2017

Pima County Multi-Jurisdictional Hazard Mitigation Plan

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SECTION 1: INTRODUCTION

1.1 Purpose

The purpose of the Plan is to identify natural hazards that impact the various jurisdictions located within Pima County, assess the vulnerability and risk posed by those hazards to community-wide human and structural assets, develop strategies for mitigation of those identified hazards, present future maintenance procedures for the plan, and document the planning process.

Pima County and all of the Cities and Towns are political subdivisions of the State of Arizona and are organized under Title 9 (cities/towns) and Title 11 (counties) of the Arizona Revised Statutes (ARS). This Pima County Multi-Jurisdictional Hazard Mitigation Plan was prepared by the Pima County Office of Emergency Management (PCOEM) and the listed participating jurisdictions, along with interested public, appointed representatives and elected officials of these jurisdictions. Accordingly, each of the participating jurisdictions is empowered to formally plan and adopt the Plan on behalf of their respective jurisdictions.

1.2 Background and Scope

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

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event. The goal of risk reduction is to reduce the risk to life and property, which includes existing structures and future construction, in the pre and post-disaster environments. This is achieved through regulations, local ordinances, land use, and building practices and mitigation projects that reduce or eliminate long-term risk from hazards and their effects."

Another way to understand hazard mitigation is in relation to the emergency management cycle in the whole community. FEMA encourages the Whole Community approach to mitigation, prevention, protection, response and recovery activities. This means that, in addition to federal, state and local emergency management entities, academia, nongovernmental organizations, community members and the private sector need to be engaged in all phases of emergency management including mitigation.

The results of a three-year congressionally mandated independent study to assess future savings from mitigation activities provides states that on average, each dollar spent on mitigation saves society an average of $4 in avoided future losses to society including saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council, 2005).[1] This study is currently being updated.

Hazard mitigation planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. This Plan documents the planning process employed by the Planning Team for Pima County's Multi-Jurisdictional Hazard Mitigation Plan (MJHMP). The Plan identifies relevant hazards and risks, and identifies the strategy that will be used to decrease vulnerability and increase resiliency and sustainability.

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

- Development of mitigation standards, regulations, policies, and programs;
- Land use/zoning policies;

[1] National Institute of Building Science Multi-Hazard Mitigation Council, 2016: http://www.nibs.org/?page=mmc_projects#nhms

- Strong building code and floodplain management regulations;
- Dam safety program, seawalls, and levee systems;
- Acquisition of flood prone and environmentally sensitive lands; or
- 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

This Plan was prepared pursuant to the requirements of the Disaster Mitigation Action of 2000 and the implementing regulations set forth in the Federal Register (hereafter, these requirements will be referred to collectively as the DMA2K). The Federal Disaster Mitigation Act of 2000 requires that a community have an approved hazard mitigation plan in order to qualify for federal funding from the following grant programs. Some of the grant programs available include:

- Pre-Disaster Mitigation Competitive (PDM-C)
- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance (FMA)

Information in this Plan will be used to help guide and coordinate mitigation activities and decisions for future land use. Proactive mitigation planning will help reduce the cost of disaster response and recovery to the community and its property owners by protecting structures, reducing exposure and minimizing overall community impacts and disruption. The community has been affected by hazards in the past and is thus committed to reducing future disaster impacts and maintaining eligibility for Federal funding. In the future, climate variability could affect the outcome of hazards by either reducing or increasing disaster impacts. This plan will attempt to address potential variables in each of the hazards addressed.

This is a multi-jurisdictional plan that geographically covers the participating communities within the Pima County boundaries (hereinafter referred to as the planning area). The following jurisdictions participated in the planning process:

- Pima County (Unincorporated)
- Town of Marana
- Town of Oro Valley
- Town of Sahuarita
- City of Tucson
- Pascua Yaqui Tribe

1.3 Tribal Assurance

The Pascua Yaqui Tribe is a federally recognized tribe, organized and established as a sovereign nation pursuant to the provisions of the Indian Reorganization Act of June 18, 1934. The Pascua Yaqui Tribe achieved federal recognition as an established tribe on September 18, 1978, and became recognized as a historic tribe in 1994.

The Pascua Yaqui Tribe will comply with all applicable Federal Statutes and regulations during the periods for which it receives grant funding, in compliance with DMA 2000 requirement §201.7(c)(6), and will amend its plan whenever necessary to reflect changes in tribal or Federal laws and statutes as required.

1.4 Plan Organization

This Plan is organized as follows:

- Section 1: Introduction
- Section 2: Community Profile
- Section 3: Planning Process
- Section 4: Hazard Identification & Risk Assessment
- Section 5: Mitigation Strategies and Action Items
- Section 6: Plan Maintenance

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SECTION 2: COMMUNITY DESCRIPTIONS

2.1 County Overview

History

Pima County is unique for being one of the oldest continuously inhabited areas of the United States. Native Americans have lived in this region from prehistoric times to the present, with the Tohono O'odham reservation being the second largest in the nation. Originally named for the Native American tribe inhabiting the area, evidence of the human settlement of Pima County dates back over 9,000 years. The Hohokam inhabited the area until the 1500s when they mysteriously disappeared. The Tohono O'odham were the next to settle the region and concentrated along the Santa Cruz and Gila Rivers. The arrival of the Spanish in the 1690s marked the first European peoples to establish settlements in the area. Missionary and explorer Father Eusebio Francisco Kino established the San Xavier del Bac mission. Throughout the 1700s, the Spanish continued to settle throughout southern Arizona. In 1775, the Tucson presidio was built to protect settlers from raiding tribes of Apaches. Residents of the fort began to refer to it as the "Old Pueblo", which remains today as a nickname for Tucson.

Pima County was created in 1864, and included all of southern Arizona acquired from Mexico by the Gadsden Purchase. It is the second largest of the four original counties. Over time, portions of Pima County were carved off to create Maricopa, Pinal, Cochise, and Graham Counties.

Development began to flourish around the middle of the 18th century when silver and gold were discovered in the geographical area and the arrival of prospectors from Mexico. With the expansion of mining and ranching in the late 1800s, Pima County continued to witness increasing populations as new residents migrated to the Tucson region settling in proximity to major transportation corridors. Slowly, development moved eastward from Tucson until abutting with federally owned land resulting in a trend reversal with new growth occurring to the northwest. In the 1960's the county flourished due to the copper industry, and by the 1970s, the industry was responsible for the employment of almost 9,000 people.

According to recent 2016 data, Pima County now has a population of around 1,010,025, with a projected population increase to 1.4 million by 2041. Pima County is multi-culturally diverse and unique in the sense that it is a very urbanized county, with more than one-third of the population living outside of any incorporated cities or towns. The county seat of Pima County is Tucson, where most of the population is located. Tucson is a major commercial and academic hub, and is home to the University of Arizona, Pima Air & Space Museum and the Arizona-Sonora Desert Museum[2].

