreement utilizing the SF 425.

When all payment of these funds has been made, the SHMO determines the final eligible administrative allowance and requests reimbursement from FEMA. Upon receipt of this allowance, the SHMO notifies the Regional Administrator in writing that no further claims for the disaster will be made and that all program activity has been closed.

HMGP Management Costs

The amounts, allowable uses, and procedures for HMGP management costs are established in 44 CFR, Part 207. Examples of allowable management costs are listed in Part IV, D.1.3. HMGP management costs will be provided at a rate of 4.89% of the HMGP ceiling. Management costs are provided outside of and separate from the HMGP ceiling amount.

Since costs to administer and manage the subgrant can be charged directly to the project grant, the State will not provide management costs to subgrantees. These funds will be used to partially reimburse the State for their cost associated with the administration and management of HMGP. This will include regular and overtime salaries, as well as the associated fringe benefits for the State's permanent and non-permanent staff. In addition, the costs for goods and services, supplies and equipment, travel, per diem and lodging will be charged to the management costs.

FEMA will establish the amount of funds that it will make available for management costs by a lock-in, which will act as a ceiling for management costs funds available to a Grantee, including its subgrantees. FEMA will determine, and provide to the State, management cost lock-ins at 30 days (or soon thereafter), at six months, and at twelve months from the date of declaration, or upon the calculation of the final HMGP lock-in ceiling, whichever is later.

Upon receipt of the initial 30-day lock-in, the State may request that FEMA obligate 25% of the estimated lock-in amount. No later than 120 days after the date of declaration, the State must submit documentation to support costs and activities for which the projected lock-in for management cost funding will be used. In extraordinary circumstances, FEMA may approve a request by the State to submit supporting documentation after 120 days.

FEMA will work with the State to approve or reject the documentation submitted within 30 days of receipt. If the documentation is rejected, the State will have 30 days to resubmit it for reconsideration and approval. FEMA will not obligate any additional management costs unless the State's documentation is approved.

Documentation for management costs must include:

- A description of activities, personnel requirements, and other costs for which the State will use the management costs funding provided; and
- The State's plan for expending and monitoring the funds provided and ensuring sufficient funds are budgeted for grant closeout.

Upon receipt of the six-month management costs lock-in, and if the State can justify a need for additional management costs, the State may submit a request to FEMA for an interim obligation.

<u>Monitoring Progress of Mitigation Strategy Actions/Projects in this Plan</u>

The Planning Coordinator and/or SHMO will evaluate the Plan one year after the date of approval from FEMA and during the update planning process to ensure actions are progressing adequately and according to Plan timeframes. The monitoring scheduled dates will be indicated on a calendar shared by the Mitigation Office staff. A database of all actions will be updated as the scheduled monitoring occurs and when additional progress is reported or other communication/correspondence is made regarding the actions. The database will include but is not limited to the following information;

- Action
- Priority level
- Lead and participating agencies
- Funding or resource source(s)
- Project start/complete dates
- Correspondence/Communication
- Progress indicated by specific activities

At the very least, the updated database will be sent to the SHMO and the Planning Team Members as per the scheduled monitoring. This information will be stored on the Mitigation Office's shared main computer network drive (which is backed up every night).

8. Plan Tools

Acronyms

ASCE	American Society of Civil Engineers
ACTIC	Arizona Counterterrorism Information Center
ADA	Arizona Department of Agriculture
DEMA	Arizona Department of Emergency and Military Affairs
ADEQ	Arizona Department of Environmental Quality
AZDEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
AZDOHS	Arizona Department of Homeland Security
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
ADEM	Arizona Division of Emergency Management
ADPP	Arizona Drought Preparedness Plan
AGFD	Arizona Game and Fish Department
AZGS	Arizona Geological Survey
APS	Arizona Public Service Company
ARS	Arizona Revised Statutes
AZSERC	Arizona State Emergency Response Commission
ASLD	Arizona State Land Department
ASU	Arizona State University
AWC	Arizona Western College
H1N1	Avian Flu
AZWARN	Arizona Water/Wastewater Agency Response network
BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
BEAR	Burned Area Emergency Response
CPRI	Calculated Priority Risk Index
CDC	Center for Disease Control and Prevention
CAC	Central Arizona College
CAP	Central Arizona Project
CFR	Code of Federal Regulations
CMAS	Commercial Mobile Alert System
CAP	Community Assistance Program
CAV	Community Assistance Visits
CRS	Community Rating System
CWPP	Community Wildfire Protection Plan
COOP	Continuity of Operations Plan
CIAO	Critical Infrastructure Assurance Office
DOT	Department of Transportation
DFIRM	Digital Flood Insurance Rate

DMA 2000	Disaster Mitigation Act of 2000
EAP	Emergency Action Plan
EAS	Emergency Alert System
EMAP	Emergency Management Accreditation Program
EPCRA	Emergency Planning and Community Right to Know Act
EPA	Environmental Protection Agency
EHS	Extremely Hazardous Substance
FEMA	Federal Emergency Management Agency
FTI	Fire Threat Index
FIRM	Flood Insurance Rate MAPS
GIS	Geographic Information System
GEF	Governors Emergency Fund
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HAZUS-MH	Hazards United States Multi-Hazard
SHCC	Homeland Security Coordinating Council
IPAWS	Integrated Public Alert and Warning System
IFCI	International Fire Code Institute
LEPC	Local Emergency Planning Committee
MCDEM	Maricopa County Department of Emergency Management
MCAS	Marine Corps Air Station
MPPM	Mitigation Planning Program Manager
MMI	Modified Mercalli Intensity
NCDC	National Climate Data Center
NDMC	National Drought Mitigation Center
NESDIS	National Environmental Satellite, Data and Information Service
NFPA	National Fire Protection Association
NFIP	National Flood Insurance Program
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NIBS	National Institute of Building Services
NIST	National Institute of Standards and Technology
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NRC	National Response Center
NSF	National Science Foundation
NWS	National Weather Service
NAFTA	North American Free Trade Agreement
OSHA	Occupational Safety and Health Administration
PSDI	Palmer Drought Severity Index
PGA	Peak ground acceleration
PDM	Pre Disaster Mitigation
RL	Repetitive Loss
SRP	Salt River Project
SRL	Severe Repetitive Loss
SRLP	Severe Repetitive Loss Properties

SHELDUS	Spatial Hazard Events and Losses Database for the U.S.
SERPP	State Emergency Response and Recovery Plan
SHMO	State Hazard Mitigation Officer
SHSAS	State Homeland Security Assessment and Strategy
SHSS	State Homeland Security Strategy
THIRA	Threat and Hazard Identification and Risk Assessment
UBC	Uniform Building Code
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
WWA	Wildfire Risk Assessment
WUI	Wildland Urban Interface

Definitions

Actions: Specific actions that help achieve goals and objectives. Multiple mitigation actions may be defined to feed into an evaluation of the alternative actions.

Asset: Any natural or human-made feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Building: A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Building / Structure Collapse: The failure and downfall of a structure. The collapse may result from a variety of natural causes such as hurricanes, earthquakes, tornadoes, floods, or from manmade circumstances such as construction deficiencies, neglect, aging infrastructure, or acts of terrorism.

Consequences: The damages (full or partial), injuries, and losses of life, property, environment, and business that can be quantified by some unit of measure, often in economic or financial terms.

Critical Facilities and Infrastructure: Systems or facilities whose incapacity or destruction would have a debilitating impact on the defense or economic security of the nation. The Critical Infrastructure Assurance Office (CIAO) defines eight categories of critical infrastructure, see 'Assessing Vulnerability' for details.

Dam Failure: Can be caused by natural occurrences such as floods, rock slides, earthquakes, or the deterioration of the foundation or the materials used in construction. Usually the changes are slow and not readily discovered by visual examination. Such a failure presents a significant potential for a disaster in that significant loss of life and property would be expected in addition to the possible loss of power and water resources.

Department of Homeland Security (DHS): Following the September 11, 2001 terrorist attacks, President George W. Bush created a new federal government department in order to bring 22 previously separate domestic agencies together. The new department's first priority is protecting the nation against further terrorist attacks. Component agencies analyze threats and intelligence, guard borders and airports, protect critical infrastructure, and coordinate the response for future emergencies. The new department is organized into five major directorates: Border and Transportation Security (BTS); Emergency Preparedness and Response (EPR); Science and Technology (S&T); and Information Analysis and Infrastructure Protection (IAIP); Management. In addition, several other critical agencies have been folded into the new department or are newly created. The FEMA is the foundation of the (EPR) Directorate.

Disaster Mitigation Act of 2000 (DMA2K): A law signed by the President on October 30, 2000 that encourages and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening statewide mitigation planning.

Drought: Occurs when water supplies cannot meet established demands. "Severe" to "extreme" drought conditions endanger livestock and crops, significantly reduce surface and ground water supplies, increase the potential risk for wildland fires, increase the potential for dust storms, and cause significant economic loss. Humid areas are more vulnerable than arid areas. Drought may not be constant or predictable and does not begin or end on any schedule. Short term droughts are less common due to the reliance on irrigation water in arid environments.

Dust / Sand Storms: A dust or sand storm is a severe windstorm that sweeps clouds of dust across an arid region. They can be hazardous to transportation and navigation and to human health. Severe or prolonged dust and sand storms can result in disasters causing extensive economic damage over a wide area and personal injury and death. In Arizona, dust or sand storms are generally associated with the advance of a thunderstorm.

Earthquake: A naturally-induced shaking of the ground, caused by the fracture and sliding of rock within the Earth's crust. The magnitude is determined by the dimensions of the rupturing fracture (fault) and the amount of displacement that takes place. The larger the fault surface and displacement, the greater the energy. In addition to deforming the rock near the fault, this energy produces the shaking and a variety of seismic waves that radiate throughout the Earth. Earthquake magnitude is measured using the Richter Scale and earthquake intensity is measured using the Modified Mercalli Intensity Scale.

Emergency Preparedness and Response (EPR) Directorate: One of five major Department of Homeland Security Directorates which builds upon the formerly independent Federal Emergency Management Agency FEMA. EPR is responsible for preparing for natural and man-made disasters through a comprehensive, risk-based emergency management program of preparedness, prevention, response, and recovery. This work incorporates the concept of disaster-resistant communities, including providing federal support for local governments that promote structures and communities that reduce the chances of being hit by disasters.

Emergency Response Plan: A document that contains information on the actions that may be taken by a governmental jurisdiction to protect people and property before, during, and after a disaster.

Exposure: The number, types, qualities, or monetary values of various types of property or infrastructure and life that may be subject to an undesirable or injurious hazard event.

Extreme Heat: A combination of very high temperatures and exceptionally humid conditions that exceed regionally based indices for perceived risk.

Federal Emergency Management Agency (FEMA): Formerly independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery. As of March 2003, FEMA is a part of the Department of Homeland Security's Emergency Preparedness and Response (EPR) Directorate.

Fissure: Earth fissures are cracks at or near the earth's surface resulting from differential land subsidence. Differential land subsidence occurs when adjacent areas subside at different rates. More subsidence occurs where the bedrock is deeper. The area of differential land subsidence is where enough tension may build to crack the earth and form a fissure. Fissures begin as small cracks and erosion causes them to grow and expand.

Flooding/Flash Flooding: Flooding is an overflowing of water onto normally dry land and is one of the most significant and costly of natural disasters. Flash flooding is caused by too much rain fall in a small area for a short period of time. Several factors contributing to flash flooding such as: rainfall intensity and duration, topography, soil conditions and ground cover. They are normally caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same the same area that occur within a few minutes or hours of excessive rainfall or a quick release from a dam failure.

Flood Insurance Rate (FIRM): of a community, prepared by FEMA, that shows the special flood hazard areas and the risk premium zones applicable to the community.

Flood Mitigation Assistance (FMA) Program: FEMA grant program that provides funds on an annual basis so measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the NFIP.

Frequency: A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1% chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered. Probability is a related term.

Fujita Scale of Tornado Intensity: Rates tornadoes with numeric values from F0 to F5 based on tornado winds peed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while an F5 indicates severe damage sustained.

Geographic Information Systems (GIS): A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

Goals: General guidelines that explain what you want to achieve. Goals are usually broad statements with long-term perspective.

Hazard: A source of potential danger or adverse condition. Hazards include both natural and man-made events. A natural event is a hazard when it has the potential to harm people or property and may include events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. Man-made hazard events originate from human activity and may include technological hazards and terrorism. Technological hazards arise from human activities and are assumed to be accidental and/or have unintended consequences (e.g., manufacture, storage and use of hazardous materials).

Hazard Event: A specific occurrence of a particular type of hazard.

Hazard Identification: The process of identifying hazards that threaten a specific area.

Hazardous Materials Incidents: A spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment of a hazardous material, but excludes: (1) any release which results in exposure to poisons solely within the workplace, with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Hazard Mitigation: Cost effective measures taken to reduce or eliminate long-term risk associated with hazards and their effects.

Hazard Mitigation Assistance (HMA): FEMA grant programs that enable mitigation measures to be implemented before, during and after the recovery from a disaster. These programs are: Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA).

Hazard Mitigation Grant Program (HMGP): FEMA grant program that assists in implementing long-term hazard mitigation measures following major disaster declarations.

Hazard Profile: A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent.

HAZUS: A GIS-based nationally standardized Flood, Earthquake and Hurricane loss estimation tool developed by FEMA.

Implementation Strategy: A comprehensive strategy that describes how the mitigation actions will be implemented.

Landslides / Mudslides: Landslides, like avalanches are massive downward and outward movements of slope-forming materials. The term landslide is restricted to movement of rock and soil and includes a broad range of velocities. Slow movements, although rarely a threat to life, can destroy buildings or break buried utility lines. A landslide occurs when a portion of a hill slope becomes too weak to support its own weight. The weakness is generally initiated when rainfall or some other source of water increases the water content of the slope, reducing the shear strength of the materials. A mud slide is a type of landslide referred to as a flow. Flows are landslides that behave like fluids: mud flows involve wet mud and debris.

Levee Failure: A levee failure/breach results when a portion of the levee breaks away, providing an opening for water to flood the landward side of the structure. Such breaches can be caused by surface erosion due to water velocities.

Liquefaction: The phenomenon that occurs when ground shaking (earthquake) causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Mitigate: To cause to become less harsh or hostile; to make less severe or painful. Mitigation activities are actions taken to eliminate or reduce the probability of the event, or reduce its severity of consequences, either prior to or following a disaster/emergency.

Mitigation Plan: A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in a defined geographic area, including a description of actions to minimize future vulnerability to hazards.

Modified Mercalli Intensity Scale: A commonly used in the United States by seismologists seeking information on the severity of earthquake effects. Intensity ratings are expressed as Roman numerals between I at the low end and XII at the high end. The Intensity Scale differs from the Richter Magnitude Scale in that the effects of any one earthquake vary greatly from place to place, so there may be many Intensity values (e.g.: IV, VII) measured from one earthquake. Each earthquake, on the other hand, should have just one Magnitude, although the several methods of estimating it will yield slightly different values (e.g.: 6.1, 6.3).

Monsoon: Any wind that reverses its direction seasonally. In the Southwestern U.S., for most of the year the winds blow from the west/northwest. Arizona is located on the fringe of the Mexican Monsoon which during the summer months turns the winds to a more south/southeast direction and brings moisture from the Pacific Ocean, Gulf of California, and Gulf of Mexico. This moisture often leads to thunderstorms in the higher mountains and Mogollon Rim, with air cooled from these storms often moving from the high country to the deserts, leading to further thunderstorm activity in the desert. A common misuse of the term monsoon is to refer to individual thunderstorms as monsoons.

Objectives: Defined strategies or implementation steps intended to attain the identified goals. Unlike goals, objectives are specific, measurable, and have a defined time horizon.

100-Hundred Year Floodplain: Also referred to as the Base Flood Elevation (BFE) and Special Flood Hazard Area (SFHA). An area within a floodplain having a 1% or greater chance of flood occurrence in any given year.

Planning: The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.

Pre-Disaster Mitigation (PDM) Grant Program: FEMA program that provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects.