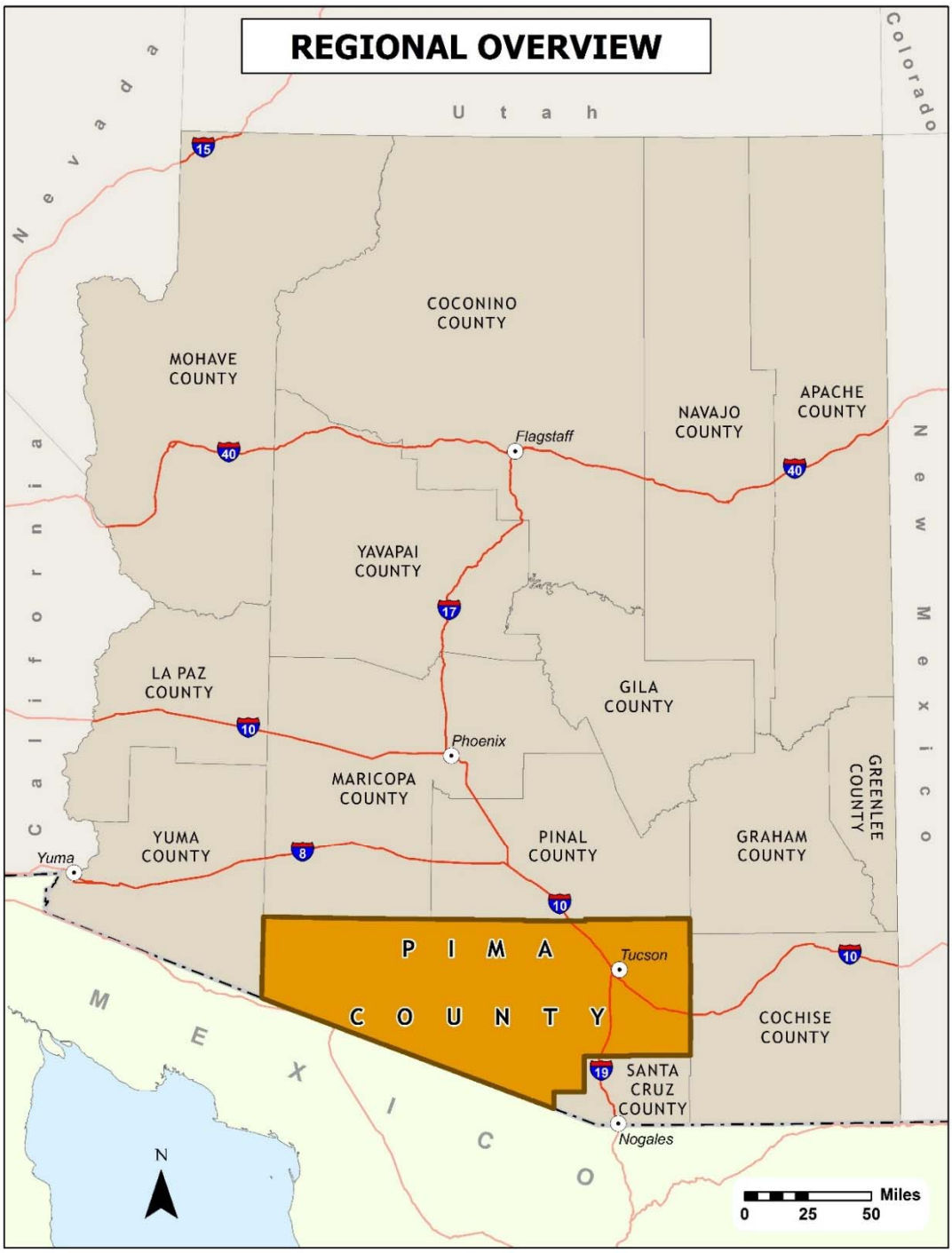
Geography

Pima County is located in southern Arizona and encompasses 9,184 square miles, which is roughly equal in area to the states of Rhode Island and Connecticut combined. Pima County shares a 120-mile border in common with Mexico. Pima County lies within the Basin and Range Physiographic Province, characterized by northwest-trending mountain ranges separated by alluvial basins. Separated by the Tucson and Sierrita Mountains, a large portion of Pima County lies in two alluvial basins: Avra Valley to the west and the Tucson basin in the east. The regional drainage network, primarily formed by the Santa Cruz River and its tributaries, is dry for a majority of the year except during the spring runoff or from heavy storms.

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. Two cactus forests traverse the county – Saguaro National Park to the northeast and Organ Pipe Cactus National Monument in the southwestern portion. In addition, the County is home to the Cabeza Prieta National Wildlife Refuge nestled along the western boundary of the

[2] Source: http://webcms.pima.gov/government/about_pima_county/, 2016

county and the Coronado National Forest in the eastern portion of the county within the Santa Catalina Mountains.



Source: Pima County Geographical Information Systems, 2016

Figure 2-1: Vicinity

The geographical characteristics of Pima County have been mapped into the following three terrestrial ecoregions:

- **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 varies between 3,000-4,500 feet. The average temperatures for the Chihuahuan Desert tends 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, relatively dry 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 wet during the summer and mild during the winter with a very dry spring and fall.

Land ownership within Pima County is divided between Indian Reservation (42%), Private (12%), U.S. Forest Service and Bureau of Land Management (12%), State Trust Land (15%), and other public lands (19%)[3].

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. 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. The Board of Supervisors has direct control over the County's general government functions including community services; indigent defense; medical, health, and welfare services; and public works functions. 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 (Town of Marana, Town of Oro Valley, Town of Sahuarita, City of South Tucson, and City of Tucson) are governed by council-manager form of government. An elected tribal council governs the Pascua Yaqui Tribe. Each of the municipalities and the tribal community are described in more detail in Section 2.3 below.

[3] Source: Pima County Geographic Information Systems, 2016

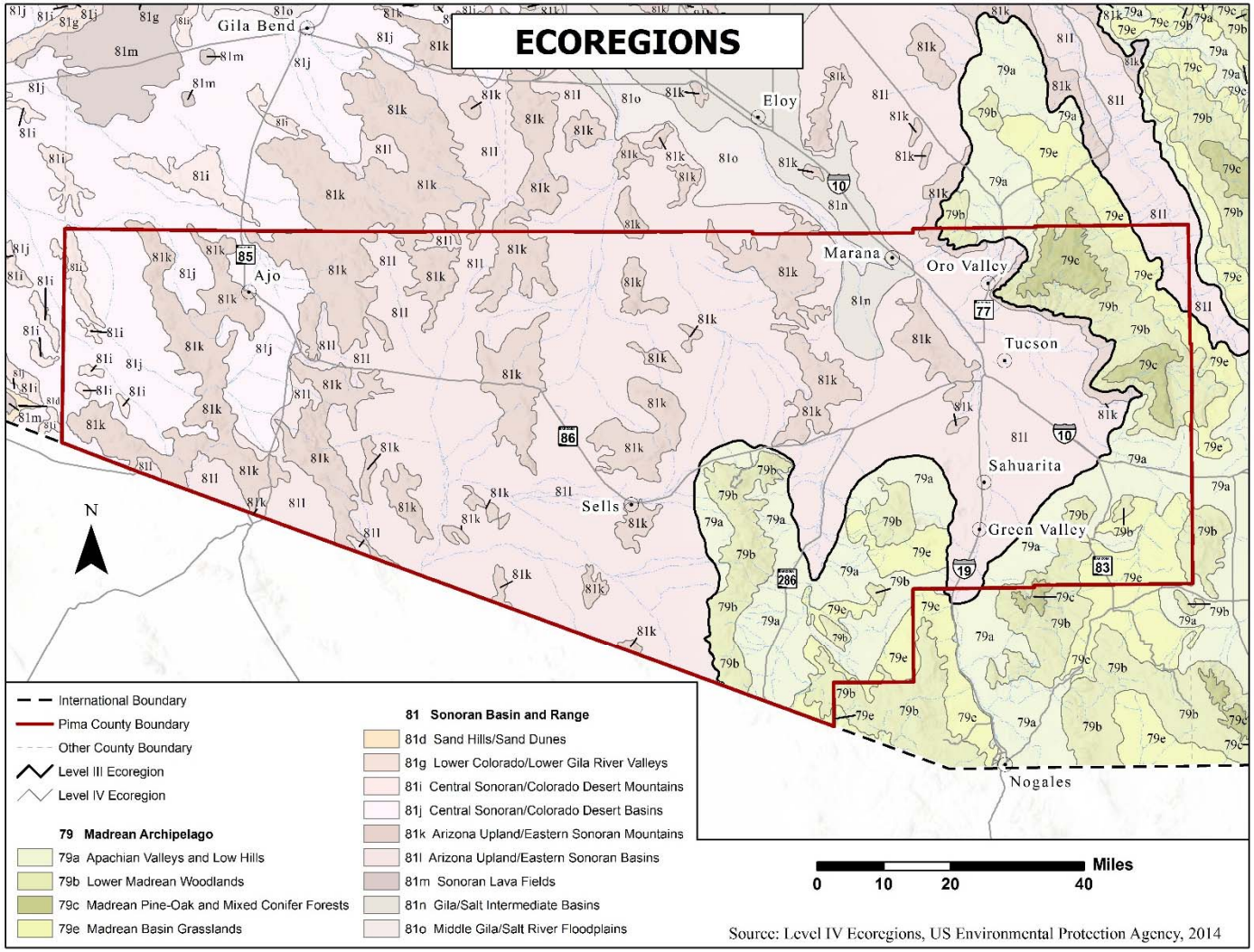


Figure 2-2: Ecoregions

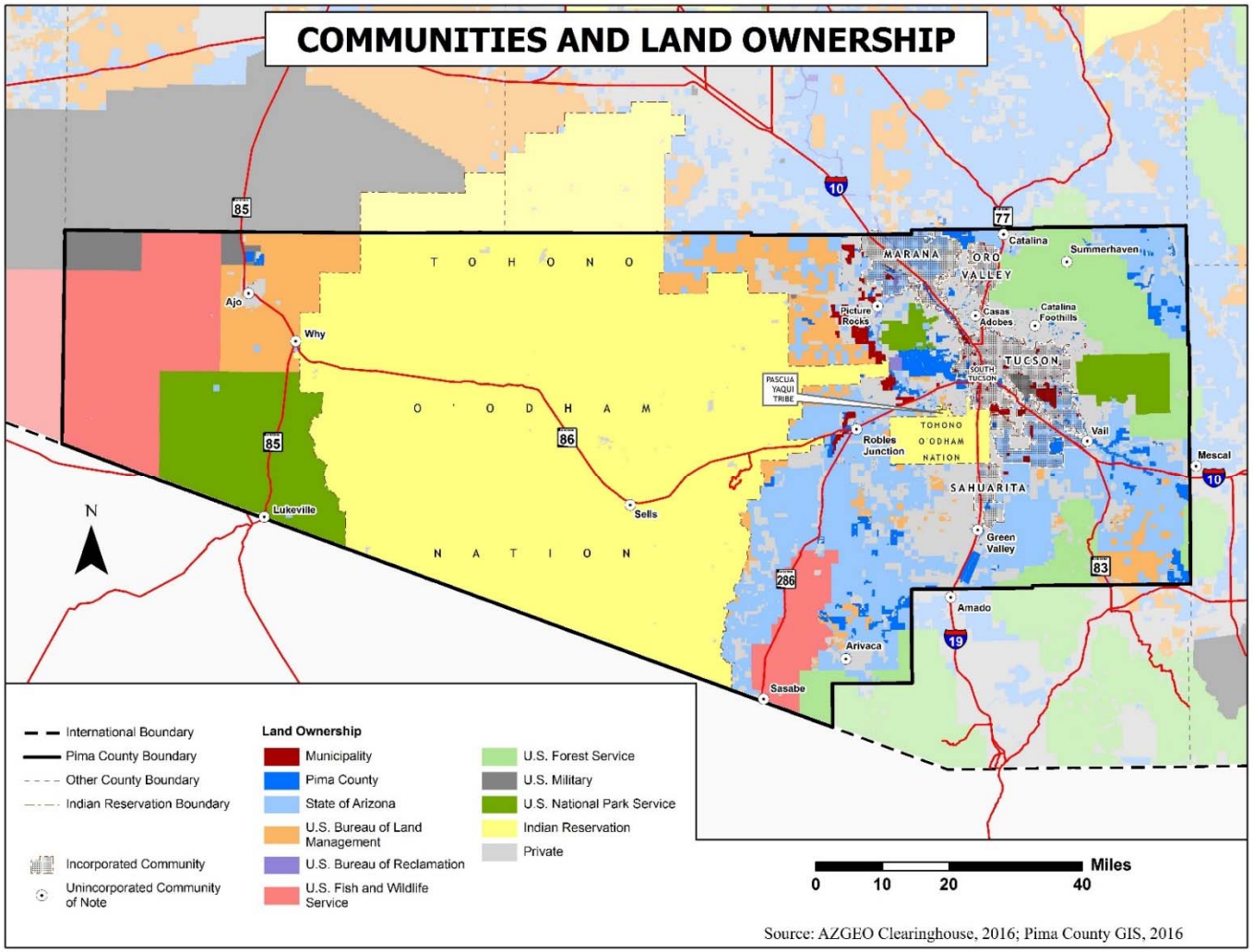


Figure 2-3: Community Location and Land Ownership

Geology

Pima County is comprised of a complex geology reflective of a history of faulting and folding of the earth's crust. The mountains include sedimentary, metamorphic volcanic, or intrusive igneous rock, or a combination of the three. The alluvial basins consist of well-consolidated sediments eroded from the surrounding mountain ranges with caliche, or hardpan, underneath. Caliche is formed as calcium carbonate and deposited within the soil through water seepage.

Transportation

As shown in Figure 2-4, several major roadways support both local and transportation needs. Interstate 10 provides connectivity with the Phoenix metropolitan area to the north and Interstate 19 with Mexico to the south. Several other State and US highways, most notably Arizona State Highways 85 and 86, coupled with key Indian Routes provide local and regional access throughout southern Arizona. Pima County is host to four municipal airports providing commercial and general aviation service to the region. In addition, the county is home to the Davis-Monthan Air Force Base in Tucson. Davis-Monthan Air Force Base has approximately 6,500 Active Duty military personnel, 1,000 Reserve and Air National Guard personnel, 3,000 civilian employees, and nearly 19,000 military retirees that reside in the Tucson area.[4]

Climate

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. Climatic statistics for weather stations within Pima County are produced by the Western Region Climate Center[5] and span records dating back to the early 1900's.

Table 2-1 lists some partial climate statistics for several of the weather stations located within the county. 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. For instance, temperature extremes in the foothill communities will generally be about 10° less than those in valley communities.