Probability: A measure of how often events of a particular magnitude are expected to occur. Probability describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1% chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered. Probability may also be measured in terms of the chance that an event will be exceeded (or not exceeded) over a specified period of time. Frequency is a related term.

Q3 Data: The Q3 Flood Data product is a digital representation of certain features of FEMA's Flood Insurance Rate (FIRM) product, intended for use with desktop mapping and Geographic Information Systems technology. The digital Q3 Flood Data are created by scanning the effective Flood Insurance Rate (FIRM) paper maps and digitizing selected features and lines. The digital Q3 Flood Data are designed to serve FEMA's needs for disaster response activities, National Flood Insurance Program activities, risk assessment, and floodplain management.

Repetitive Loss Property: A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1,000 each have been paid within any 10-year period since 1978.

Richter Magnitude Scale: A logarithmic scale devised by seismologist C. F. Richter in 1935 to express the total amount of energy released by an earthquake. While the scale has no upper limit, values are typically between 1 and 9, and each increase of 1 represents a 32-fold increase in released energy.

Risk: The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage beyond a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: A process or method for evaluating risk associated with a specific hazard and defined in terms of probability and frequency of occurrence, magnitude and severity, exposure, and consequences.

Severe Repetitive Loss Property: A residential property that has at least four NFIP claim payments over $5,000 each, when at least two such claims have occurred within any ten-year period, and the cumulative amount of such claims payments exceeds $20,000; or for which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any ten-year period.

Severe Wind: For the purpose of this Plan, includes Thunderstorm/High Winds, Tornado/Dust Devils, and Tropical Storms/Hurricanes.

Subsidence: Occurs when large amounts of ground water have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rocks fall in on itself.

Substantial Damage: Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50% of the market value of the structure before the damage.

Thunderstorms / High Winds: Violent storms typically associated with high winds, dust storms, heavy rainfall, hail, lightning strikes, and/or tornadoes. The unpredictability of thunderstorms, particularly their formation and the rapid movement to new locations heightens the possibility of floods. Thunderstorms, dust/sand storms and the like are most prevalent in Arizona during the monsoon season, which is a seasonal shift in the winds that causes an increase in humidity capable of fueling thunderstorms. The monsoon season in Arizona typically is from late-June or early-July through mid-September.

Tornadoes / Dust Devils: A violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds in excess of 250 mph. Damage paths can exceed a mile wide and 50 miles long. Tornadoes are one of nature's most violent storms. In an average year, 800 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The damage from tornadoes is due to high winds. The Fujita Scale of Tornado Intensity measures tornado / high wind intensity and damage.

Dust devils are small but rapidly rotating columns of wind made visible by the dust, sand, and debris it picks up from the surface. They typically develop best on clear, dry, hot afternoons and are common during the summer months in the desert portions of Arizona. While resembling tornadoes, dust devils typically do not produce damage, although in Arizona they have done so occasionally.

Tropical Storms / Hurricane: A tropical system which the maximum sustained surface wind ranges from 34 to 63 knots (39 to 73 mph). Tropical storms are associated with heavy rain, high wind, and thunderstorms. High intensity rainfall in short periods is typical. A tropical storm is classified as a hurricane when its sustained winds reach or exceed 74 mph (64 knots). These storms are medium to large in size and are capable of producing dangerous winds, torrential rains, and flooding, all of which may result in tremendous property damage and loss of life, primarily in coastal populated areas. The effects are typically most dangerous before a hurricane makes landfall, when most damage occurs. However, Arizona has experienced a number of tropical storms that caused extensive flooding and wind damage.

Vulnerability: Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power–if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Vulnerability Analysis: The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability analysis should address impacts of hazard events on the existing and future built environment.

Vulnerable Populations: Any segment of the population that is more vulnerable to the effects of hazards because of things such as lack of mobility, sensitivity to environmental factors, or physical abilities. These populations can include, but are not limited to, senior citizens and school children.

Wildfires: A rapid, persistent chemical reaction that releases heat and light, especially the exothermic combination of a combustible substance with oxygen. Wildfires present a significant potential for disaster in the southwest, a region of relatively high temperatures, low humidity, low precipitation, and during the spring moderately strong daytime winds. Combine these severe burning conditions with people or lightning and the stage is set for the occurrence of large, destructive wildfires.

Winter Storms: Cold wind accompanied by blowing snow; freezing rain or sleet, cold temperatures, and possibly low visibility and drifting snow. The storms often make roads impassable. Residents, travelers, and livestock may become isolated or stranded without adequate food, water, and fuel supplies. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are considered deceptive killers as they indirectly cause transportation accidents, and injury and death resulting from exhaustion/overexertion, hypothermia and frostbite from wind chill, and asphyxiation.

Appendix A – Arizona State & Federal Declared Disasters

		DECLARATION DATE		STATE	FEDERAL
	DISASTER AREA	STATE	FEDERAL	EXPENDITURES	EXPENDITURES
	Flooding - Graham, Greenlee,				
1	Maricopa, Pima & Pinal Counties	24-Feb-66	30-Apr-66	$ 43,673.00	$ 3,256,224.00
2	**Flooding** - Graham County	12-Nov-67		$ 15,000.00	
	Heavy Snow - Coconino, Yavapai,				
3	Gila & Navajo Counties	19-Dec-67		$ 466,470.00	
4	**Forest Fire** - Yavapai County	23-Jun-68		$ 3,898.00	
	Flooding - Apache, Coconino, Gila,				
5	Maricopa, Navajo & Yavapai Counties	15-Sep-70	22-Sep-70	$ 12,977.00	$ 9,613,107.00
6	**Flooding** - Navajo & Pinal Counties	12-Oct-71		$ 254,514.00	
	Wind / Flooding -				
7	Maricopa, Pima, & Pinal Counties	15-Jun-72	03-Jul-72	$ 16,158.00	$ 10,879,002.00
	Flooding -				
8	Graham & Greenlee Counties	19-Oct-72	25-Oct-72	$ 58,177.00	$ 16,819,609.00
9	**Forest & Wildland Fires** - Statewide	28-Apr-73		$ 36,718.00	
10	**Fire & Explosion** - Kingman	12-Jul-73		$ 19,520.00	
11	**Energy Shortage** - Statewide	07-Jan-74		$ 199,028.00	
12	**Flooding** - Mohave County	19-Jul-74		$ 85,000.00	
13	**Forest & Wildland Fires** - Statewide	22-Apr-75		$ 8,923.00	
	Flooding -				
14	Graham & Greenlee Counties	19-Sep-75		$ 91,500.00	
15	**Flooding** - Mohave County	10-Sep-76		$ 150,000.00	
16	**Flooding** - Maricopa County	07-Nov-76		$ 186,950.00	
	Illumination Assistance				
17	State Prison Disturbance	19-23 Apr-77		$ 1,016.10	
	Grasshopper Infestation -				
18	Gila County	24-May-77			
	Emergency Duty - Coconino				
19	**National Forest "Radio Fire"**	17-23 Jun-77		FEDERAL FUNDS	
20	**Flooding** - Cochise County	21-Jul-77		$ 50,000.00	
	Emergency Duty - Hualapai				
21	**Reservation "Canyon Fire"**	06-13 Aug -77		FEDERAL FUNDS	
	Emergency Duty - Tonto Nation				
22	**Forest Fire Suppression**	15-16 Aug-77		FEDERAL FUNDS	
23	**Flooding** - Mohave, Gila Counties	24-Aug-77		$ 70,000.00	

	Cotton Crop Pesticide Application -				
24	Statewide	02-Sep-77			
	Flooding -		DR-540		
25	Pima, Pinal Santa Cruz Counties	09-Oct-77	04-Nov-77	$ 298,422.00	
	Flooding - Statewide & Apache,				
	Navajo, Graham, Greenlee,		DR-551		
	Yavapai, Gila, Maricopa, Pima,				
26	Mohave, Navajo Reservations	02-Mar-78	04-Mar-78	$ 485,718.00	$ 67,122,627.00
	Potential Lettuce Farmer Blockade -				
27	Nogales, AZ	09-10 Mar-78		$ 576.60	
28	Forest & Wildland Fires - Statewide	21-Apr-78		$ 11,528.00	
	Assist in Inspection of Earthen				
29	Dams - Apache & Navajo Counties	08-11 May-78		$ 397.40	
	Aid to law Enforcement-Florence				
30	Prison Break	10-Aug-78		$ 5,943.72	
31	Hazardous Material Incident	06-Aep-78		$ 164.94	
	Potential Dam Failure - Apache				
32	County Tsaile Dam	29-Sep-78		$ 4,888.00	
	Flooding -				
33	Graham & Greenlee Counties	28-Nov-78		$ 70,119.86	
34	Prison Escape - Statewide	30-Nov-78		$ 425.00	
	Flooding - Statewide & Coconino,				
	Navajo, Pima, Pinal Maricopa,				
	Greenlee, Graham, Gila, Santa Cruz,			Expenditures to	
	Yavapai Counties			date 30 Jan 85	
			DR-570		
	Navajo Nations, White Mt. Apache				
	Tribe, San Carlos Tribe, Fort McDowell				
	Indian Community, Gila River Indian				
	Community & Hopi Tribe, Ak Chin				
35	Indian Community.	18-Dec-78	21-Dec-78	$ 1,909,498.15	$ 113,561,122.00
	Snow Relief - Mohave, Coconino				
	Counties Snowfall caused hazard par				
36	Indians	05-Feb-79		FEDERAL FUNDS	
	High Winds & Flooding				
37	Maricopa County	29-Mar-79		$ 39,283.76	

38	Forest & Wildland Fires - Statewide	16-Apr-79		$ 204,206.88	
	Water Emergency - Cochise County				
39	Huachuca City	29-Jun-79		$ 5,952.72	
	Emergency Duty - "Castle Fire" and				
40	"Verde Fire"	30-12 Jul-79		FEDERAL FUNDS	
41	Movement of Contaminated Food	21-Aug-79		$ 58.34	
	Tucson (American Atomic Corp)				
42	Hazardous Material (Tritium Incident)	25-Sep-79		$ 1,118,702.00	
43	Earthquake Flooding - Yuma County	19-Dec-79		$ 25,000.00	
44	Asbestos Tailings - Gila County	16-Jan-80		$ 193,169.00	
	Flooding - Maricopa, Gila, Yavapai,				
	Mohave Counties, White Mt. Apache				
	Tribe, San Carlos Apache Tribe, Fort				
	Gila River Indian Community, Fort		DR-614		
	McDowell Indian Community, Salt				
45	River Indian Community	15-Feb-80	19-Feb-80	$ 1,958,610.97	$ 42,744,642.00
	Flood Damage Assessment -				
46	Navajo Reservation	02-04 Apr-80		$ 581.23	
				DEPARTMENT OF	
47	Lights & Generator - State Prison	27-May-80		CORRECTIONS	
	Flood Damage Assessment				
48	White Mt. Reservation	28-May-80		$ 979.61	
49	Forest & Wildland Fires - Statewide	02-Jun-80		$ 298,844.73	
	Grasshopper Infestation - Coconino,				
	Gila, Yavapai, Mohave, Apache,				
50	Graham, Navajo, Cochise Counties	16-Jun-80		$ 67,773.40	
	Fire Suppression Assistance -				
51	Tonto National Forest	30-03 Jul-80		FEDERAL FUNDS	
	Fire Suppression Assistance -				
52	Prescott National Forest	30-04 Jul-80		FEDERAL FUNDS	
	Search & Rescue Operations				
53	Refrigerated Trucks for Alien Bodies	06-08 Jul-80		$ 8,305.00	
	Fire Suppression Assistance -				
54	Bureau of Land Management	25-28 Jul-80		FEDERAL FUNDS	
55	Flooding - Santa Cruz County	21-Aug-80		$ 102,319.29	
				Expenditures to	

				Date 30 Jun 82	
56	Hazardous Materials - Statewide	31-Mar-81		$ 492,635.00	
57	Forest & Wildland Fires - Statewide	30-Jun-81		$ 256,904.00	
58	Fire Suppression Assistance	26-30 Jun-81		FEDERAL FUNDS	
				Expenditures to	
				Date 30 Jun 85	
59	Forest & Wildland Fires - Statewide	30-Jun-82		$ 492,635.00	
	Flooding – Mohave County				
60	Colorado City	05-Nov-83		$ 65,000.00	
	Navajo Reservation Emergency -				
61	Severe winter conditions on portions of Navajo Nation, Coconino, Apache and Navajo Cos	25-Apr-83		$ 43,140.25	
	Santa Cruz County Emergency -				
62	Heavy Rainfall	03-Mar-83		$ 104,335.45	
	Globe Asbestos Emergency -				
	Presence of asbestos tailing state of			Expenditures to	
	emergency at Mountain View Monile			date 30 Jun 85	
63	Home Estates - Globe	11-May-83		$ 298,940.00	
	Colorado River Flooding - Overflow		DR-686	Expenditures to	
	of dams, Colorado River, state of			date 18 Apr 86	
	Emergency in La Paz, Mohave, Yuma				
64	Counties	16-Jun-83	01-Jul-83	$ 825,096.53	$ 2,501,740.00
	Copper Strike - Unlawful acts of				
	violence in the mining communities,				
65	primarily Clifton	10-Aug-83		$ 564,851.00	
	Heavy Winds, Rains & Flooding -				
66	Prescott/Yavapai Area	23-Sep-83	05-Oct-83		
	Statewide Flood - All counties			Expenditures to	
	except La Paz, Yuma, Coconino,		DR-691	date 30 Jun 85	
	Maricopa. Navajo County declared				
67	for White Mt. Apache Tribe	30-Sep-83	05-Oct-83	$ 863,282.55	$ 13,446,148.00
	Flooding & Windstorm - Mohave,		DR-730		
68	Yuma & Maricopa Counties	23-Jul-84	12-Jun-85	$ 55,372.66	$ 505,323.00
69	Flooding - Graham/Greenlee Counties	30-Dec-84		$ 426,679.00	
	Mudlift Emergency Airlift of supplies to				
	Navajo & Hopi Indian Reservations;				

	Apache, Coconino, Navajo, Mohave				
70	Counties	29-Jan-85		$ 50,917.87	
	Grasshopper Infestation -				
71	Graham & Cochise Counties	01-Apr-86		$ 136,528.00	
	Grand Canyon Coconino County				
72	Air Crash Killing 25 People	18-Jun-86		$ 42,700.00	
				Expenditures to	
	Nogales Dump Site			date 18 Aug 86	
73	Santa Cruz County	27-Jun-86		$ 40,000.00	
	Bisbee/Cochise **Flood**				
74	Town of Bisbee	18-Jul-86		$ 223,351.61	
75	La Paz County **Flood** - Ehrenberg	25-Jul-86		$ 250,686.75	
	Imported Red Fire Ants -				
76	Maricopa County	14-Oct-86		$ 48,897.31	
	Severe Winter Storm -				
77	Navajo, Apache Counties	22-Jan-87		$ 148,897.31	
	Severe Snowstorm - Apache, Navajo,				
78	Gila, Coconino, Yavapai Counties	25-Feb-87		$ 3,347.40	
79	**Hazardous Materials -** Statewide	31-Mar-87			
80	**Wildland Fires -** Statewide	17-Mar-87			
81	**Drought -** Cochise, Graham Counties	17-May-88	USDA		
	Southern Arizona **Drought**				
82	Maricopa, Pima, Pinal Counties	12-Aug-87		$ 14,940.58	
	Isolated Citizens Airlift - Navajo,				
83	Apache Counties	12-Feb-88		$ 44,933.54	
	Grasshopper Infestation - Mohave,				
84	Coconino Counties	09-May-89			
	Homeless Temporary Shelter				
85	Statewide	21-Dec-88		$ 129,624.16	
	Grasshopper Infestation				
86	Gila County	06-Jun-89		$ 7,724.42	
	Drought - Coconino, Gila, Navajo,				
	Apache, Graham & Indian Res.				
87	within the Counties	21-Jul-89	USDA		
88	Yuma County I **Flood** - Yuma County	27-Jul-89		$ 182,119.00	
89	Yuma County II **Flood** - Yuma County	08-Aug-89		$ 416,274.00	