Table 2-1: Climate statistics for Stations in Pima County

	Average Temperature (F)				Precipitation (inches)		
	January		July				
Location	Min	Max	Min	Max	Wettest Month	Driest Month	Total Annual Average
Ajo	41.6	64.2	77.8	103	1.90 (August)	0.07 (May)	8.37
Cascabel	30.0	64.8	65.3	99.2	2.59 (August)	0.31 (May)	13.33
Kitt Peak	33.0	49.6	60.8	80.4	4.53 (August)	0.44 (May)	23.16
Sabino Canyon	37.1	66.4	72.4	101.9	2.41 (August)	0.19 (May)	12.73
Green Valley/Sahuarita	37.0	67.7	73.6	98.8	3.23 (July)	0.21 (May)	13.42
Sells	36.9	66.0	72.1	101.1	2.58 (July)	0.15 (May)	11.77
Tucson Magnetic Observatory	34.2	64.8	71.3	100.5	2.25 (August)	0.24 (May)	12.62
Tucson, University of Arizona	38.7	64.9	74.0	99.4	2.36 (August)	0.22 (May)	11.4

Note: Period of record varies by station but generally spans from the early 1900's to 2010. Sabino Canyon 1941-2002. Green Valley 1988-2016 is near Sahuarita.
Source: Western Regional Climate Center, 2016.

[4] Davis-Monthan & 355th Fighter Wing Fact Sheet, 2015

[5] Most of the data provided and summarized here taken from the WRCC website beginning at the following URL: http://www.wrcc.dri.edu/CLIMATEDATA.html, 2016

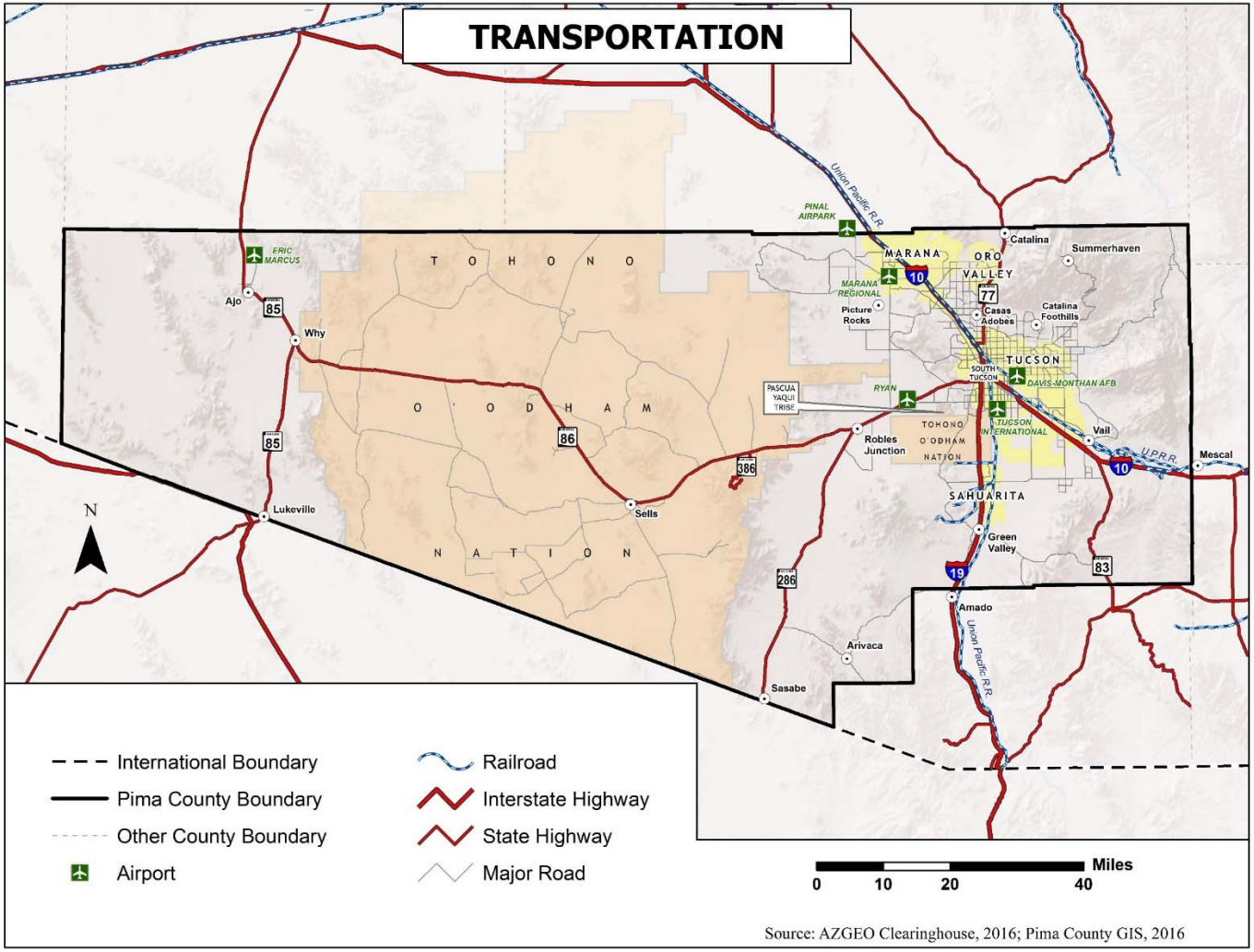


Figure 2-4: General Location and Transportation

Precipitation throughout Pima County is governed largely 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 (Gulf of California) and aloft from the southeast (Gulf of Mexico). 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 hailstorms.[6]

Average wind speeds are similar across Arizona, averaging approximately 6 to 9 miles per hour annually. Pima County generally experiences average wind speeds at approximately 8 miles per hour. However, significant variations can exist throughout the year, as evidenced by Tucson's statewide record of 76 miles per hour maximum-recorded wind gust. The surrounding mountains and topography of the region influence wind velocities and directions in the Tucson basin.

Population

As of July 2016, 1,009,371 residents call Pima County home[7]. The majority of the citizens still live in the incorporated communities or reservation portion of Pima County. The largest community is the City of Tucson. The two incorporated cities and three towns are geographically located in the eastern portion of Pima County.

Table 2-2: Population Estimates

Jurisdiction	2010	2015
Pima County	981,168	1,009,371
Town of Marana*	35,051	41,655
Town of Oro Valley	40,984	43,499
Pascua Yaqui Tribe (Pascua Pueblo Reservation)	3,745	8,831**
Town of Sahuarita	25,259	27,637
City of South Tucson	5,672	5,712
Tohono O'odham Nation	9,051	Not reported
City of Tucson	520,795	529,845
Unincorporated County	353,319	361.023

2010 Pascua Yaqui Tribe and Tohono O'odham Nation estimates from 2010 Census Block data
2010 and 2015 data from AZDOA: https://population.az.gov/population-estimates
*A portion of Marana is in Pinal County
** Provided by Pascua Yaqui Tribe and current as of September 2016

Economy

The metropolitan Tucson area is the center of economic activity for the County. As of July 2016, the countywide labor force was estimated at 470,100 with an unemployment rate of 5.8%.[8] A majority of workers in Pima County are employed in the educational services, healthcare, and social assistance sector of the economy, followed by arts and entertainment, and then professional, scientific and management. The labor force is reflective of the influence of tourism, academia, and the retirement population in the Tucson metropolitan area.

6 Office of the State Climatologist for AZ, 2004. http://geography.asu.edu/azclimate/narrative.htm

7 U.S. Census Bureau, Quick Facts, 2016. http://www.census.gov/quickfacts/table/PST045216/00

8 AZ Department of Administration Employment and Population Statistics, August 2016. https://laborstats.az.gov/sites/default/files/Emp-Report.pdf

2.2 Jurisdictional Overviews

2.2.1 Town of Marana

Nestled along Interstate 10 approximately one mile northwest of Tucson, the Town of Marana has experienced dramatic growth in the past decade because of aggressive annexation policies and the development of master-planned communities. Founded in 1881, in conjunction with the development of rail transportation, Marana solidified itself as a destination with its appearance on Southern Pacific Railroad maps in 1890. Although ranching and the railroad dominated the community prior to World War I, the post-war years brought significant change to the region with the implementation of extensive agricultural irrigation systems and the development of cotton farming. Other substantial factors in Marana's development were the location of Marana Army Air Field (now Pinal Airpark and Evergreen Air Center) and the removal of the downtown business district due to the widening of Interstate 10 in the early 1960's.

In March of 1977, the Town of Marana incorporated with an area roughly 10 square miles. Governed by a seven-member Town Council consisting of a Mayor and six council members elected for four-year terms, the Town utilizes a Council-Manager form of government. The Town Council appoints a Town Manager responsible for the daily operation of town services and the orderly administration of affairs.

Although a majority of Marana's topography is flat, much of the area is designated as floodplain. In addition, the existing Town boundaries include portions of the Tortolita and Tucson Mountain foothills that are dominated by slopes exceeding 15%. The development constraints posed by these environmentally sensitive lands provide the potential for natural open space and habitat conservation areas to balance with the urban development occurring. Several riparian features, including major wash crossing in the Tortolita Fan and the Santa Cruz River provide natural wildlife habitat for diverse species native to the Sonoran Desert.

Although witnessing substantial urban growth during the past decade, Marana continues to hold onto its agricultural and ranching roots and serves as the main trade and transportation center for the surrounding rural periphery for the eastern portion of Pima County. As illustrated in Table 2-2, the 2015 Census population of Marana is 41,655. On average between the years of 2010-2014, the civilian labor force was 64.5% of the town's population. In 2012, when data was last recorded by the U.S. Census Bureau, there was approximately $23,436 worth of retail sales per capita in the town. New building permits issued in 2015 were 622.[9]

Marana's General Plan, adopted on December 7, 2010, reflects a community preparing for unprecedented future growth. Marana's Land Use Map (Figure 2-5) defines a pattern of growth sensitive to the natural environment and reflective of the Town's goal to preserve and protect natural habitats. The Marana General Plan designates a majority of northeast Marana as environmentally sensitive, best suited for less intense uses such as low-density residential development or open space. Low and medium density residential in proximity to environmentally sensitive areas provide a transition to more intensive commercial and industrial uses located in proximity to major transportation corridors including Interstate 10 and the Marana Northwest Regional Airport.

The Town's reputation for a business-friendly environment with no city property taxes has led to substantial recent investment in economic development activities. Although agriculture remains a major force in Marana's economy, a recent influx of residential and commercial development has occurred due to its location between Phoenix and Tucson along I-10 and the Union Pacific Railroad, a business-friendly government and no town property taxes. To the south, adjacent to Tucson, is a new commercial business district. Continental Ranch/Peppertree Ranch Industrial Park has several new tenants and new industrial properties will soon be available at Marana Northwest Regional

[9] U.S. Census Bureau, QuickFacts, 2016. http://www.census.gov/quickfacts/

Airport. Marana's major private employers include Arizona Portland Cement, Costco, Home Depot, Wal-Mart, Lowes, Sargent Controls & Aerospace, and Tucson Ready Mix. Major public employers include the Marana Unified School District and the Town of Marana. Marana's planning area encompasses approximately 228 square miles in Pima and Pinal Counties. Existing land uses include natural undisturbed desert, improved drainage areas, agriculture, recreational lands, and residential, commercial, and industrial development. A majority of the Planning Area beyond the Town boundaries is undeveloped.

Marana's Town limits reflect the many changes and transitions that have occurred since its incorporation. Marana's rural heritage is reflected in traditional family farms and agricultural activities that continue on many acres of land historically used for agriculture. Older, low-density residential and commercial development was located west of Interstate 10 (I-10), in and near the traditional Town area where many Marana pioneer families settled. This northwest part of Marana began a transition to a more densely populated area in early 2000. At that time, the Cactus Ferruginous Pygmy-owl was listed as an endangered species, which limited development in much of the area east of I-10. This shifted the development focus to the farm fields in northwest Marana. The extension of bank protection along the Santa Cruz River to Sanders Road took many of the farm fields out of the floodplain and opened them up to development opportunities. The extension of close to six miles of sewer lines in 2003 brought urban services to the northwest area. By 2010, there were more than 4,000 new lots platted in this developing part of the Town and close to half of those lots had constructed homes. The new growth brought approximately 5,000 new residents to this once rural area. The northwest area is the number one growth area for Marana, with more than 17,000 additional lots entitled in this area.

Marana's planning area includes natural areas, such as the Tortolita Mountain Alluvial Fan in the northeast, which provide physical constraints that limit development. Characterized by steep slopes, natural drainage ways, native vegetation and floodplains, this area provides natural undisturbed open space and habitat for a multitude of plant and animal species. The Town has proactively moved to direct new growth and development away from the fan to other more appropriate areas.

The Town of Marana 2010 General Plan indicates that residential development is the predominant land use, occupying more than 50% of the total land area. The residential categories provide a range of densities within each designation. However, the maximum density cannot always be achieved because of land use policies or physical constraints. Commercial and industrial uses may potentially accommodate a wide range of uses.

The new Twin Peaks Road extension and Twin Peaks/I-10 freeway interchange has created access and provided infrastructure to new areas previously unavailable for development. Related to this, Tangerine Road, from La Canada Drive to I-10, is currently in design for the expansion of up to six lanes that will facilitate the expected growth in three activity centers in the region including the Tangerine Road/I-10 Activity Center; Tangerine Corridor Activity Center; and Dove Mountain Activity Center. The new Tangerine Road will eventually connect to a fully planned, new Tangerine/I-10 freeway interchange. These roadway projects will allow for the capacity necessary for future growth in the area as well as provide better circulation and connectivity in the community including access to the Town of Oro Valley.

At the Marana Regional Airport, a future focal point of the town's local economy, continual upgrading and expansion of the facility has benefit to the airport and to the Town's ability to attract commerce. The recent addition of road and utility infrastructure in the 1-10 area directly east of the airport will attract new businesses to the Town while others will be attracted to the airport because of its business-class jet capabilities, convenient location and access for business or pleasure.