	Cochise/Wilcox **Flood**				
90	Cochise County	20-Oct-89			
	Gila County **Snowstorm**				
91	Gila County	04-Jan-90		$ 1,563.10	
	Wildland Fire Contingency				
92	Statewide	17-Mar-90			
93	**Dude Fire** - Gila County	25-Jun-90		$ 29,716.69	
94	**Water** Emergency - Graham County	29-Jun-90		$ 1,440.71	
	Monsoon Flood Emergency -		DR-884		
	Mohave, Gila, Pima, Pinal, Yavapai,				
95	Graham, Coconino, Maricopa Counties	07-Sep-90	06-Dec-90	$ 1,175,040.00	$ 5,875,202.00
	Nogales Health Emergency				
96	Santa Cruz County	05-Oct-90		$ 336,667.65	
	Chloride Water Emergency -				
97	Mohave County	09-Nov-90		$ 25,000.00	
	Graham County **Flood** Emergency				
98	Graham County	16-Apr-91		$ 114,249.78	
99	**Search and Rescue**	1991			
100	Coconino (Navajo) **Snow**	04-Dec-91		$ 6,839.94	
	Maricopa County **Health/Flooding** -				
	Salt River, Pima, Maricopa Indian				
101	Community	14-Feb-92		$ 35,000.00	
	Prisoner Escape May 12, 1992				
	Coconino, Yavapai, Navajo, Gila,				
102	Maricopa Counties	10-Jun-92		$ 100,000.00	
	Emergency Government				
103	State Budget	25-Jun-92		$ -	
104	Eloy/Pinal County **Tire Fire**	17-Jul-92		$ 27,743.58	
	Flood Emergency				
105	Graham/La Paz County	02-Sep-92		$ 40,852.69	
	Statewide **Flood**				
106	All Counties except La Paz, Mohave	08-Jan-93	DR-977	$ 30,072,157.03	$ 104,069,362.11
107	Public Safety - Yavapai	01-Oct-93		$ 8,082.73	
	Wildfire Suppression Statewide				
108	Department of Land	09-Sep-93		$ 200,000.00	
	Public Health & Safety				

109	Santa Cruz County	23-Mar-94		$ 21,622.83	
	Public Health & Safety				
110	Mohave County	26-Jul-94		$ 646,236.34	
111	Flood - Santa Cruz	30-Aug-94		$ 139,440.74	
	Wildfire Suppression - Statewide				
112	Department of Lands	14-Oct-94		$ 600,000.00	
113	Public Safety - Coconino County	16-Nov-94		$ 13,054.84	
114	Flood - Greenlee County	28-Nov-94		$ 627,378.44	
	Flood - Apache, Gila, Graham,				
115	Greenlee, and Navajo Counties	10-Jan-95		$ 510,789.19	
	Flood - Coconino, Gila, Graham,				
	Greenlee, La Paz, Maricopa, Navajo,				
116	Pinal, Yavapai, Yuma Counties	15-Feb-95		$ 1,525,663.17	
	Flood - Coconino, Mohave, Yavapai				
117	Counties	07-Mar-95		$ 280,436.09	
118	Trail Derailment - Maricopa	09-Oct-95		$ 49,939.33	
	Moenkopi Landslide				
119	Coconino County	11-Dec-95		$ 7,761.89	
120	Wheat (Karnal Bunt) Statewide	13-Mar-96		$ 796,455.78	
121	Wildfire - Statewide	16-May-96		$ 1,000,728.63	
122	Drought - Statewide	07-Jun-96		$ 211,499.19	
123	Maricopa County Windstorm	15-Aug-96		$ 2,642,139.81	
	Winterstorm - Coconino, Navajo,				
124	Mohave Counties	14-Jan-97		$ 1,590,468.36	
125	Blackwater Tire Fire - Pinal County	04-Aug-97		$ 336,398.43	
126	Tropical Storm Hurricane Nora - Yuma, Gila, LaPaz, Maricopa, Mohave, Santa Cruz & Yavapai	24-Sep-97		$ 2,318,258.57	
	Rainbow Family Gathering				
127	Apache & Navajo	29-Jun-98		$ 311,394.53	
	Red Imported Fire Ant Emergency				
128	State of Arizona	20-Jan-99		$ 177,702.02	
	New River Hazardous Materials				
129	Incident - Maricopa County	23-Mar-99		$ 325,266.81	
	Statewide Wildland Fire Emergency				
130	State of Arizona	06-May-99		$ 4,894.09	
	Rainbow Fire Emergency				

131	Navajo County	17-Jun-99		$ 185,774.94	
	Statewide **Drought** Emergency				
132	State of Arizona	23-Jun-99		$ -	
	Pima County **Flash Flood** Emergency				
133	Pima County	16-Aug-99		$ -	
	Cochise County **Flash Flood**				
134	Emergency - Cochise County	16-Aug-99		$ 1,091,188.75	
	Santa Cruz County **Flash Flood**				
135	Emergency - Santa Cruz County	27-Aug-99		$ 921,206.51	
	Summer Monsoon Storm Emergency		DR-1304		(IA & HM Only)
136	Maricopa & Cochise County	21-Sep-99	15-Oct-99	$ 3,002,389.80	$ 89,017.17
137	Y2K - State of Arizona	05-Jan-00		$ 23,073.19	
	Gila County **Potable Water Shortage**				
138	Gila County	28-Jul-00		$ 42,111.38	
	Mohave County **Wind Storm**				
139	Emergency - Mohave County	25-Aug-00		$ 20,483.91	
	Tropical Storm Olivia				
140	Santa Cruz County	17-Oct-00		$ 3,215.19	
	Arizona 2000 **Flood** Emergency		DR-1347		
141	La Paz, Maricopa, Santa Cruz, Cochise & Pinal County	23-Oct-00	27-Oct-00	$ 1,432,117.82	$ 5,471,560.47
	Gila Bend/Ajo Storm Emergency				
142	Maricopa & Pima County	17-Aug-01		$ 14,237.94	
	September **Terrorism Incident**				
143	State of Arizona	12-Sep-01		$ 2,913,677.35	
	Military Airport Security				
144	State of Arizona	16-Oct-01		$ 8,110.65	
	Citrus Wood Chip Fire				
145	Pinal County	30-Oct-01		$ 129,104.84	
	Yavapai County **Indian Fire**				
146	Yavapai County	16-May-02		$ 151,357.67	
	Rodeo/Chediski Fire		DR-1422		
147	Navajo, Gila & Coconino	19-Jun-02	25-Jun-02	$ 1,418,717.63	$ 1,093,574.15
	Potable Water Emergency				
148	Coconino, Gila & Navajo County	03-Jul-02		$ 42,844.61	
	Exotic Newcastle Disease				
149	Yuma, La Paz & Mohave County	03-Feb-03		$ -	

	Forest Health Emergency				
150	State of Arizona	22-May-03		$ 2,378,061.14	
	Aspen Fire		DR-1477		
151	Pima & Pinal County	19-Jun-03	14-Jul-03	$ 675,568.52	$ 5,363,459.27
	Kinishba Fire				
152	Gila, Navajo & Apache County	15-Jul-03		$ 33,358.85	
	Gila County Flash Flood Emergency				
153	Gila County	05-Dec-03		$ 62,497.14	
	Petroleum Distribution Emergency				
154	Maricopa County	21-Aug-03		$ -	
	River Reservoir Emergency				
155	Apache County	19-Apr-04		$ 344,165.31	
	Mitigation Projects				
156	Mitigation Funds	08-Jun-04		$ 1,558,788.64	
	Nuttall Coplex & Willow Fires				
157	Graham & Gila County	15-Jul-04		$ 281,298.28	
	Flash Flood Emergency				
158	Pinal County	21-Sep-04		$ 159,534.61	
	Mediterranean Fruit Fly Emergency				
159	La Paz, Pima, Santa Cruz & Yuma	23-Sep-04		$ 197,421.08	
	Winter Storm Emergency		1581-DR	Est.	Est.
160	Coconino, Yavapai, Gila, Navajo, Apache, Maricopa & Mohave	29-Dec-04	17-Feb-05	$ 2,591,969.00	$ 5,109,723.96
	Winter Storms & Flooding		1586-DR	Est.	Est.
161	Gila, Graham, Greenlee, Pinal, Yavapai, Maricopa & Mohave	16-Feb-05	14-Apr-05	$ 4,669,288.00	$ 9,344,510.53
	Severe Weather Emergency				
162	Navajo County	07-Apr-05		$ 5,550.66	
	Border Security Emergency				
163	Cochise, Pima, Santa Cruz & Yuma	15-Aug-05		$ 1,492,758.44	
	Clifton Flash Flood Emergency				
164	Greenlee County	26-Aug-05		$ 41,964.78	
	Operation Good Neighbor		3241-EM		
165	State of Arizona	03-Sep-05	12-Sep-05	$ 113,040.05	$ 5,726,164.08
	Summer Monsoon Emergency				
166	La Paz County	16-Sep-05		$ 594,923.19	
	Flash Flood Emergency				

167	Pima County	16-Sep-05		$ 256,948.47	
	Wildfire Resources Emergency				
168	State of AZ (Pre-suppression)	22-Feb-06		$ 192,390.07	
	Brins Wildfire Emergency				
169	Coconino & Yavapai County	19-Jun-06		$ 33,905.33	
	Glassy-Winged Sharpshooter Inf.				
170	Cochise, Yuma, Pima, Pinal, Maricopa & Santa Cruz	23-Jun-06		$ 567,257.48	
	Monsoons & Flooding		1660-DR	Est.	
171	Pinal, Pima, Gila, Graham, Greenlee, Navajo	08-Aug-06	07-Sep-06	$ 2,409,278.00	$ 12,141,752.40
	Nogales Wash Emergency				
172	Santa Cruz County	28-Aug-07		$ 131,052.23	
	Monsoon 2007 Emergency				
173	Mohave County, Town of Cave Creek, Town of Mammoth	14-Sep-07		$ 683,583.65	
	January 2008 Severe Precipitation				
174	Emergency - Pima County	19-Feb-08		$ 231,798.65	
	Nogales Wash 2008 Emergency				
175	Santa Cruz County	15-Jul-08		$ 203,680.68	
	Havasupai Reservation Flood				
176	Havasupai	15-Aug-08		$ -	
	Sedona Flash Flood				
177	City of Sedona	17-Sep-09		$ 166,693.74	
	January 2010 Severe Winter Storm		EM-3307 DR-1888	Est.	Est.
178	Apache, Coconino, Gila, Greenlee La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Yavapai, City of Yuma	21-Jan-10	18-Mar-10	$ 4,497,895.00	$ 14,210,904.00
	Schultz Fire Post-Fire Flooding		DR-1940	Est.	
179	Coconino County	21-Jul-10	04-Oct-10	$ 1,500,000.00	$ 5,500,000.00
	Hopi Tribe Flood Emergency				
180	Navajo County	30-Jul-10		$ 50,033.02	
	Monsoon 2010 Flooding Emergency			Est.	
181	Greenlee & Santa Cruz Counties	04-Aug-10		$ 315,000.00	
	Coconino County Twister		DR-1950		
182	Coconino County	08-Oct-10	21-Dec-10	$ 63,840.24	
	December 2010 Flood Emergency			Est.	

183	Mohave County	27-Jan-11		$ 100,000.00	
	Wallow Fire Emergency			Est.	
184	Apache & Greenlee Counties	06-Jun-11		$ 200,000.00	
	Horseshoe Two & Monument Fires				
185	Cochise County	17-Jun-11		$ 99,017.76	
	Tombstone Waterline Flooding				
186	City of Tombstone	17-Aug-11		$ 38,048.43	
	Northern Greenlee County Flooding			Est.	
187	Greenlee County	09-Sep-11		$ 400,000.00	
	Coconino Cnty Campbell Ave Flood			Est	
188	Coconino County	13-Sep-11		$ 400,000.00	
	Gladiator Fire			Est	
189	Yavapai County	23-May-12		$ 40,000.00	
	Gladiator Post-Fire Flooding			Est	
190	Yavapai County	23-Aug-12		$ 100,000.00	
	Town of Duncan Flooding			Est	
191	Greenlee County	12-Oct-12		$ 100,000.00	
	Operation Winter Freeze			Est	
192	Apache, Coconino & Navajo Counties	11-Feb-13		$ 200,000.00	
	Highway 89 Collapse			Est	
193	Coconino County	28-Feb-13		$ -	
	Doce Fire			Est	
194	Yavapai County	19-Jun-13		$ 100,000.00	
	Yarnell Hill Fire			Est	
195	Yavapai County	01-Jul-13		$ 200,000.00	
				$ 101,002,909.69	$ 454,444,774.14

Appendix B – Climate Change

Climate Change

An Aggravating Factor for Arizona's Natural Hazards

LEAD AUTHOR:

Anthony Cox (Arizona Division of Emergency Management)

EXPERT REVIEW EDITORS:

Nalini Chhetri (Arizona State University)

Gregg Garfin (University of Arizona)

Nancy Selover (Arizona State University)

Climate Change and Emergency Management Adaptation:

It has become increasingly clear, based on a growing body of research, the world's climate is changing. While the scope and severity of impacts resulting from climate change are still difficult to predict, emergency managers should consider the implications for hazards addressed during mitigation planning. The projected challenges posed by climate change, more intense storms, frequent heavy precipitation, rising temperatures and heat waves, increased drought and wildfire risk, and extreme flooding, could significantly increase the frequency and magnitude of emergencies and disasters faced by communities in Arizona (FEMA, 2011). The need to identify hazards and risks with the potential to cause future disasters, including those that may be intensified by climate changes, is an essential part of emergency management's mission to reduce physical and economic loss and promote life saving measures. Proper acknowledgement and adequately accounting for climate change and resulting challenges will greatly assist emergency management in fulfilling this mission in the future.

Research Background:

Arizona is located in the hottest and driest region in the U.S., the American Southwest. Climate change poses challenges for Arizona, which is dependent upon water and electrical power for human habitation. Arizona is already impacted by drought and Arizona's climate is expected to get hotter and significantly drier. If expectations are realized, increased heat and changes to precipitation amounts and snowpack will impact Arizona's residents and economy. These impacts will be magnified due to a larger anticipated population. Population growth projections show an increase from 56 to 94 million inhabitants by 2050 in the Southwest region[1] (Theobald et al., 2013).

Increasing temperatures and decreasing precipitation in an already arid environment has ramifications that are important for Arizona's future and are worthy of consideration for emergency management efforts. The 3rd National Climate Assessment draft chapter on the Southwest (Garfin et al., 2013) specifically addresses key issue areas related to an anticipated altered climate:

Water Supply: Snowpack and streamflow amounts are projected to decline in parts of the Southwest, decreasing water supply for cities, agriculture, and ecosystems;

Agriculture: The Southwest produces more than half the nation's high-value specialty crops, which are irrigation-dependent and particularly vulnerable to extremes of moisture, cold, and heat.

[1] US Census data shows patterns in US population settlement and the propensity for people to live in areas more likely affected by climate change, including the rapidly growing and arid Southwest.

Reduced yields from increased temperatures and increasing competition for scarce water supplies will displace jobs in some rural communities;

Wildfire: Increased warming, due to climate change, and drought 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;

Heat: Projected regional temperature increases, combined with the way cities amplify heat, will pose increased threats and costs to public health in Southwestern cities, which are home to more than 90 percent of the region's population. Disruptions to urban electricity and water supplies will exacerbate these health problems (Garfin et al., 2013).

Water Supply in Arizona

Arizona is already experiencing the impacts of climate change. The Southwest region as a whole, including Arizona, has warmed substantially in recent decades (Garfin et al., 2013). The state continues to experience drought and future droughts have the potential to be longer lasting and intense. Longer lasting and intense drought on major river basins like the Colorado River Basin (Cayan et al., 2012) increase vulnerabilities for populations that depend on water systems based on drought susceptible sources. What this means for the future of Arizona's most precious resource is unclear. Drought already puts pressure on limited water resources and it is not unrealistic to imagine pressure and strain being placed on management practices in the future with more severe or longer lasting drought.