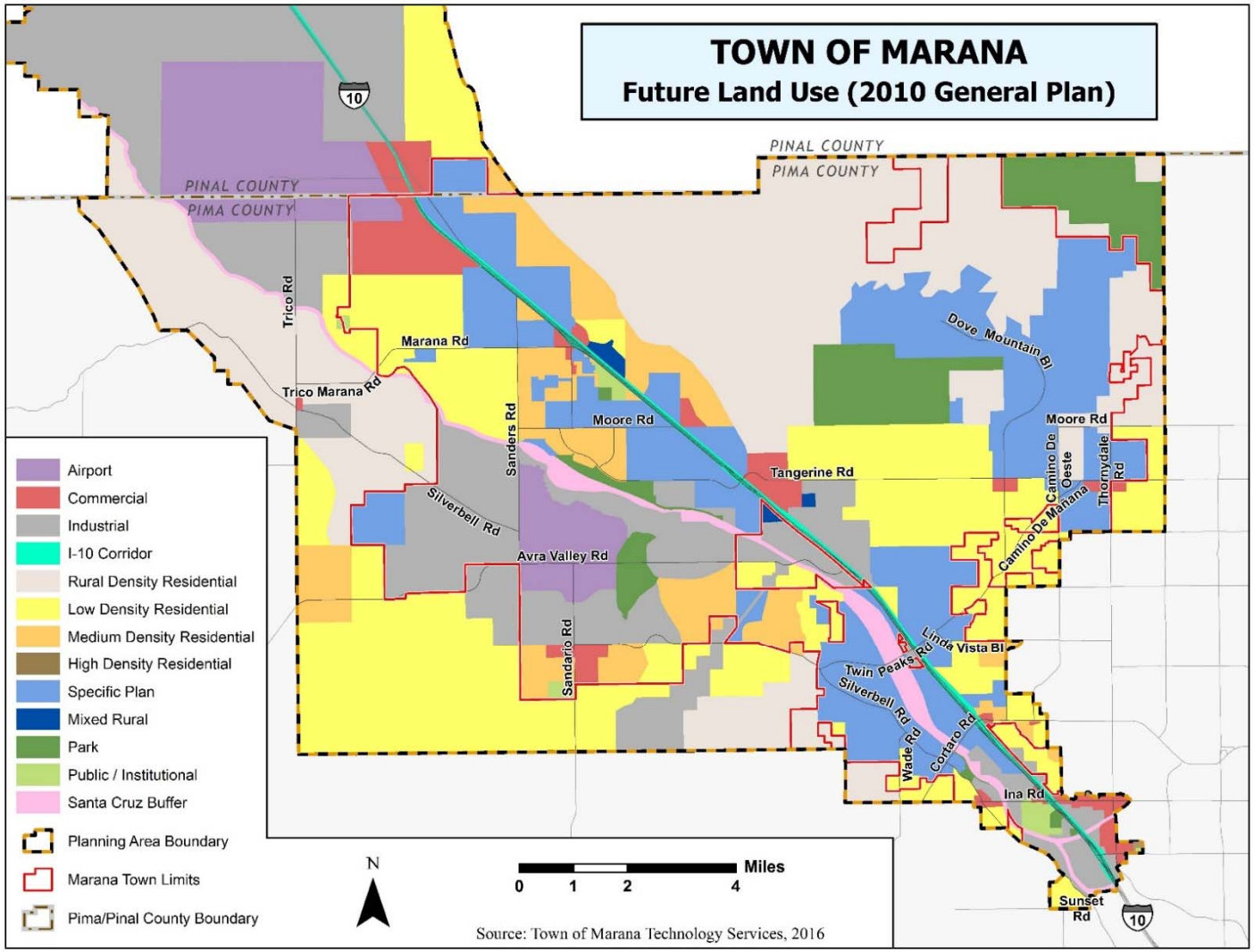


Figure 2-5: Town of Marana Land Use

2.2.2 Town of Oro Valley

Located between the Santa Catalina Mountains to the east and the Tortolita Mountains to the northwest, Oro Valley is located six miles northwest of the Tucson city limits. Other nearby communities include the Town of Marana to the west and the unincorporated community of Catalina to the north. Oro Valley serves as a gateway to regional parks, sharing its eastern border with Catalina State Park and the Coronado National Forest. These areas provide vast recreational and natural open space opportunities for the community and are integral to the Town's identity as a community known for its integration of residential uses within the natural Sonoran Desert and as a resort area. Major access to Oro Valley is via Interstate 10, located approximately 12 miles to the west, and State Route 77, or Oracle Road, which runs north-south through the Town, and is the original transportation corridor linking Tucson with the Phoenix metropolitan area to the north. The Town incorporated in April of 1974 and operates under a Council-Manager form of government, which includes a mayor and six council members elected at large. The Mayor is directly elected while the Vice Mayor is selected by the Council from among the six Council members.

Oro Valley is a growing community. The 2015 population of Oro Valley is estimated at 43,500. This population is forecasted to grow to around 50,000 by 2030. Residential growth has been a large part of economic activity in the past and will remain important into the future. In recent years, more diverse employment opportunities have become part of the community. Oro Valley's large employers include Ventana Medical Systems, a member of the Roche Group, Honeywell Aerospace, Oro Valley Hospital, Town of Oro Valley, Amphitheater School District, Hilton El Conquistador Golf & Tennis Resort, Fry's Food & Drug Store, Walmart Supercenter, Splendido at Rancho Vistoso and Meggitt Securaplane. Oro Valley is emerging as a regional center for the biotech industry, with Innovation Park, featuring medical and biotech campuses.

The Town of Oro Valley's General Plan guides the character and future directions for the community over a 10-year period. The *Your Voice, Our Future* General Plan was adopted by Town Council on September 21, 2016 and ratified by the Oro Valley voters on November 8, 2016. The Plan supports the potential of an evolving community, with a focus on family-friendly features, economic development and amenities contributing to a "complete community". This is balanced with long-held values for the natural environment and lower density development. Future commercial growth will likely be concentrated in designated growth areas, primarily the Oracle Road corridor and secondarily smaller neighborhood commercial clusters dispersed throughout the Town. Residential growth will likely occur in both smaller infill projects as well as a few larger tracts of land on the western portion of Town.