Winter snowpack is important to Arizona's hydrology and water supply. Most streams in the Southwest can attribute 75% of annual discharge to snow melt (Cayan, 1996). This is an important aspect for Arizona which is highly dependent upon reliable flow from the Colorado River and its tributaries (Svoma, 2011). The Phoenix metropolitan area for example receives a large share of its water supply from Colorado River sub-basins, the Salt and Lower Verde watersheds in central Arizona (Wentz and Gober, 2007)[1]. The primary source of runoff in these sub-basins is snowfall (Svoma, 2011). Climate variability has been shown to be a catalyst for increases in snow level elevation over the Salt and Lower Verde watersheds, a negative influence on runoff (Svoma, 2011). Impacts from increase to snow level elevation, resulting from climate change, is critically important for water supply to this urban desert population center that is projected to grow (Svoma, 2011). If there is reduction in runoff, there will be a greater risk to the water supply necessary to maintain large urban centers (Cayan et al., 2008; Cayan et al., 2010; Christensen and Lettenmaier, 2007).

Arizona Agriculture

Agriculture contributes to Arizona's economy through high-value specialty crops, major field crops, ranching, livestock and dairy production. This sector accounts for 79% of the Southwest region's water withdrawals (Frisvold et al., 2013) and Arizona has unique and distinctive water demands, rights, and management within the region. Agricultural areas access necessary water from multiple sources, such as the Central Arizona Project (CAP), groundwater, or direct from the Colorado River. Vulnerabilities from climate change, for these sources and sector dependencies upon them, will vary depending on water rights and management practices.

Uncertainty in the face of climate change, for a sector that draws heavily upon available water for irrigation and livestock watering, requires awareness that small changes in usage can have significant impacts on residential living and industrial use (Frisvold et al., 2013). Impacts from climate change have the potential to strain supply, change agricultural water use, and negatively impact Arizona livelihood due to resulting competition for more scarce water supplies. Water managers and the agriculture sector are known for the ability to adapt to changes, however the

[1] Approximately 2837 million cubic meters annually (Wentz and Gober, 2007).

potential exists that climate change could outdo this ability due to its pace and extent (Garfin et al., 2013).

Wildfires in Arizona

While wildfire is a natural part of ecosystem health, excessive occurrence destroys residential and private property, threatens public health, causes economic damage, and leads to post-fire flooding, slope erosion and landslides (Frisvold et al., 2011; Morton and Global Institute of Sustainable Forestry, 2003; Richardson et al., 2011; WFLC, 2010). Excessive wildfire is more likely when fire season in Arizona starts earlier and lasts longer than in the past. This unfortunately is already being shown to occur due to increased temperatures, protracted drought, longer snow-free season, and reduced humidity during spring and summer which double the frequency of extreme fire danger (Abatzoglou and Kolden, 2011; Westerling et al. 2006). The intersection of these aspects with invasive species, tree die-off, and forest management practices will have influence on Arizona's future with wildfire and determine whether there is greater occurrence of excessive wildfire.

It is well understood that climate has affect on fuels available for fire and fuel flammability. Changes to climate have significant bearing on wildfires in Arizona because of this. If fuels are available, their response to increases in temperature and evapotranspiration may raise the area of forest burned by wildfire in the future (Fleishman et al., 2013). Negative response can lead to changes in ecology, such as drought-and-heat-stress tree mortality, fuel load and flammability. Coniferous tree mortality in more widespread areas at increasing rates has been attributed to changes in climate, specifically higher temperatures and drought (Breshears et al., 2005; Westerling et al., 2006). Most mortality has been linked with tree responses to outbreaks of bark beetle, which have been correlated with increased temperatures, decreased precipitation, and tree stress (Fleishman et al., 2013). As an example of these impacts, mortality due to drought of pinyon pine (*Pinus edulis*) in Arizona approached 90% in areas near the upper elevation limit for their occurrence where precipitation and available water are relatively higher than other areas where the species is found (Breshears et al., 2005; Weiss et al., 2009).

Changes in climate that influence tree die-off can also allow for the spread of invasive species. Invasive species such as annual grasses have spread in Southwestern deserts because of warming, longer frost-free seasons, and changes in wet winter frequency (Abatzoglou and Kolden, 2011). Buffelgrass[1] (*Pennisetum ciliare*) has significantly increased over the past three decades in the Sonoran Desert (Betancourt, 2007). Where surface fire used to not carry, buffelgrass in Arizona is making it possible. In addition to increasing fuel load and continuity, buffelgrass has lower fuel moisture that cures earlier than native species which increases wildfire potential (Abatzoglou and Kolden, 2011). Increasing occurrence of wildfire involving buffelgrass also means increasing invasion. Buffelgrass resprouts well after wildfires that remove native species.

As population grows in Arizona and building continues to expand into previously undeveloped areas these natural reactions to changes in climate and their influence on wildfire will become increasingly important to the wildland urban interface and fire suppression efforts. To decrease the occurrence of excessive wildfire there will be greater importance on forest management, mechanical thinning, prescribed burning, and private property mitigation efforts. Without adequate adaptation measures, alterations to Arizona's landscapes will have significant affects on the residents that access these lands and the communities that depend on them.

Arizona Heat Threats

With a majority of Arizona's residents living in large urban centers located in the arid basin desert region of the state, heat waves are already a public health concern. Increased occurrence and

[1] Buffelgrass introduced from Africa for livestock feeding in parts of Texas and Mexico has spread vigorously in southern Arizona, invading native Sonoran desert ecosystem (USGS, 2002).

extended duration of heat waves would exacerbate this existing hazard because heat stress is a greater threat when increased heat persists without relief. The public health issue of urban resident heat stress has been the leading weather-related cause of death in Arizona, which also has the highest national rates (Brown et al., 2012; NWS, 2012). The 'urban heat spiral' demonstrates how this threat could grow with increasing heat waves. More frequent and longer lasting heat waves can require more air conditioning use, cause greater demand for electricity, potentially stress energy systems and lead to electrical power outages (Garfin et al., 2013). The potential certainly exists given that heat waves are projected to increase in frequency, duration, and intensity (Gershunov et al., 2009; Sheridan et al., 2011) and cause a greater number of deaths (Ostro et al., 2011) in the future.

Climate Change Impacts and Society

It's important to note that impacts on society from climate change cannot be generalized. Characteristics of society, with emphasis placed on Arizona's unique community, can make different segments either more vulnerable or more capable of adaptation. Thus, risk and economic costs will be distributed differently based upon exposure to impacts and capacity of society members to adjust given new conditions.

Further, societal impacts from climate change do not occur in isolation. Hazards intensified by climate changes will be exacerbated when combined with other factors such as increased urban populations, aging critical infrastructure, human migration due to climate issues, conflict over resources, shifting disease patterns, aging population, pollution, low-income groups, and natural climatic variability.

References

Abatzoglou, J. and Kolden, C., 2011: Climate Change in Western US Deserts: Potential for Increased Wildfire and Invasive Annual Grasses. *Rangeland Ecology & Management*: September 2011, Vol. 64, No. 5, pp. 471-478.

Betancourt, J., 2007: From fireproof desert to flammable grassland: buffelgrass invasion in the Sonoran desert. *Eos Transactions AGU* 88(52), Fall Meeting Supplement, Abstract B34A-02.

Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens, M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer, 2005: Regional Vegetation Die-off in Response to Global-change-type Drought. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 15144-15148 doi: DOI 10.1073/pnas.0505734102, [Available online at http://www.pnas.org/content/102/42/15144.full.pdf+html]

Brown, H.E., A. Comrie, D. Drechsler, C.M. Barker, R. Basu, T. Brown, A. Gershunov, A. M. Kilpatrick, W. K. Reisen, and D. Ruddell, 2012: Health effects of climate change in the Southwest. *Assessment of Climate Change in the Southwest United States: a Technical Report Prepared for the U.S. National Climate Assessment*, G. Garfin, A. Jardine, R. Merideth, M. 1 Black, and J. Overpeck, Eds.

Cayan D., 1996: Interannual climate variability and snowpack in the western United States. *Journal of Climate* **9**: 928–948.

Cayan, D.R., A.L. Luers, G. Franco, M. Hanemann, B. Croes, and E. Vine, 2008: Overview of the California climate change scenarios project. *Climatic Change*, **87,** 1-6.

Cayan, D.R., T. Das, D.W. Pierce, T.P. Barnett, M. Tyree, and A. Gershunov, 2010: Future dryness in the southwest US and the hydrology of the early 21st century drought. *Proceedings of the National Academy of Sciences*, **107,** 21271-21276.

Cayan, D., M. Tyree, K. E. Kunkel, C. Castro, A. Gershunov, J. Barsugli, A. Ray, J. Overpeck, M. Anderson, J. Russell, B. Rajagopalan, I. Rangwala, and P. Duffy, 2012: The Southwest Climate of the Future—Projections of Mean Climate. *Assessment of Climate Change in the Southwest United States: a Technical Report Prepared for the U.S. National Climate Assessment*, G. Garfin, A. Jardine, R. Merideth, M. Black, and J. Overpeck, Eds.

Christensen, N.S. and D.P. Lettenmaier, 2007: A multimodel ensemble approach to assessment of climate change impacts on the hydrology and water resources of the Colorado River Basin. *Hydrology and Earth System Sciences*, **11,** 1417-1434.

FEMA, 2011: Climate Change: Long Term Trends and Their Implications for Emergency Management. *Strategic Foresight Initiative* **|** *FEMA.gov*. FEMA, Aug. 2011. Web. 25 Apr. 2013. <http://www.fema.gov/strategic-planning-analysis-spa-division/strategic-foresight-initiative>.

Fleishman, E., J. Belnap, N. Cobb, C. A. F. Enquist, K. Ford, G. MacDonald, M. Pellant, T. Schoennagel, L. M. Schmit, M. Schwartz, S. van Drunick, A. L. Westerling, A. Keyser, and R. Lucas., 2013: Natural Ecosystems. In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 148–167. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Frisvold, G., X. Ma, and S. Ponnaluru, 2011: Climate, water availability, energy costs, and national park visitation. Adaptation and Resilience. *The Economics of Climate-Water-Energy Challenges in the American Southwest*, B. Colby, and G. Frisvold, Eds., RFF Press.

Frisvold, G. B., L. E. Jackson, J. G. Pritchett, and J. P. Ritten., 2013: Agriculture and Ranching. In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 218–239. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Garfin, G., G. Franco, H. Blanco, A. Comrie, P. Gonzalez, T. Piechota, R. Smyth, and R. Waskom. Southwest. Chapter 20 in *Federal Advisory Committee Draft Climate Assessment Report Released for Public Review*. U.S. Global Change Research Program, 11 Jan. 2013. Web. 24 Apr. 2013. <http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap20-southwest.pdf>.

Gershunov, A., D.R. Cayan, and S.F. Iacobellis, 2009: The Great 2006 Heat Wave over 22 California and Nevada: Signal of an Increasing Trend. *Journal of Climate*, **22,** 6181-6203 doi: 23 10.1175/2009jcli2465.1, Web. 29 Apr. 2013. <http://journals.ametsoc.org/doi/pdf/10.1175/2009JCLI2465.1>.

Hidalgo, H., T. Das, M. Dettinger, D. Cayan, D. Pierce, T. Barnett, G. Bala, A. Mirin, A. Wood, and C. Bonfils, 2009: Detection and attribution of streamflow timing changes to climate change in the western United States. *Journal of Climate*, **22,** 3838-3855.

Morton, D.C. and Global Institute of Sustainable Forestry, 2003: Assessing the environmental, social, and economic impacts of wildfire*. Yale University, School of Forestry and Environmental Studies, Global Institute of Sustainable Forestry*.

NWS, 2012: Weather Fatalities. Web. 29 Apr. 2013. <http://www.nws.noaa.gov/os/hazstats/resources/weather_fatalities.pdf>.

Ostro, B., S. Rauch, and S. Green, 2011: Quantifying the health impacts of future changes in temperature in California. *Environmental Research*, **111,** 1258-1264.

Pierce, D.W., T.P. Barnett, H.G. Hidalgo, T. Das, C. Bonfils, B.D. Santer, G. Bala, M.D. Dettinger, D.R. Cayan, and A. Mirin, 2008: Attribution of declining western US snowpack to human effects. *Journal of Climate*, **21**, 6425-6444 doi: 10.1175/2008JCLI2405.1, Web. 29 Apr. 2013. <http://journals.ametsoc.org/doi/abs/10.1175/2008JCLI2405.1>.

Richardson, L.A., P.A. Champ, and J.B. Loomis, 2011: The hidden cost of wildfires: Economic 9 valuation of health effects of wildfire smoke exposure in Southern California. *Journal of Forest* 10 *Economics*, **18,** 14-35.

Sheridan, S., C. Lee, M. Allen, and L. Kalksteinard, 2011: A spatial synoptic classification approach to projected heat vulnerability in California under future climate change scenarios. *Final report to the California Air Resources Board*.

Svoma, B. M., 2011: Trends in snow level elevation in the mountains of central Arizona. *International Journal of Climatology*, 31: 87–94. doi: 10.1002/joc.2062

Theobald, D. M., W. R. Travis, M. A. Drummond, and E. S. Gordon., 2013: The Changing Southwest. In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 37–55. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

United States Geological Survey, 2002: Buffelgrass, An Invader Fueling Wildfires In The Sonoran Desert. *ScienceDaily*, 20 May 2002. Web. 21 May 2013. <http://www.sciencedaily.com/releases/2002/05/020517075618.htm>

Weiss, J. L., Castro, C. L., & Overpeck, J. T., 2009: Distinguishing Pronounced Droughts in the Southwestern United States: Seasonality and Effects of Warmer Temperatures. *Journal of Climate*, **22**, 5918-5932.

Wentz, E., Gober, P., 2007: Determinants of Small Area Water Consumption for the City of Phoenix, Arizona. *Water Resources Management,* 21(4): 1849—1863

Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam, 2006: Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. *Science*, **313**, 940-943 doi: DOI 10.1126/science.1128834

WFLC, 2010: The True Cost of Wildfire in the Western U.S. , 15 pp., Web. 29 Apr. 2013. <http://www.wflccenter.org/news_pdf/324_pdf.pdf>.

FEMA ADMINISTRATOR POLICY

2011-OPPA-01

FEMA CLIMATE CHANGE ADAPTATION POLICY STATEMENT

I. Purpose

The purpose of this policy statement is to establish an Agency-wide directive to integrate climate change adaptation planning and actions into Agency programs, policies, and operations.

II. Scope

This directive applies to all Agency activities and is intended to guide FEMA personnel responsible for the oversight and implementation of organizational plans, policies, and procedures.

III. Background

While the scope, severity, and pace of future climate change impacts are difficult to predict, it is clear that potential changes could affect our Agency's ability to fulfill its mission. The challenges posed by climate change, such as more intense storms, frequent heavy precipitation, heat waves, drought, extreme flooding, and higher sea levels could significantly alter the types and magnitudes of hazards faced by communities and the emergency management professionals serving them. Some specific areas where climate change could influence our capabilities and the need for our services are:

- *Impacts on mitigation, preparedness, response, and recovery operations:* as coastal regions become increasingly populated and developed, more frequent or severe storms may increase the requirements for emergency services and response and recovery capacity.
- *Resiliency of critical infrastructure and various emergency assets:* continuity of operations, delivery of services, and emergency response efforts may be challenged and made increasingly complex by damages or disruptions to the interconnected energy and infrastructure networks.
- *Climate change could trigger indirect impacts that increase mission risks:* intensifying droughts, heat waves, and periods of heavy precipitation could create human and economic suffering that may lead to internal displacement, cross-border migration, and the spread of life-threatening diseases.

The need to address risks associated with future disaster-related events, including those that may be linked to climate change, is inherent to FEMA's long-term vision of promoting physical and economic loss reduction and life saving measures. Working within existing statutes and authorities, FEMA will strive to be consistent in the Agency's incorporation of climate change adaptation actions and activities into on-going plans, policies, and procedures.

This policy statement identifies seven initial actions we will take to help integrate climate change adaptation considerations into our programs and operations. These actions also align with our vision of a Whole Community approach to emergency management, as it is expected that extensive collaboration with the public, all levels of government, the private sector, non-governmental organizations, and community organizations will be required.

IV. Policy and Procedures

A. In addition to the actions taken pursuant to Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* with respect to federal facilities, FEMA will undertake the below high-level actions to integrate climate change adaptation considerations into the Agency's programs, policies, and operations. These actions directly support the White House Council for Environmental Quality's (CEQ) Implementing Instructions for Federal Agency Climate Change Adaptation Planning and are designed to enhance our climate change awareness, further evaluate the effects climate change may have on FEMA programs and operations, and identify potential areas for future exploration.

1. **To enhance climate research, monitoring, and adaptation capabilities, FEMA will continue to establish partnerships with other agencies and organizations that possess climate science and climate change adaptation expertise.** FEMA will continue to develop and maintain partnerships that enable the Agency to monitor the projected effects of climate change, and communicate climate science data and research needs related to emergency management and disaster resilience. FEMA will also collaborate with other Federal agencies, State, Local, Tribal and Territorial (SLTT) partners, intergovernmental organizations, nongovernmental organizations, the private sector, academia, and the international community to share lessons learned and develop best practices regarding climate adaptation.

2. **FEMA will continue to study the impacts of climate change on the National Flood Insurance Program (NFIP) and incorporate climate change considerations in the NFIP reform effort.** An initial 2-year study concluded that climate change is likely to have significant impacts on the NFIP; Special Flood Hazard Areas are projected to increase significantly across the nation, with impacts mounting over time as the number of policyholders are projected to double by 2100. In order to ensure the program serves the public most effectively, FEMA will continue efforts to understand the potential impacts of climate change on the NFIP and identify areas where future climate conditions can be included as part of the larger reform effort.

3. **FEMA will evaluate how climate change considerations can be incorporated into grant investment strategies with specific focus on infrastructure and evaluation methodologies or tools such as benefit/cost analysis.** FEMA will evaluate methods

2

for addressing future climate conditions through its grant programs to SLTT entities. FEMA will also study how to introduce long-term climate change risks into the benefit/cost analysis methods that guide the awarding of grants.

4. **FEMA will seek to understand how climate change will impact local communities and engage them in addressing those impacts.** FEMA will proactively engage and partner with SLTT communities to gain a greater understanding of their climate change adaptation challenges and activities, and look for ways FEMA can take action to support them in those efforts.

5. **FEMA will promote building standards and practices, both within FEMA programs and in general, that consider the future impacts of climate change.** FEMA currently promotes programmatic guidance and standards for use by SLTT partners to mitigate hazards through regulation of building and infrastructure construction. The current standards and guidance, based on today's climate, may not anticipate the risks structures will face as the climate changes. Therefore, it is important to review guidance and standards to determine the feasibility of incorporating future climate change considerations, and encourage the integration of adaptation measures into local planning and development practices.

6. **Through partnerships with the climate science community, FEMA will evaluate the potential impact climate change may have on existing risk data and the corresponding implications for Threat Hazard Identification Risk Assessment (THIRA) development and operational planning.** Changes in the climate will affect the accuracy and practice of using historical records to predict the magnitude, location, and frequency of future hazards—with significant challenges for important analytic processes and decisions. In response, FEMA will continue to work with the climate science and risk analysis community to evaluate the impacts of climate change on the viability of existing risk data.

7. **FEMA will continue to pursue a flexible, scalable, well equipped, and well trained workforce that is educated about the potential impacts of climate change.** Changes in the frequency and magnitude of severe weather events could potentially strain FEMA resources. FEMA will continue to assess and address its staffing and equipment needs to create a more flexible workforce by increasing employee readiness, cross-training staff, and increasing the pool of employees who are qualified and trained to respond to disasters or other events.

V. Responsibilities

Roles, responsibilities, and timelines for completing each of the above actions will be set forth in the follow-on FEMA Climate Change Adaptation Implementation Plan.

VI. Definitions

Climate Change: According to the Intergovernmental Panel on Climate Change (IPCC), climate change refers to "a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use."

Climate Change Adaptation: The IPCC defines climate change adaptation as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."

VII. Authorities

The Homeland Security Act of 2002, as amended (6 U.S.C. 101 et seq.), the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (42 U.S.C. 5121 et seq.), the President's Executive Order 13514 of October 2009, the 2010 Climate Change Adaptation Report drafted by ICCATF, and the Instructions for Implementing Climate Change Adaptation Planning issued by the CEQ.

VIII. Responsible Office

The Office of Policy and Program Analysis is responsible for the coordination and oversight of all aspects of this directive.

IX. Supersession

None

W. Craig Fugate Administrator FEMA	David J. Kaufman Director OPPA
Date: 1/23/2012	Date: 11/1/2011

4

Appendix C – NFIP & Flood Loss Data

National Flood Insurance Program (NFIP)
Policy Holders as of 3/31/2013

County	Policies In Force	Insured Value
Apache	114	$23,827,800
Apache County*	57	$11,465,700
Eager, Town of	50	$11,000,900
Springville, Town of	2	$765,000
St. Johns, City of	5	$596,200
Cochise	1591	$281,793,900
Benson, Town of	9	$1,729,000
Bisbee, City of	129	$19,915,200
Cochise County*	798	$153,724,200
Douglas, City of	125	$17,273,000
Huachuca City, Town of	49	$5,067,500
Sierra Vista, City of	135	$30,558,200
Wilcox, City of	346	$53,526,800
Coconino	1521	$392,082,000
Coconino County*	877	$232,980,600
Flagstaff, City of	453	$108,948,200
Fredonia, Town of	3	$760,000
Page, City of	2	$350,000
Sedona, City of	150	$38,144,000
Williams, City of	36	$10,899,200
Gila	483	$81,849,500
Gila County*	347	$57,504,200
Globe, City of	46	$9,544,800
Hayden, Town of	1	$175,000
Miami, Town of	26	$2,704,100
Payson, Town of	42	$9,363,100
Star Valley, Town of	21	$2,558,300
Graham	226	$37,491,100
Graham County*	126	$20,853,800
Pima, Town of	64	$8,768,000
Safford, City of	13	$2,975,500
Thatcher, Town of	23	$4,893,800
Greenlee	74	$9,334,900
Clifton, Town of	13	$3,264,300
Duncan, Town of	22	$2,337,700
Greenlee County*	39	$3,732,900
La Paz	316	$64,550,300
La Paz County*	267	$56,690,600
Parker, Town of	5	$1,087,100
Quartzsite, Town of	44	$6,772,600
Maricopa	18075	$4,484,894,600
Apache Junction, City of	51	$10,369,400
Avondale, City of	45	$10,823,400
Buckeye, Town of	42	$9,129,500
Carefree, Town of	21	$6,240,900
Cave Creek, Town of	81	$20,884,900
Chandler, City of	292	$75,808,200
El Mirage, City of	12	$2,908,000
Fountain Hills, Town of	27	$7,204,600

County	Policies In Force	Insured Value
Gila Bend, Town of	11	$1,560,900
Gilbert, Town of	340	$103,884,400
Glendale, City of	188	$56,696,200
Goodyear, City of	106	$27,011,200
Guadalupe, Town of	4	$493,000
Litchfield Park, City of	10	$2,770,000
Maricopa County*	2,331	$536,307,600
Mesa, City of	376	$94,501,600
Paradise Valley, Town of	93	$33,453,600
Peoria, City of	219	$61,918,300
Phoenix, City of	4,654	$1,075,629,000
Queen Creek, Town of	32	$7,973,000
Scottsdale, City of	8,672	$2,220,129,300
Surprise, City of	184	$48,845,600
Tempe, City of	191	$50,511,100
Tolleson, City of	33	$7,961,200
Wickenburg, Town of	57	$11,249,700
Youngtown, Town of	3	$630,000
Mohave	2117	$415,744,900
Bullhead City, City of	541	$99,675,600
Kingman, City of	95	$18,977,900
Lake Havasu, City of	42	$10,916,100
Mohave County*	1,439	$286,175,300
Mojave	11	$2,085,500
Fort Mojave Indian Tribe	11	$2,085,500
Navajo	1018	$168,645,800
Holbrook, City of	10	$2,176,800
Navajo County*	147	$26,144,500
Pinetop-Lakeside, Town of	21	$4,991,900
Show Low, City of	45	$10,101,500
Snowflake, Town of	30	$6,452,100
Taylor, Town of	47	$9,300,200
Winslow, City of	718	$109,478,800
Pima	5118	$1,146,005,900
Marana, Town of	388	$105,440,800
Oro Valley, Town of	142	$38,606,000
Pima County*	2,535	$570,918,700
Sahuarita, Town of	44	$11,711,000
Tucson, City of	2,009	$419,329,400
Pinal	819	$180,054,400
Casa Grande, City of	89	$18,400,700
Coolidge, City of	5	$860,000
Eloy, City of	69	$14,728,500
Florence, Town of	23	$6,254,900
Kearny, Town of	3	$355,000
Mammoth, Town of	5	$347,400
Maricopa, City of	167	$44,048,600
Pinal County*	443	$93,831,600
Superior, Town of	15	$1,227,700
Santa Cruz	775	$169,806,400
Nogales, City of	325	$64,184,900

County	Policies In Force	Insured Value
Patagonia, Town of	70	$12,377,300
Santa Cruz County*	380	$93,244,200
Yavapai	1948	$411,767,200
Camp Verde, Town of	279	$58,796,700
Chino Valley, Town of	27	$6,623,100
Clarkdale, Town of	24	$5,431,800
Cottonwood, City of	78	$17,503,900
Dewey-Humboldt, Town of	12	$2,566,200
Prescott Valley, Town of	73	$18,048,700
Prescott, City of	420	$86,428,500
Yavapai County*	1,035	$216,368,300
Yuma	752	$127,580,000
Somerton, City of	2	$630,000
Wellton, Town of	8	$1,751,500
Yuma County*	179	$36,054,300
Yuma, City of	563	$89,144,200
Total	**34,958**	**$7,997,514,200**

* Unincorporated areas of county only

Source: NFIP Bureau Net online at http://bsa.nfipstat.com/reports/reports.htm

National Flood Insurance Program (NFIP) Loss Statistics
January 1, 1978 to March 31, 2013

County	Losses	Payments	Average Payment
Apache	6	$5,743	$1,149
Apache County*	3	$3,181	$1,060
Eager, Town of	2	$2,562	$1,281
St. Johns, City of	1	$0	$0
Cochise	78	$305,400	$3,966
Bisbee, City of	17	$82,932	$4,878
Cochise County*	31	$128,163	$4,134
Douglas, City of	7	$47,360	$6,766
Huachuca City, Town of	1	$0	$0
Sierra Vista, City of	7	$16,869	$2,410
Wilcox, City of	15	$30,076	$2,005
Coconino	205	$3,131,680	$15,276
Coconino County*	138	$2,311,722	$16,752
Flagstaff, City of	30	$278,848	$9,295
Sedona, City of	34	$506,053	$14,884
Williams, City of	3	$35,057	$11,686
Gila	127	$2,231,391	$17,570
Gila County*	72	$1,299,278	$18,046
Globe, City of	15	$19,084	$1,272
Hayden, Town of	3	$51,979	$17,326
Miami, Town of	4	$597	$149
Payson, Town of	2	$6,553	$3,276
Star Valley, Town of	2	$3,408	$1,704
Winkelman, Town of	29	$850,492	$29,327
Graham	31	$165,639	$5,343
Graham County*	15	$93,844	$6,256
Pima, Town of	5	$37,150	$7,430
Safford, City of	10	$34,485	$3,448
Thatcher, Town of	1	$161	$161
Greenlee	152	$2,412,585	$15,872
Clifton, Town of	110	$1,885,384	$17,140
Duncan, Town of	36	$468,512	$13,014
Greenlee County*	6	$58,689	$9,782
La Paz	77	$816,692	$10,606
La Paz County*	39	$208,554	$5,348
Parker, Town of	37	$608,138	$16,436
Quartzsite, Town of	1	$0	$0
Maricopa	2017	$11,529,414	$5,716
Apache Junction, City of	2	$0	$0
Avondale, City of	5	$76,828	$15,366
Buckeye, Town of	58	$406,280	$7,005
Carefree, Town of	1	$3,407	$3,407
Cave Creek, Town of	6	$86,546	$14,424
Fountain Hills, Town of	1	$0	$0
Gila Bend, Town of	3	$35,036	$11,679

County	Losses	Payments	Average Payment
Gilbert, Town of	3	$24,453	$8,151
Glendale, City of	59	$219,243	$3,716
Goodyear, City of	6	$214,419	$35,737
Maricopa County*	319	$2,475,675	$7,761
Mesa, City of	50	$304,659	$6,093
Paradise Valley, Town of	34	$469,082	$13,797
Peoria, City of	15	$77,865	$5,191
Phoenix, City of	1,067	$4,609,236	$4,320
Queen Creek, Town of	2	$30,836	$15,418
Scottsdale, City of	198	$817,783	$4,130
Surprise, City of	1	$14,725	$14,725
Tempe, City of	29	$211,747	$7,302
Tolleson, City of	118	$1,054,313	$8,935
Wickenburg, Town of	39	$395,460	$10,140
Youngtown, Town of	1	$1,820	$1,820
Mohave	141	$1,021,621	$7,246
Bullhead City, City of	8	$57,222	$7,153
Kingman, City of	22	$66,556	$3,025
Lake Havasu, City of	1	$0	$0
Mohave County*	110	$897,844	$8,162
Navajo	102	$966,493	$9,475
Holbrook, City of	4	$5,997	$1,499
Navajo County*	27	$223,829	$8,290
Show Low, City of	1	$1,160	$1,160
Snowflake, Town of	6	$46,686	$7,781
Taylor, Town of	12	$134,629	$11,219
Winslow, City of	52	$554,192	$10,658
Pima	452	$6,012,563	$13,302
Marana, Town of	10	$17,918	$1,792
Oro Valley, Town of	7	$47,693	$6,813
Pima County*	284	$3,952,046	$13,916
Tucson, City of	151	$1,994,906	$13,211
Pinal	94	$1,588,729	$16,901
Casa Grande, City of	12	$59,762	$4,980
Coolidge, City of	2	$44,503	$22,251
Eloy, City of	5	$3,569	$714
Kearny, Town of	4	$81,819	$20,455
Mammoth, Town of	1	$22,750	$22,750
Pinal County*	70	$1,376,326	$19,662
Santa Cruz	161	$1,327,165	$8,243
Nogales, City of	84	$584,069	$6,953
Patagonia, Town of	9	$31,426	$3,492
Santa Cruz County*	68	$711,670	$10,466
Yavapai	337	$579,057	$1,718
Camp Verde, Town of	18	$279,861	$15,548
Chino Valley, Town of	4	$25,201	$6,300
Clarkdale, Town of	3	$11,319	$3,773

County	Losses	Payments	Average Payment
Cottonwood, City of	8	$43,274	$5,409
Prescott Valley, Town of	3	$20,436	$6,812
Prescott, City of	38	$99,483	$2,618
Yavapai County*	263	$99,483	$378
Yuma	153	$1,151,314	$7,525
Yuma County*	105	$1,013,355	$9,651
Yuma, City of	48	$137,959	$2,874
Total	**4,133**	**$35,922,981**	**$8,692**

* Unincorporated areas of county only. Source: NFIP Bureau Net online at: http://bsa.nfipstat.fema.gov/reports/1040.htm#04

Community Vulnerability to Flood Loss (By County)