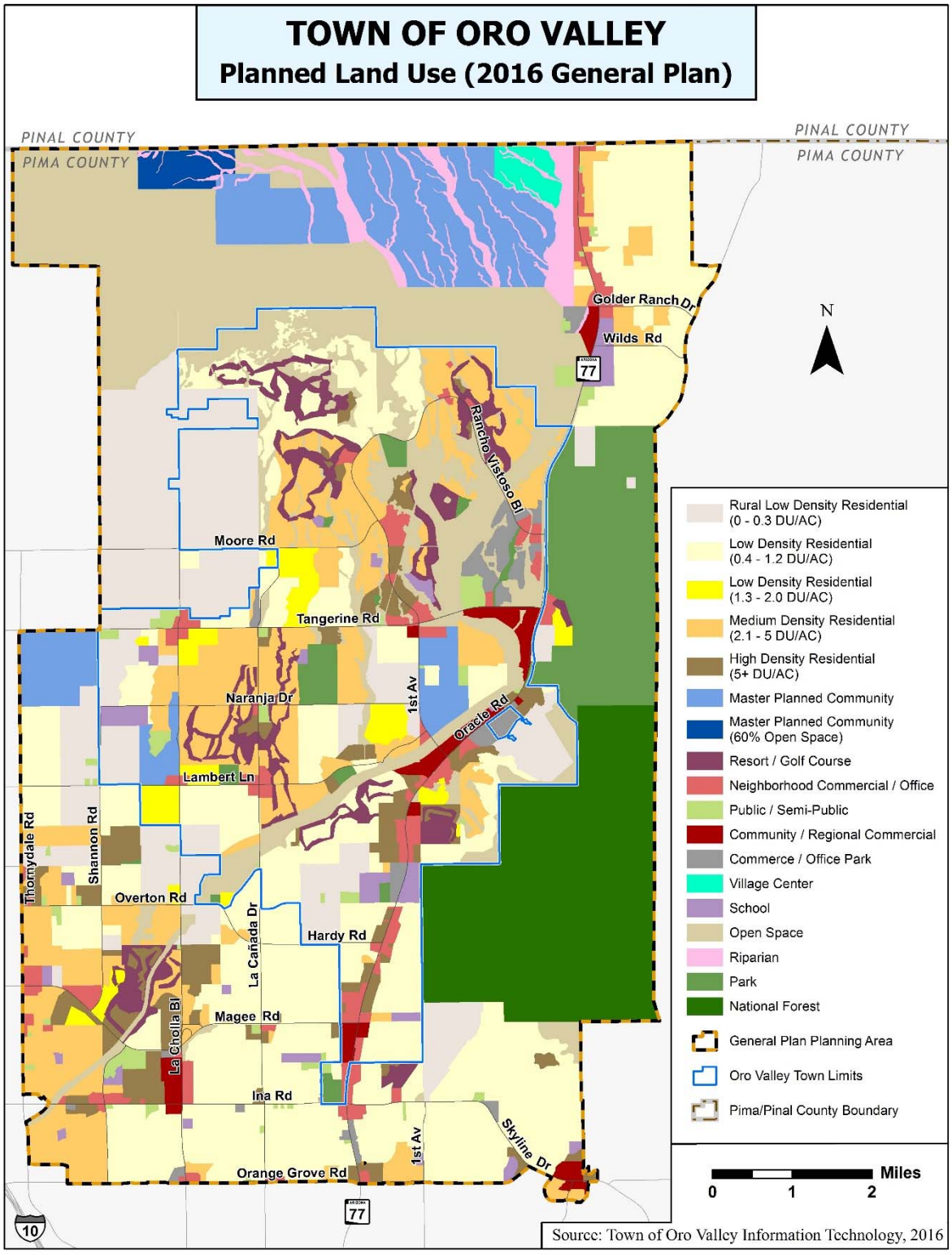


Figure 2-6: Town of Oro Valley Land Use

2.2.3 Pascua Yaqui Tribe

The lands of the Pascua Yaqui became part of the United States in the 1870s. Calling themselves the Yaquis, the first modern settlements of these descendants from the ancient Uto-Azteca people, were near Nogales and South Tucson. Over time, the Yaquis spread out, settling north of Tucson in an area they named Pascua Village and in Guadalupe near Tempe. Retaining their religious and cultural ways of life, the Yaquis began calling themselves the Pascua Yaqui Tribe and accepted political integration into American society during the 1950s. In 1952, the Pascua Yaqui Tribe was annexed by the City of Tucson. In 1964, Congress transferred 202 acres of desert land southwest of Tucson to the Pascua Yaquis who were looking for an area to preserve their tribal identity. Members of the Pascua Yaqui Tribe relocating to the reservation struggled to secure federal recognition for the tribe until finally being recognized in 1978. The Tribe acquired an additional 690 acres in 1988. In 1994, the tribe's status was changed from a created tribe to a historic tribe.

Today, the Pascua Yaqui Tribe is scattered throughout eastern Pima County and includes several small communities. These communities include Yoem Pueblo in Marana, Old Pascua in Tucson, Barrio Libre in South Tucson, and the Pascua Pueblo, a 1.87-square mile reservation located southwest of the City of Tucson.

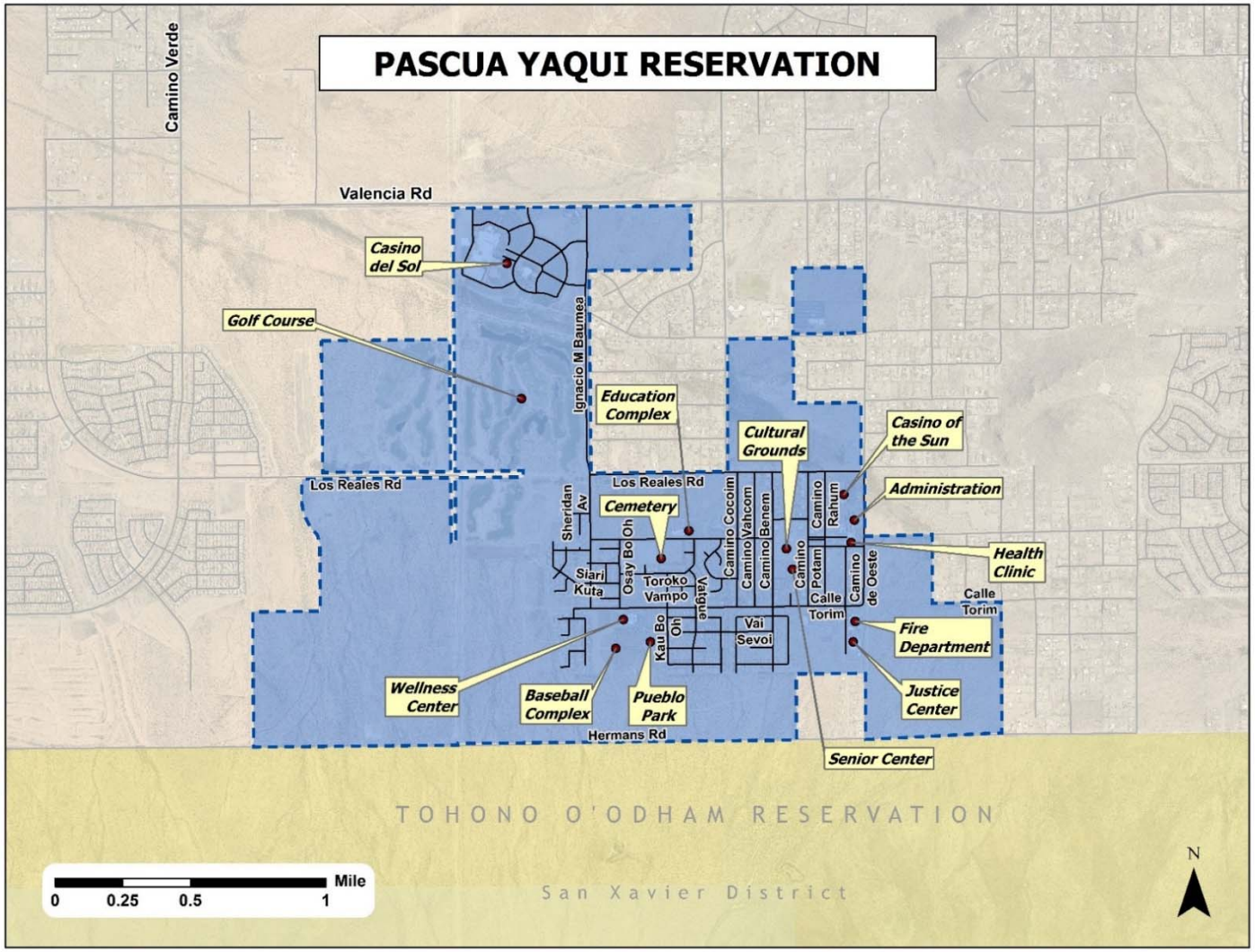
According to Tribal sources, the population as of September 2016 for the Pascua Yaqui Tribe within Pima County communities was 8,831. Table 2-3 summarizes enrolled Tribal membership by the various Pascua Yaqui communities located both within Pima County and outside. Enrollment demographics for the Pascua Yaqui Tribe have increased due to housing development. Between 2013 and 2015, Housing Urban Development Grants were obtained to build housing for tribal members. The Pascua Yaqui Tribe also had proposed amendments to its constitutions effecting the tribe's base enrollment to its tribal members. The amendments were passed by the federal government that gave the authority to the Pascua Yaqui Tribal Council to have the power to enact ordinances, subject to the approval of the Secretary of the Interior, governing future membership and loss of membership. This rise in enrolment is reflected in Table 2-3 demographics with the Yaqui Communities of New Pascua and Marana falling under the tribes and included in the Plan.