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Apache	36,818	1,130	$4,353,765	$176,433	$20,493
Eager	2,088	2,088	$315,454	$315,454	$63,089
Springerville	1,155	1,153	$198,316	$198,199	$39,605
St. Johns	1,724	206	$252,954	$24,396	$1,226
Unincorporated Apache County	6,811	5,802	$828,995	$711,579	$95,620
Cochise**	59,633	14,373	$11,794,138	$2,230,452	$286,365
Benson	2,966	0	$478,689	$0	$0
Bisbee	3,197	958	$469,443	$154,869	$23,127
Douglas	5,682	4	$687,106	$594	$30
Huachuca City	913	3	$163,862	$628	$31
Sierra Vista	19,322	556	$4,793,748	$138,415	$9,095
Tombstone	1,021	90	$167,976	$23,033	$1,152
Unincorporated Cochise County	24,836	2,315	$4,807,675	$455,908	$48,948
Wilcox	1,696	1	$225,639	$171	$9
Coconino**	53,466	4,781	$11,823,344	$1,447,872	$196,281
Flagstaff	18,163	6,905	$5,635,607	$1,915,295	$319,720
Page	2,661	0	$453,473	$0	$0
Williams	1,595	190	$274,805	$45,467	$7,348
Unincorporated Coconino County	19,223	14,934	$3,487,942	$2,720,244	$420,681
Sedona	2,056	523	$517,945	$115,361	$8,548
Gila	29,170	3,087	$4,854,321	$560,937	$91,566
Globe	3,449	146	$652,028	$34,374	$1,953
San Carlos Indian Reservation	1,356	1,242	$144,605	$136,405	$7,477
Hayden	393	0	$110,560	$0	$0
Miami	1,005	147	$146,602	$19,266	$963
Payson	7,393	1,410	$1,396,629	$244,308	$34,059
Star Valley	1,262	622	$175,766	$85,891	$12,681
Winkelman	205	1	$28,762	$67	$3
Unincorporated Gila County	13,625	6,736	$2,139,459	$1,077,332	$169,935
White Mountain Apache Indian	441	406	$55,614	$50,926	$5,308
Yavapai Tonto Apache Reservation	40	9	$4,296	$980	$131
Graham	13,130	1,701	$1,935,759	$203,261	$32,430
Pima	973	0	$93,431	$0	$0
Safford	4,254	4,254	$793,292	$0	$0

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Thatcher	1,675	0	$261,875	$0	$0
Unincorporated Graham County	5,066	153	$629,042	$13,018	$1,420
Greenlee	4,078	899	$510,861	$92,964	$13,121
Clifton	1,146	24	$169,798	$2,303	$115
Duncan	492	8	$55,926	$946	$47
Unincorporated Greenlee County	2,440	270	$285,138	$24,702	$2,661
La Paz	16,200	9,347	$2,888,808	$1,669,414	$183,838
Parker	1,126	2	$196,455	$10	$0
Quartzsite	3,419	257	$609,531	$57,846	$2,892
Unincorporated La Paz County	9,801	817	$1,749,299	$670,335	$114,384
Maricopa	541,259	511,476	$164,894,580	$154,428,928	$8,436,895
Avondale	4,812	0	$1,110,256	$33	$7
Buckeye	1,710	3	$277,303	$494	$99
Carefree	1,259	0	$403,103	$0	$0
Cave Creek	1,393	1	$301,783	$55	$3
Chandler	29,596	1	$9,141,874	$214	$11
El Mirage	1,696	0	$290,507	$0	$0
Fountain Hills	4,360	1	$1,154,569	$177	$9
Fort McDowell Yavapai Nation	143	8	$34,855	$1,897	$271
Gila Bend	619	1	$56,761	$26	$5
Gilbert	18,942	0	$5,907,161	$0	$0
Glendale	34,626	0	$10,531,793	$0	$0
Goodyear	3,622	0	$1,071,137	$6	$1
Guadalupe	681	0	$121,838	$0	$0
Litchfield Park	641	0	$231,665	$0	$0
Unincorporated Maricopa County	58,982	199	$12,197,366	$53,943	$7,658
Mesa	73,908	0	$17,925,668	$0	$0
Paradise Valley	2,591	0	$1,127,647	$0	$0
Peoria	18,824	0	$5,158,074	$0	$0
Phoenix	202,741	1	$67,660,277	$179	$36
Queen Creek	980	3	$197,411	$253	$13
Salt River Pima-Maricopa Indian Community	2,603	0	$569,385	$0	$0
Scottsdale	40,899	4	$16,132,795	$2,086	$118
Surprise	6,871	0	$1,440,857	$2	$0
Tempe	24,923	0	$10,877,790	$0	$0
Tolleson	1,050	0	$483,553	$0	$0

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Wickenburg	1,414	0	$238,077	$0	$0
Youngtown	892	0	$166,023	$0	$0
Mohave	86,841	14,314	$14,065,296	$2,255,850	$274,759
Bullhead City	17,465	3,525	$2,518,988	$648,851	$50,107
Colorado City	880	157	$72,060	$11,086	$1,004
Kingman	10,947	1,656	$2,162,149	$305,301	$24,146
Lake Havasu City	23,707	21,720	$5,447,187	$4,993,812	$256,417
Unincorporated Mohave County	32,783	12,662	$3,707,170	$1,378,709	$146,227
Navajo	53,472	6,263	$7,668,023	$919,231	$149,945
Holbrook	2,543	614	$357,360	$85,581	$4,279
Pinetop-Lakeside	2,999	2,946	$540,295	$529,847	$99,060
Show Low	4,810	4,775	$842,136	$835,930	$165,512
Snowflake	1,918	879	$357,193	$142,266	$9,013
Taylor	1,302	398	$181,858	$59,472	$3,085
Unincorporated Navajo County	18,399	17,406	$2,629,133	$2,506,305	$449,910
Winslow	4,340	983	$708,504	$216,311	$10,816
Pima**	440,794	39,210	$96,840,841	$10,144,920	$1,525,224
Marana	14,845	5,677	$3,629,307	$1,493,697	$151,244
Oro Valley	20,185	4,321	$6,831,456	$1,512,702	$160,862
Pascua Yaqui Tribe	908	59	$187,175	$233,607	$45,123
Sahuarita	10,625	7,262	$2,229,431	$1,685,851	$89,317
South Tucson	2,131	0	$452,144	$0	$0
Tucson	231,782	10,328	$40,805,270	$2,125,974	$146,291
Unincorporated Pima County	160,318	29,820	$42,706,058	$865,188	$676,910
Pinal	85,740	20,520	$13,472,739	$2,946,847	$232,585
Apache Junction	19,819	224	$2,387,367	$32,130	$1,607
Casa Grande	11,785	189	$2,501,776	$42,858	$2,285
Coolidge	4,050	8	$570,664	$891	$44
Eloy	3,507	201	$452,850	$28,852	$1,499
Florence	4,243	177	$798,252	$107,123	$5,363
Kearny	990	82	$195,772	$16,979	$1,199
Mammoth	817	41	$93,413	$4,478	$289
Maricopa	861	6	$107,585	$833	$45
Superior	1,603	20	$214,096	$3,503	$175
Unincorporated Pinal County	34,789	4,529	$5,431,500	$709,856	$56,985
Santa Cruz	14,217	4,692	$3,098,495	$1,113,224	$217,276
Nogales	6,390	0	$1,565,944	$0	$0
Patagonia	555	0	$60,385	$0	$0

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Unincorporated Santa Cruz County	7,271	747	$1,472,166	$158,910	$20,213
Yavapai	87,895	7,219	$16,149,585	$1,293,164	$219,182
Camp Verde	4,076	1,386	$671,671	$246,130	$18,481
Chino Valley	3,802	241	$504,025	$32,434	$1,622
Clarkdale	1,720	3	$249,817	$1,341	$69
Cottonwood	4,620	26	$1,085,252	$5,545	$740
Dewey-Humboldt	1,536	730	$205,684	$95,360	$10,036
Jerome	340	67	$57,485	$7,665	$564
Prescott	17,261	5,337	$4,251,176	$1,070,233	$133,138
Prescott Valley	10,461	942	$2,032,455	$233,489	$13,466
Sedona	4,460	589	$813,676	$119,256	$11,379
Unincorporated Yavapai County	39,327	14,673	$6,235,594	$2,365,756	$313,808
Yavapai-Apache Nation	221	91	$26,798	$12,215	$699
Yavapai-Prescott Nation	64	17	$15,630	$4,001	$201
Yuma	68,384	67,128	$12,584,649	$12,421,691	$693,881
San Luis	3425	603	$535,702	$65,543	$13,109
Somerton	2230	0	$334,112	$0	$0
Yuma City	31396	4,119	$7,780,175	$775,157	$64,893
Cocopah Indian Tribe	855	717	$91,976	$68,652	$13,730
Wellton	1153	9	$105,386	$733	$37
Unincorporated Yuma County	29325	6,089	$3,737,299	$720,898	$68,500
** Does not include Critical Facilities in Total Estimated Asset Value. Only includes residential structures. Sources: Individual county plans flood vulnerability tables.					

Appendix D – RiskMAP Progress Status

COUNTY NAME	PROJECT TYPE	PROJECT STATUS	FIRST FUNDED FEDERAL FY	PRELIMIN MAP	EFFECT MAP	PROJECT NAME	COMMUNITY NAME
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Cochise Co*
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Benson
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Bisbee
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Douglas
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Huachuca City
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Sierra Vista
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Willcox
Cochise	Levee	On-hold	FY10			Cochise, AZ (PAL) (Douglas-Rose Canal)	Tombstone
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Cochise Co*
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Benson
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Bisbee
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Douglas
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Huachuca City
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Sierra Vista
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Willcox
Cochise	Riverine	On-hold	FY09	FY12 (Planned)		Richland Area PMR (Cochise, AZ)	Tombstone

Colorado River Indian Res	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Colorado River Indian Tribe
Colorado River Indian Res	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Colorado River Indian Tribe
La Paz	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Parker
La Paz	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Parker
La Paz	Levee	Active	FY09	FY12	FY15 (Planned)	La Paz AZ (PAL)	La Paz Co*
La Paz	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Colorado River Indian Tribe
La Paz	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Quartzsite
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Maricopa Co*
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Avondale
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Buckeye
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Chandler
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	El Mirage
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Gila Bend
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Gilbert
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Glendale
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Goodyear
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Mesa

Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Paradise Valley
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Peoria
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Phoenix
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Surprise
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Tempe
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Tolleson
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Wickenburg
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Youngtown
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Guadalupe
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Apache Junction
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Carefree
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Litchfield Park
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Cave Creek
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Queen Creek
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Fountain Hills
Maricopa	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Scottsdale
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Maricopa Co*

Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Avondale
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Buckeye
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Chandler
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	El Mirage
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Gila Bend
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Gilbert
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Glendale
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Goodyear
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Mesa
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Paradise Valley
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Peoria
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Phoenix
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Surprise
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Tempe
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Tolleson
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Wickenburg
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Youngtown

Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Guadalupe
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Apache Junction
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Carefree
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Litchfield Park
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Cave Creek
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Queen Creek
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Fountain Hills
Maricopa	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Scottsdale
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Maricopa Co*
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Avondale
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Buckeye
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Chandler
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	El Mirage
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Gila Bend
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Gilbert
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Glendale
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Goodyear

Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Mesa
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Paradise Valley
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Peoria
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Phoenix
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Surprise
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Tempe
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Tolleson
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Wickenburg
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Youngtown
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Guadalupe
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Apache Junction
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Carefree
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Litchfield Park
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Cave Creek
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Queen Creek
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Fountain Hills
Maricopa	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Scottsdale

Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Maricopa Co*
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Avondale
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Buckeye
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Chandler
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	El Mirage
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Gila Bend
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Gilbert
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Glendale
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Goodyear
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Mesa
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Paradise Valley
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Peoria
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Phoenix
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Surprise
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Tempe
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Tolleson
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Wickenburg

Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Youngtown
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Guadalupe
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Carefree
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Litchfield Park
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Cave Creek
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Queen Creek
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Fountain Hills
Maricopa	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Scottsdale
Mohave	Levee	Completed	FY09	FY10	2/20/2013	REG-Mohave AZ Colorado River PMR-FY09 (L)	Mohave Co*
Mohave	Levee	Completed	FY09	FY10 (Planned)	2/20/2013	REG-Mohave AZ Colorado River PMR-FY09 (L)	Colorado City
Mohave	Levee	Completed	FY09	FY10 (Planned)	2/20/2013	REG-Mohave AZ Colorado River PMR-FY09 (L)	Kingman
Mohave	Levee	Completed	FY09	FY10 (Planned)	2/20/2013	REG-Mohave AZ Colorado River PMR-FY09 (L)	Lake Havasu City
Mohave	Levee	Completed	FY09	FY10	2/20/2013	REG-Mohave AZ Colorado River PMR-FY09 (L)	Bullhead
Navajo	Levee	Active	FY09	FY13	FY15 (Planned)	REG-Holbrook Levee D Zone Correction (Navajo, AZ)(L)	Navajo Co*
Navajo	Levee	Active	FY09	FY13	FY15 (Planned)	REG-Holbrook Levee D Zone Correction (Navajo, AZ)(L)	Holbrook
Navajo	Levee	Active	FY09	FY13	FY15 (Planned)	REG-Holbrook Levee D Zone Correction (Navajo, AZ)(L)	Show Low
Navajo	Levee	Active	FY09	FY13	FY15 (Planned)	REG-Holbrook Levee D Zone Correction (Navajo, AZ)(L)	Pinetop-Lakeside

Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	Pima Co*
Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	S. Tucson
Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	Tucson
Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	Oro Valley
Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	Marana
Pima	Riverine	Completed	Map Mod	FY09	6/16/2011	Pima County, AZ (w/PM 34)	Sahuarita
Pima	Riverine	Completed	FY09	FY11	9/28/2012	Agua Caliente PMR (Pima, AZ)	Pima Co*
Pima	Riverine	Completed	FY09	FY11	9/28/2012	Agua Caliente PMR (Pima, AZ)	Tucson
Pinal	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Apache Junction
Pinal	Levee	Active	FY10	FY12 (Planned)		Maricopa, AZ (PAL)	Queen Creek
Pinal	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Apache Junction
Pinal	Levee	Active	FY09	FY13 (Planned)		REG-Maricopa, AZ (CTP-PMR)-FY09	Queen Creek
Pinal	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Apache Junction
Pinal	Watershed	Closed	FY11			REG-Agua Fria, Lower Salt, and Middle Gila AZ-FY11 (D)	Queen Creek
Pinal	Riverine	Active	FY09	FY11	10/16/2013	Maricopa, AZ-CW(NAVD, PM34)	Queen Creek
Pinal	Riverine	Active	FY09	FY12	FY14 (Planned)	City of Maricopa PMR (Pinal, AZ)	Maricopa Co*
Pinal	Riverine	Active	FY09	FY12	FY14 (Planned)	City of Maricopa PMR (Pinal, AZ)	Pinal Co*

Santa Cruz	Riverine	Completed	Map Mod	FY08	12/2/2011	Santa Cruz County, AZ	Santa Cruz Co*
Santa Cruz	Riverine	Completed	Map Mod	FY08	12/2/2011	Santa Cruz County, AZ	Nogales
Santa Cruz	Riverine	Completed	Map Mod	FY08	12/2/2011	Santa Cruz County, AZ	Patagonia
Yavapai	Riverine	Active	FY10	FY12	FY14 (Planned)	Verde River PMR (Yavapai, AZ)	Yavapai Co*
Yavapai	Riverine	Active	FY10	FY12	FY14 (Planned)	Verde River PMR (Yavapai, AZ)	Clarkdale
Yavapai	Riverine	Active	FY10	FY12	FY14 (Planned)	Verde River PMR (Yavapai, AZ)	Cottonwood
Yavapai	Riverine	Active	FY10	FY12	FY14 (Planned)	Verde River PMR (Yavapai, AZ)	Camp Verde
Yavapai	Riverine	Active	FY10	FY12	FY14 (Planned)	Verde River PMR (Yavapai, AZ)	Jerome
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Yuma Co*
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Parker
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Yuma
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Wellton
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	Somerton
Yuma	Levee	Active	FY09	FY12	FY14 (Planned)	Yuma AZ (PAL)	San Luis
Yuma	Levee	Active	FY09	FY12 (Planned)	FY15 (Planned)	La Paz AZ (PAL)	Parker

Source: http://www.riskmapprogress.com/RiskMAPProjectStatus/ (August 2013)

Appendix E – Federal & State Regulated Dams in Arizona

Apache County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	01.03	AZ00004	Lyman Dam	Safety Deficiency	Outdated	Outdated (1993)	St. Johns	16
	01.14	AZ00007	River Reservoir #3	No Deficiency	Yes	Yes	Springerville	12
	01.29	AZ00009	Colter	Unsafe Dams Requiring Rehabilitation or Removal	Outdated	Yes	Greer	6.5
	N/A	AZ10428	A-1	N/A	Yes	No Data	Whiteriver	40
	N/A	AZ10418	Bog Tank	N/A	Yes	No Data	Whiteriver	32
	N/A	AZ10427	Christmas Tree	N/A	Yes	No Data	Whiteriver	17
	N/A	AZ10431	Cyclone	N/A	Yes	No Data	Whiteriver	19
	N/A	AZ10419	Davis (Hawley Lake)	N/A	Yes	No Data	Whiteriver	28
	N/A	AZ10421	Drift Force	N/A	Yes	No Data	Whiteriver	6
	N/A	AZ10424	Horseshoe Cienega	N/A	Yes	No Data	Whiteriver	30
	N/A	AZ10422	Pacheta	N/A	Yes	No Data	Whiteriver	2
	N/A	AZ10425	Reservation	N/A	Yes	No Data	Whiteriver	7
	N/A	AZ10430	Shush Be Tou	N/A	Yes	No Data	Whiteriver	20
	N/A	AZ10429	Shush Be Zah Ze	N/A	Yes	No Data	Whiteriver	19
	N/A	AZ10432	Sunrise	N/A	Yes	No Data	Whiteriver	32
Significant	01.02	AZ00032	Concho Springs	No Deficiency	Yes	Outdated (2000)	Concho	1
	01.28	AZ00033	Lee Valley	No Deficiency	Yes	Yes	Greer	7
	01.31	AZ00061	Big Lake	No Deficiency	Yes	Yes	Deer Creek	8
	01.36	AZ00030	Luna	No Deficiency	Yes	No, provided flood inundation description	Luna, New Mexico	8
	01.46	AZ00155	Coronado Gen. Station	No Deficiency	Yes	Yes	Holbrook	65
	01.64	AZ00321	Alpine Sanitary	Pending	No	Draft	Residence	0
	N/A	AZ00306	Crescent Lake	No Deficiency	No Data	No Data	Deer Creek	8
	N/A	AZ10159	Hulsey Lake	No Deficiency	Not Required (per NID)	Not Required (per NID)	Nutrioso	4
Sources: NID, ADWR Dam Safety Database (October 2009)								

Cochise County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	02.02	AZ00014	Parker Canyon	Safety Deficiency	Yes	Yes	Los Matates, Mexico	15

Cochise County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	02.03	AZ00222	Apache Station Ash/Scrubber WDF	No Deficiency	Yes	No, provided flood inundation description	One residence	0
	02.05	AZ00255	Amerind #8	No Deficiency	No	No	Private Museum	1
Significant	N/A	AZ10157	Rucker Canyon	N/A	Not Required (according to NID)	Not Required (per NID)	Cypress Park CG	0.5
Significant	N/A	AZ83483	Campbell Yard Containment	N/A	No Data	No Data	Bakerville	0.3
Significant	N/A	AZ20008	Creighton Detention	N/A	No	No	Solomon	36
Sources: NID, ADWR Dam Safety Database (October 2009)								

Coconino County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	03.04	AZ00031	Santa Fe	Safety Deficiency	Draft	No	Williams	0.1
High	03.07	AZ00095	Masonry #2	No Deficiency	Yes	Yes	I-40 & Steel Dam	1.5
High	03.09	AZ00010	City	No Deficiency	Yes	Yes	Williams	1
High	03.16	AZ00218	Walnut Canyon	Unsafe Dams with Uncertain Stability during Extreme Events (Requiring Study)	No	Yes	Winona	5.5
High	03.43	AZ00138	Fredonia	Unsafe Dams with Elevated Risk of Failure	Outdated	Yes	Fredonia	1
High	03.44	AZ00062	Continental #1	No Deficiency	Yes	Yes	Flagstaff	2
High	03.45	AZ00063	Continental #2	No Deficiency	Yes	Yes	Flagstaff	2
High	03.47	AZ00156	Odell	Unsafe Dams Requiring Rehabilitation or Removal	Yes	Yes	Pinewood & Munds Park	0.2
High (cont'd)	03.62	AZ00305	Clay Avenue Wash Detention Basin	No Deficiency	No (dam under construction)	No	Flagstaff	0
High (cont'd)	N/A	AZ10439	Pasture Canyon	N/A	Yes	Yes	Moenkopi	4
Significant	03.02	AZ00038	West Cataract Creek	Safety Deficiency	Draft	No	Williams	2
Significant	03.10	AZ00039	Dogtown	Safety Deficiency	Draft	No	Havasupai Indian Reservation & I-40	11

Coconino County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	03.18	AZ00016	Upper Lake Mary	No Deficiency	Yes	Yes	Walnut Canyon National Monument & I-40	16
	N/A	AZ10307	Glen Canyon	N/A	Yes	Yes	Lees Ferry	15
	N/A	AZ00021	Blue Ridge (Cragin)	N/A	Yes	Yes	Winslow	90
	N/A	AZ00094	Steel Dam	N/A	Yes	Yes	Monte Carlo Truck Stop, near Ashfork	0.5
Sources: NID, ADWR Dam Safety Database (October 2009)								

Gila County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	04.15	AZ00223	Green Valley Park	No Deficiency	Yes	Yes	Payson	0
	N/A	AZ10446	Elgo	N/A	Yes	Yes	San Carlos	4
	N/A	AZ10407	Tufa Stone	N/A	Yes	Yes	San Carlos	2
Significant	04.13	AZ00194	Gold Gulch #2	No Deficiency	Yes	Outdated (1998)	Roosevelt Lake Estates	16
	04.14	AZ00195	Asarco 82	No Deficiency	Yes	Yes (Limits drawn on USGS quadrangle)	Hayden (Outskirts)	0.25
	04.16	AZ00224	Gold Gulch 1A	No Deficiency	Yes	Outdated (1998)	Roosevelt Lake Estates	16
Sources: NID, ADWR Dam Safety Database (October 2009)								

Graham County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distanc e in Miles
High	05.04	AZ00071	Cluff Ranch #3	Safety Deficiency	Yes	Yes	Dublin & Pima	6
	05.06	AZ00065	Central Detention	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Outdated	Yes	Central	2

Graham County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	05.07	AZ00069	Frye Mesa	Unsafe Dams with Uncertain Stability during Extreme Events (Requiring Study)	Yes	Yes	Thatcher	8
	05.16	AZ00066	Graveyard Wash	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Yes	Yes	Safford	2
	05.17	AZ00072	Freeman Wash Retarding	Safety Deficiency	Yes	Yes	Thatcher	1
	05.18	AZ00067	Stockton Wash Retarding	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Yes	Yes	Safford	2
	05.19	AZ00068	Frye Creek Retarding	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Yes	Yes	Thatcher	1
	05.21	AZ00091	Roper Lake	No Deficiency	Yes	Yes	Safford	5
	05.23	AZ00055	Haralson	No Deficiency	Draft	Draft (2004)	Thatcher	4
	05.24	AZ00159	Grant Morris	No Deficiency	Yes	Yes	Thatcher	2
	05.25	AZ00160	Howard	No Deficiency	Yes	Yes	Pima	3
	05.26	AZ00161	Chesley-Wamslee	No Deficiency	Yes	Yes	Pima	3
	05.27	AZ00162	Foote Wash	No Deficiency	Draft	Yes	Lone Star	2
High (cont'd)	05.28	AZ00163	No Name Wash	No Deficiency	Yes	Yes	Lone Star	2
	05.29	AZ00164	Lee	No Deficiency	Yes	Yes	Eden	5
	05.30	AZ00165	Indian Farms	No Deficiency	Yes	Yes	Eden	1
	05.31	AZ00166	Billingsley	No Deficiency	Yes	Yes	Eden	2
	05.33	AZ00245	Cook Reservoir	Unsafe Dams with Elevated Risk of Failure	No	Yes	Safford	0.5
	N/A	AZ10381	Dry Lake	N/A	Yes	Yes	Point of Pines	9
	N/A	AZ10380	Point of Pines	N/A	Yes	Yes	Point of Pines	3
	N/A	AZ11000	Upper Point of Pines	N/A	Yes	Yes	Point of Pines	5
Significant	05.08	AZ00158	Riggs Reservoir	Safety Deficiency	Yes	No	Thatcher	4
	05.10	AZ00054	Lebanon Reservoir #1 (Upper)	Safety Deficiency	Yes	Yes	Safford	13
	05.14	AZ00070	Judy Wash Retarding	Safety Deficiency	Outdated (1987)	Outdated (1987)	Solomon	1
Sources: NID, ADWR Dam Safety Database (October 2009)								

Greenlee County

Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	06.06	AZ00197	Lower Chase Creek	No Deficiency	Yes	Yes	Clifton	1
Significant	06.07	AZ00277	New Town #2	Safety Deficiency	Yes	Yes	U. S. Highway 191	0.5
Sources: NID, ADWR Dam Safety Database (October 2009)								

La Paz County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	N/A	AZ10437	Headgate Rock	N/A	Yes	Yes	Parker	1
Significant	N/A	AZ20004	Butler Valley	N/A	Yes	Yes	Bouse	14
Sources: NID, ADWR Dam Safety Database (October 2009)								

Maricopa County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	07.21	AZ10003	McMicken	Safety Deficiency	Yes	Yes	Surprise	0.5
	07.28	AZ00108	White Tanks #3	Safety Deficiency	Yes	Yes	Litchfield Park	0.25
	07.29	AZ00109	White Tanks #4	Safety Deficiency	Yes	Yes	Goodyear	8
	07.31	AZ00073	Fountain Lake	No Deficiency	Yes	Yes	Fountain Hills	0
	07.32	AZ00077	Sunridge Canyon (No. 7)	Safety Deficiency	Outdated (1996)	Yes	Fountain Hills	0
	07.33	AZ00011	Golden Eagle Park (No. 4)	No Deficiency	Yes	Yes	Fountain Hills	0
	07.35	AZ00111	West Park	No Deficiency	Yes	Yes	Phoenix	0
	07.36	AZ00112	East Park	No Deficiency	Yes	Yes	Phoenix	0
	07.38	AZ00074	Hesperus Wash (No. 36)	No Deficiency	Yes	Yes	Fountain Hills	0
	07.39	AZ00075	Aspen (No. 6)	No Deficiency	Yes	Yes	Fountain Hills	0
	07.40	AZ00167	North Heights (# 11)	No Deficiency	Yes	Yes	Fountain Hills	0
	07.41	AZ00076	Stoneridge (# 19)	No Deficiency	Yes	Yes	Fountain Hills	0
	07.42	AZ00143	Buckeye FRS #1	Unsafe Dams Requiring Rehabilitation or Removal	Yes	Yes	Buckeye	3
	07.43	AZ00168	Guadalupe	No Deficiency	Yes	Yes	Guadalupe	0.1
High (cont'd)	07.44	AZ00169	Buckeye FRS #2	Safety Deficiency	Yes	Yes	Buckeye	4
	07.45	AZ00170	Buckeye FRS #3	No Deficiency	Yes	Yes	Buckeye	4
	07.47	AZ00172	North Mountain Flood Detention #3	No Deficiency	Yes	Yes	Phoenix	0
	07.48	AZ00173	Sunnycove	No Deficiency	Yes	Yes	Wickenburg	3
	07.49	AZ00174	Sunset	No Deficiency	Yes	Yes	Wickenburg	0.1
	07.50	AZ00175	Spook Hill	No Deficiency	Yes	Yes	Mesa	7

Maricopa County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	07.51	AZ00176	Phoenix Detention Basin #7	Safety Deficiency	Yes	Yes	Phoenix	0
	07.54	AZ00201	Palo Verde Evaporation Pond #1	No Deficiency	Yes	Yes	Mesquite Generating Station	1
	07.55	AZ00202	New River	No Deficiency	Yes	Yes	Glendale & Sun City	6
	07.56	AZ10006	Dreamy Draw	No Deficiency	Yes	Yes	Phoenix	4
	07.57	AZ00203	Adobe	No Deficiency	Yes	Yes	Glendale & Sun City	5
	07.58	AZ10007	Cave Buttes	No Deficiency	Yes	Yes	Phoenix	19
	07.59	AZ00204	Thunderbird Park Reservoir	No Deficiency	Yes	Yes	Glendale	0
	07.60	AZ00205	Signal Butte FRS	No Deficiency	Yes	Yes	Apache Junction	0.5
	07.62	AZ00198	Palo Verde Evaporation Pond #2	Unsafe Dams Requiring Rehabilitation or Removal	Yes	Yes	Mesquite Generating Station	1
	07.65	AZ00230	Casandro Wash	No Deficiency	Yes	Yes	Wickenburg	0
	07.76	AZ00309	Red Mountain Freeway Levee	No Deficiency	Yes	Yes	Red Mountain 202 Freeway	0
	07.77	AZ01096	Plains LPG Dam	No Deficiency	Yes	Yes	Glendale	0
	07.79	AZ00317	Palo Verde Evap. Pond No. 3	No Deficiency	Yes	Yes	Mesquite Generating Station	1
	N/A	AZ10002	Painted Rock	N/A	Yes	Yes	Agua Caliente	17
	N/A	AZ10308	Bartlett	N/A	Yes	Yes	Mesa	33
High (cont'd)	N/A	AZ10310	Horseshoe	N/A	Yes	Yes	Fort McDowell	16
	N/A	AZ82915	Reach 11 Detention Dike 2	N/A	Yes	Yes	Phoenix	1
	N/A	AZ82916	Reach 11 Detention Dike 3	N/A	Yes	Yes	Phoenix	1
	N/A	AZ82917	Reach 11 Detention Dike 4	N/A	Yes	Yes	Phoenix	1
	N/A	AZ10317	Theodore Roosevelt	N/A	Yes	Yes	Globe	30
	N/A	AZ10311	Horse Mesa	N/A	Yes	Yes	Mesa	26
	N/A	AZ10313	Mormon Flat	N/A	Yes	Yes	Mesa	15
	N/A	AZ10318	Stewart Mountain	N/A	Yes	Yes	Mesa	10
	N/A	AZ82929	New Waddell	N/A	Yes	Yes	Peoria	8
Significant	07.23	AZ00113	Camp Dyer Diversion	No Deficiency	Yes	Yes	Sun City	18
	07.24	AZ00106	Gillespie	Safety Deficiency	Yes	Yes	Gila Bend	18
	07.52	AZ00199	Saddleback FRS	No Deficiency	Yes	Yes	Scattered farms	0.25

Maricopa County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	07.53	AZ00200	Harquahala FRS	No Deficiency	Yes	Yes	I-10, CAP, & Ranches	3
	07.66	AZ00236	Rio Salado Town Lake	No Deficiency	Yes	Yes	Tempe	0
	07.75	AZ00304	Black Hill Tank	Safety Deficiency	No	No	Scottsdale	1

Sources: NID, ADWR Dam Safety Database (October 2009)

Mohave County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	08.10	AZ00177	Short Creek Southside #1	Safety Deficiency	Yes	Yes	Colorado City	1
	N/A	AZ10309	Davis BOR	N/A	Yes	Yes	Bullhead City	4
	N/A	NV10122	Hoover	N/A	Yes	Yes	Bullhead City	56
Significant	08.09	AZ00078	Short Creek Southside #2	Safety Deficiency	No	Yes	Colorado City	1
	08.11	AZ00219	Stockton Hill	No Deficiency	Yes	No	Kingman	2
	08.13	AZ00250	Brine Disposal Pond Dam	No Deficiency	Yes	No	Topock	42

Sources: NID, ADWR Dam Safety Database (October 2009)

Navajo County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	09.07	AZ00059	Millett Swale	Unsafe Dams Requiring Rehabilitation or Removal	Outdated (1997)	Yes	Taylor & Shumway	4
	09.09	AZ00012	Lone Pine	Unsafe Dams Requiring Rehabilitation or Removal	Outdated (1994)	No	Schoens Dam	6.5
	09.11	AZ00013	Daggs	Safety Deficiency	Outdated (1997)	No	Taylor	8
	09.13	AZ00023	Jaques	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Yes	Yes	Show Low	4
	09.18	AZ00044	Woodland	Safety Deficiency	Draft	Draft	Pinetop & Lakeside	3
	09.19	AZ00051	Fool Hollow	Unsafe Dams Pending Evaluation of Flood-Passing Capacity (Requiring Study)	Yes	Yes	Taylor	14

Navajo County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High (cont'd)	09.20	AZ00042	Black Canyon	Unsafe Dams Requiring Rehabilitation or Removal	Yes	Yes	Heber & Overgaard	9.9
	09.27	AZ00178	Cholla Bottom Ash Pond	No Deficiency	Yes	Yes	Joseph City	5
	09.28	AZ00179	Cholla Fly Ash Pond	No Deficiency	Yes	Yes	Joseph City	5
	09.33	AZ00207	Schoens	No Deficiency	Yes	Yes	Taylor	6
	N/A	AZ10415	Bootleg	N/A	Yes	Yes	Amos Ranch	4
	N/A	AZ10416	Cooley	N/A	Yes	Yes	Amos Ranch	4
Significant	09.14	AZ00056	Scott	Safety Deficiency	No	No	Jaques Dam & Show Low	5
	09.16	AZ00024	Lakeside	Safety Deficiency	No	No	Show Low	7
	09.29	AZ00180	Cholla Cooling Pond	No Deficiency	Yes	Yes	Joseph City	5
	09.30	AZ00181	Trophy Lake	No Deficiency	Yes	Yes	Taylor	9
	09.34	AZ00208	Jacques Marsh	No Deficiency	Yes	Yes	Show Low	4
Sources: NID, ADWR Dam Safety Database (October 2009)								

Pima County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	10.07	AZ00080	Leach Flood #1	No Deficiency	Yes	Yes	Mining Facility	0
	10.13	AZ00026	Kennedy Park	Safety Deficiency	Yes	Yes	Tucson	0
	10.14	AZ00217	Murphy Reservoir	Safety Deficiency	Yes	Outdated (1988)	Tucson	1
	10.20	AZ00307	Park Ave Detention Basin Comp	No Deficiency	No	No	Tucson	0
Significant	10.12	AZ00131	Arivaca	Safety Deficiency	Yes	Yes	Arivaca	6
	10.16	AZ00210	Clearwell Reservoir	Safety Deficiency	Outdated	Outdated (1994)	Tucson	0
	N/A	AZ82410	Sycamore	N/A	Yes	Yes	Tucson	5
Sources: NID, ADWR Dam Safety Database (October 2009)								

Pinal County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	11.02	AZ00082	Powerline	Unsafe Dams with Elevated Risk of Failure	Yes	Yes	Mesa / Apache Junction	3

Pinal County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	11.05	AZ00083	Magma Retarding	Unsafe Dams Requiring Rehabilitation or Removal	Yes	Yes	Florence	0.5
	11.06	AZ00027	Florence Retarding	No Deficiency	Yes	Yes	Florence	1.5
	11.11	AZ00084	Vineyard Road	No Deficiency	Yes	Yes	Williams Air Force Base	9
	11.12	AZ00085	Rittenhouse	No Deficiency	Yes	Yes	Williams Air Force Base	10
	11.15	AZ00211	Apache Junction FRS	No Deficiency	Yes	Yes	Apache Junction	0.5
	11.19	AZ00244	Kearny Lake	No Deficiency	Yes	Outdated (1999)	Gila River	0
	N/A	AZ10004	Whitlow Ranch	N/A	Yes	Yes	Queen Valley	1
	N/A	AZ10436	Coolidge	N/A	Yes	Yes	Winkelman	25
	N/A	AZ10008	Tat Momolikot	N/A	Yes	Yes	Cockleburr	1
Significant	11.16	AZ00233	Main PLS	No Deficiency	Yes	Yes	Roosevelt Lake Estates	20
	11.18	AZ00235	Inlet Control Structure	No Deficiency	Yes	Yes	Roosevelt Lake Estates	20
	N/A	AZ82905	Tat Momolikot East Saddle Dike	N/A	No Data	No Data	Stanfield	22
	N/A	AZ82906	Tat Momolikot Village Dike	N/A	No Data	No Data	Stanfield	22
	N/A	AZ82907	Tat Momolikot West Saddle Dike	N/A	No Data	No Data	Stanfield	22
Sources: NID, ADWR Dam Safety Database (October 2009)								

Santa Cruz County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	12.05	AZ00028	Pena Blanca	No Deficiency	Yes	Yes	1-19	8.3
	12.06	AZ00029	Lake Patagonia	No Deficiency	Yes	Yes	Rio Rico, I-40 & Railroad	8.2
Sources: NID, ADWR Dam Safety Database (October 2009)								

Yavapai County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	13.03	AZ00134	Pan	No Deficiency	Yes	Yes	Paulden	33
	13.13	AZ00019	Willow Creek	No Deficiency	Yes	Yes	Granite Dells	10
	13.14	AZ00020	Granite Creek	No Deficiency	Yes	Yes	Granite Dells	1
	13.17	AZ00005	Lower Goldwater	No Deficiency	Yes	Yes	Prescott	4
	13.18	AZ00153	Upper Goldwater	Safety Deficiency	Yes	Yes	Prescott	4
	13.20	AZ00049	Lynx Lake	Safety Deficiency	Yes	Yes	Prescott	7

Yavapai County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
	13.39	AZ00215	Little Hell's Canyon	Safety Deficiency	Yes	No	US 89	0
Significant	13.45	AZ00256	Paulden Tank #2	No Deficiency	Yes	Yes	Paulden	0
	13.47	AZ00266	Seligman	Safety Deficiency	No	No	Seligman WWTP	0.1
	N/A	AZ10142	Horsethief	N/A	Not Req'd (per NID)	Not Required (per NID)	Black Canyon	25
	N/A	AZ10143	Granite Basin	N/A	Not Req'd (per NID)	Not Required per NID)	Wildwood Estates	2.5
Sources: NID, ADWR Dam Safety Database (October 2009)								

Yuma County								
Hazard Class	SID	NID	Dam Name	ADWR Safety Types	EAP	Inundation Mapping	Nearest Downstream Development	Distance in Miles
High	N/A	AZ10312	Parker	N/A	Yes	Yes	Parker	12
	N/A	AZ82203	Alamo	N/A	Yes	Yes	Parker	40
	N/A	CA10159	Imperial	N/A	No Data	No Data	Yuma	6
Significant	N/A	AZ10437	Headgate Rock	N/A	Yes	Yes	Parker	0
Sources: NID, ADWR Dam Safety Database (October 2009)								

Appendix F - Community Vulnerability to Wildfire Loss

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Apache	36,818	27,418	$4,353,765	$3,320,611	$350,389
Eager	2,088	2,088	$315,454	$315,454	$63,089
Springerville	1,155	1,153	$198,316	$198,199	$39,605
St. Johns	1,724	206	$252,954	$24,396	$1,226
Unincorporated Apache County	6,811	5,802	$828,995	$711,579	$95,620
Cochise**	59633	3,927	$11,794,138	$773,618	$82,392
Benson	2966	0	$478,689	$0	$0
Bisbee	3197	958	$469,443	$154,869	$23,127
Douglas	5682	4	$687,106	$594	$30
Huachuca City	913	3	$163,862	$628	$31
Sierra Vista	19322	556	$4,793,748	$138,415	$9,095
Tombstone	1021	90	$167,976	$23,033	$1,152
Unincorporated Cochise County	24836	2,315	$4,807,675	$455,908	$48,948
Wilcox	1696	1	$225,639	$171	$9
Coconino**	53,466	28,066	$11,823,344	$5,568,627	$806,554
Flagstaff	18,163	6,905	$5,635,607	$1,915,295	$319,720
Page	2,661	0	$453,473	$0	$0
Williams	1,595	190	$274,805	$45,467	$7,348
Unincorporated Coconino County	19,223	14,934	$3,487,942	$2,720,244	$420,681
Sedona	2,056	523	$517,945	$115,361	$8,548
Gila	29,170	10,718	$4,854,321	$1,649,551	$252,512
Globe	3,449	146	$652,028	$34,374	$1,953
San Carlos Indian Reservation	1,356	1,242	$144,605	$136,405	$7,477
Hayden	393	0	$110,560	$0	$0
Miami	1,005	147	$146,602	$19,266	$963
Payson	7,393	1,410	$1,396,629	$244,308	$34,059
Star Valley	1,262	622	$175,766	$85,891	$12,681
Winkelman	205	1	$28,762	$67	$3
Unincorporated Gila County	13,625	6,736	$2,139,459	$1,077,332	$169,935
White Mountain Apache Indian	441	406	$55,614	$50,926	$5,308
Yavapai Tonto Apache Reservation	40	9	$4,296	$980	$131
Graham	13,130	834	$1,935,759	$118,213	$9,308
Pima	973	0	$93,431	$0	$0
Safford	4,254	4,254	$793,292	$0	$0
Thatcher	1,675	0	$261,875	$0	$0
Unincorporated Graham County	5,066	153	$629,042	$13,018	$1,420
Greenlee	4,078	302	$510,861	$27,951	$2,823
Clifton	1,146	24	$169,798	$2,303	$115
Duncan	492	8	$55,926	$946	$47
Unincorporated Greenlee County	2,440	270	$285,138	$24,702	$2,661
La Paz	16,200	1,111	$2,888,808	$734,321	$118,471
Parker	1,126	2	$196,455	$10	$0
Quartzsite	3,419	257	$609,531	$57,846	$2,892
Unincorporated La Paz County	9,801	817	$1,749,299	$670,335	$114,384

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Maricopa	541,259	386	$164,894,580	$72,881	$10,844
Avondale	4,812	0	$1,110,256	$33	$7
Buckeye	1,710	3	$277,303	$494	$99
Carefree	1,259	0	$403,103	$0	$0
Cave Creek	1,393	1	$301,783	$55	$3
Chandler	29,596	1	$9,141,874	$214	$11
El Mirage	1,696	0	$290,507	$0	$0
Fountain Hills	4,360	1	$1,154,569	$177	$9
Fort McDowell Yavapai Nation	143	8	$34,855	$1,897	$271
Gila Bend	619	1	$56,761	$26	$5
Gilbert	18,942	0	$5,907,161	$0	$0
Glendale	34,626	0	$10,531,793	$0	$0
Goodyear	3,622	0	$1,071,137	$6	$1
Guadalupe	681	0	$121,838	$0	$0
Litchfield Park	641	0	$231,665	$0	$0
Unincorporated Maricopa County	58,982	199	$12,197,366	$53,943	$7,658
Mesa	73,908	0	$17,925,668	$0	$0
Paradise Valley	2,591	0	$1,127,647	$0	$0
Peoria	18,824	0	$5,158,074	$0	$0
Phoenix	202,741	1	$67,660,277	$179	$36
Queen Creek	980	3	$197,411	$253	$13
Salt River Pima-Maricopa Indian	2,603	0	$569,385	$0	$0
Scottsdale	40,899	4	$16,132,795	$2,086	$118
Surprise	6,871	0	$1,440,857	$2	$0
Tempe	24,923	0	$10,877,790	$0	$0
Tolleson	1,050	0	$483,553	$0	$0
Wickenburg	1,414	0	$238,077	$0	$0
Youngtown	892	0	$166,023	$0	$0
Mohave	86,841	40,583	$14,065,296	$7,460,080	$492,466
Bullhead City	17,465	3,525	$2,518,988	$648,851	$50,107
Colorado City	880	157	$72,060	$11,086	$1,004
Kingman	10,947	1,656	$2,162,149	$305,301	$24,146
Lake Havasu City	23,707	21,720	$5,447,187	$4,993,812	$256,417
Unincorporated Mohave County	32,783	12,662	$3,707,170	$1,378,709	$146,227
Navajo	53,472	41,440	$7,668,023	$6,056,887	$890,391
Holbrook	2,543	614	$357,360	$85,581	$4,279
Pinetop-Lakeside	2,999	2,946	$540,295	$529,847	$99,060
Show Low	4,810	4,775	$842,136	$835,930	$165,512
Snowflake	1,918	879	$357,193	$142,266	$9,013
Taylor	1,302	398	$181,858	$59,472	$3,085
Unincorporated Navajo County	18,399	17,406	$2,629,133	$2,506,305	$449,910
Winslow	4,340	983	$708,504	$216,311	$10,816
Pima**	440,794	57,467	$96,840,841	$15,461,422	$1,269,697
Marana	14,845	5,677	$3,629,307	$1,493,697	$151,244
Oro Valley	20,185	4,321	$6,831,456	$1,512,702	$160,862
Pascua Yaqui Tribe	908	59	$187,175	$233,607	$45,123

County/Jurisdiction	Total Buildings	Exposed Buildings	Total Estimated Asset Value (x $1000)	Asset Value Exposed to Hazard (x $1,000)	Estimated Potential Losses (x $1,000)
Sahuarita	10,625	7,262	$2,229,431	$1,685,851	$89,317
South Tucson	2,131	0	$452,144	$0	$0
Tucson	231,782	10,328	$40,805,270	$2,125,974	$146,291
Unincorporated Pima County	160,318	29,820	$42,706,058	$865,188	$676,910
Pinal	11,785	5,932	$13,472,739	$1,008,006	$72,656
Apache Junction	19,819	224	$2,387,367	$32,130	$1,607
Casa Grande	11,785	189	$2,501,776	$42,858	$2,285
Coolidge	4,050	8	$570,664	$891	$44
Eloy	3,507	201	$452,850	$28,852	$1,499
Florence	4,243	177	$798,252	$107,123	$5,363
Kearny	990	82	$195,772	$16,979	$1,199
Mammoth	817	41	$93,413	$4,478	$289
Maricopa	861	6	$107,585	$833	$45
Superior	1,603	20	$214,096	$3,503	$175
Unincorporated Pinal County	34,789	4,529	$5,431,500	$709,856	$56,985
Santa Cruz	14,217	747	$3,098,495	$158,910	$20,213
Nogales	6,390	0	$1,565,944	$0	$0
Patagonia	555	0	$60,385	$0	$0
Unincorporated Santa Cruz County	7,271	747	$1,472,166	$158,910	$20,213
Yavapai	87,895	24,104	$16,149,585	$4,193,422	$504,202
Camp Verde	4,076	1,386	$671,671	$246,130	$18,481
Chino Valley	3,802	241	$504,025	$32,434	$1,622
Clarkdale	1,720	3	$249,817	$1,341	$69
Cottonwood	4,620	26	$1,085,252	$5,545	$740
Dewey-Humboldt	1,536	730	$205,684	$95,360	$10,036
Jerome	340	67	$57,485	$7,665	$564
Prescott	17,261	5,337	$4,251,176	$1,070,233	$133,138
Prescott Valley	10,461	942	$2,032,455	$233,489	$13,466
Sedona	4,460	589	$813,676	$119,256	$11,379
Unincorporated Yavapai County	39,327	14,673	$6,235,594	$2,365,756	$313,808
Yavapai-Apache Nation	221	91	$26,798	$12,215	$699
Yavapai-Prescott Nation	64	17	$15,630	$4,001	$201
Yuma	68,384	11,483	$12,584,649	$1,630,983	$160,269
San Luis	3425	603	$535,702	$65,543	$13,109
Somerton	2230	0	$334,112	$0	$0
Yuma City	31396	4,119	$7,780,175	$775,157	$64,893
Cocopah Indian Tribe	855	717	$91,976	$68,652	$13,730
Wellton	1153	9	$105,386	$733	$37
Unincorporated Yuma County	29325	6,089	$3,737,299	$720,898	$68,500
** Does not include Critical Facilities in Total Estimated Asset Value. Only includes residential structures					

Sources: Individual County plans fire vulnerability tables.