Table 2-3: Pascua Yaqui Tribal Enrollment Demographics

Pascua Yaqui Communities	No. of Enrolled Members
• New Pascua	• 5,086
• Old Pascua	• 775
• Barrio Libre (South Tucson)	• 741
• Yoem Pueblo (Marana)	• 123
• Guadalupe (Maricopa County)	• 3,537
• High Town (Chandler)	• 113
• Penjamo Pueblo (Scottsdale)	• 250
• Eloy/Coolidge (Pinal County)	• 247
Community Total	**10,872**
• Other Arizona Cities	• 6,446
• Outside the State of AZ	• 2,011
Total Active Membership	**19,329**

Source: Pascua Yaqui Tribe, September 2016

The Pascua Yaqui Tribe operates two casinos within Pima County, the 40,000 square foot Casino of the Sun and the 75,000 square foot Casino del Sol. Other tribal enterprises include the brand new Sol Casino Hotel and Convention Center, which includes 215 rooms and a 20,000 square foot ballroom, the Anselmo Valencia Amphitheater 4,470 seat open-air concert venue, and the Del Sol Marketplace. The Sewailo Golf Course opened in 2013 measures 7,400 yards from the championship tees, with 5 different tee boxes on each hole to allow for players of all abilities. It is known as one of the finest golf courses in Tucson and the state of Arizona.



Source: Pima County Geographical Information Systems, 2016

Figure 2-7: Pascua Location

2.2.4 Town of Sahuarita

The Town of Sahuarita, incorporated in 1994, now encompasses a little over 31 square miles. Land uses within the incorporated boundaries of the Town include primarily residential and agricultural uses and vacant land. The next largest land use in the town is institutional, which includes schools, public uses, and utilities. In addition to these, there is commercial and light industrial land and recreational/open space uses.

The 2010 census found 10,615 dwelling units and 9,020 occupied households with a population of 25,259 (see Table 1). The Town has seen significant growth, with a 679% increase in population from 2000 to 2010. The Town's population in the year 2015 was at 27,637. As of 2013 a lower 13.2% vacancy rate was reported in the 2011-2013 American Community Survey 3 Year Estimate.

Table 2-4 Population and Housing

	2015 Total Census Population	Total Units 2010	Total Occupied 2010	Total Vacant 2010	Group Quarters Population 2010	Owner Occupied 2010	Renter Occupied
Sahuarita	27,637	10,615	9,020	1,595	63	7,615	1,405

Source: U.S. Census Bureau; 2015 and 2010 Census

Using the 2010 Census average household size and average family size of 2.79 and 3.14, respectively, the Town calculates future population projections using 2.89 persons per unit. The 2010 Census found an almost equal male/female ratio within the study area. The Town does not currently have a large group quarters facility.

Within Sahuarita are five age-restricted communities: Quail Creek, a fully age-restricted master planned community; Rancho Resort and Sonora within Rancho Sahuarita; La Jolla Verde, which lies southeast of I-19, and Duval Mine Road; and the Green Valley RV Resort that lies west of I-19 and north of Duval Mine Road. The Town shows a more traditional mix of population by age category not indicative of being skewed to the senior age groups. The Town of Sahuarita prides itself in being open to families with children as well as other household types.

Nearly 85% of the 9,020 occupied housing stock within the Town was owner-occupied in 2010. Based on this demographic holding in the future, the Town should plan either on ensuring that there is an adequate supply of single-family housing or assume that a significant part of its housing stock will likely be owner-occupied units. National trends, however, show a shift towards smaller household sizes and an increase in renting vs homeownership. It is unclear if this trend will affect Sahuarita, but it may be prudent to plan for a variety of housing types to best position the Town for the future.

Sahuarita represents five predominant land use themes today. First are the existing, older residential areas, primarily on larger lots, located in the western portion of the town, and interspersed by undeveloped properties.

Secondly, there is the rise of the master planned community from Rancho Sahuarita to the northwest and Madera Highlands and age–restricted Quail Creek to the southeast. Most of the growth anticipated in the Town during the life of the 2015 general plan will occur within master planned communities. Each is unique and caters to its individual market, but differs from more rural Sahuarita.

Third are the developing commercial and potentially mixed-use centers in the southern portion of the Town around the intersection of I-19 and Duval Mine Road. These centers provide regional services to Green Valley and much of the Upper Santa Cruz Valley in addition to Town residents.

Fourth are the production agriculture orchards and ranches in the eastern portion of the Town. Some of this land lies within the 100-year floodplain, but some of it lies outside and is imminently developable. Agricultural employment, in particular the pecan orchards owned and operated by FICO, provides a source of employment in the community that brings in revenues from outside the Town and helps the local economy. It is expected that over time, FICO holdings will likely convert to more urban scale development, completely or in part. The Sahuarita Farms Specific Plan and River Master Plan reflect the type of transition anticipated in this area.

Lastly, the Santa Cruz River and its large floodplain, which bisect the Town, provide both a constraint and an opportunity. Most of the river's floodplain within the Town is not in a natural condition today; indeed, there are a number of structural uses, particularly around the historic Sahuarita townsite as well as irrigated agriculture and

institutional uses. Currently, there are no flood control measures planned for the Santa Cruz River within the Town of Sahuarita; however, consideration of such measures in the future may occur, pursuant to pre-existing agreements and the recently approved Sahuarita and Continental Farms River Master Plans.

Major employers in the area include Freeport-McMoRan and Asarco; Caterpillar Proving Grounds; FICO; Wal-Mart; Fry's; Safeway; Desert Diamond Casino, an Enterprise of the Tohono O'odham Nation; the Sahuarita School District; and the Town of Sahuarita itself.

Size and Location

Currently 31 square miles in area, Sahuarita is located just 15 minutes south of Tucson and approximately 40 minutes north of the Mexican border. Tucson International Airport is within a 20-minute drive.

Located along I-19, 40 minutes north of the U.S./Mexico border and 18 miles south of downtown Tucson, Sahuarita is uniquely positioned to capture 24 million annual visitors from Mexico. Sahuarita is overflowing with retail opportunities, executive living and a viable center for companies and employers to conduct business with Mexico.

Each day, on average, more than 65,000 Mexican residents come to Arizona to work, visit friends and relatives, recreate, shop, and spend over $7,350,000. This contributes substantially to Arizona's export trade with Mexico. Familial ties, long-term friendships, work opportunities, leisure activities and shopping experiences not yet available in Mexico continue to support strong cross-border interactions between Arizona and its neighbor, Sonora.

Town Government

The Town of Sahuarita operates under the council-manager form of government. The Sahuarita Town Council is responsible for the policy matters of the town, and the town manager oversees staff and carries out the day-to-day functions of the town. Sahuarita is administered by the seven-member town council, which includes a Mayor and Vice Mayor. The Mayor and Vice Mayor are not elected into those positions, but are instead chosen among elected council members. The Town Council oversees all issues pertaining to Sahuarita, including residential and commercial development and natural preservation.

Population

As one of Arizona's fastest-growing communities, the Town of Sahuarita is the newest jurisdiction in Pima County, incorporated in 1994. The Town of Sahuarita's population increased nearly 700 percent during the period from the 2000 Census to the Census of 2010.

Table 2-5: Town of Sahuarita Population Growth

Year	Population	% Increase
2010	25,259	11.5%
2011	25,722	1.8%
2012	26,244	2.0%
2013	26,772	2.0%
2014	27,232	1.7%

Source: U.S. Census Bureau; 2015 Census; Sahuarita Economic Development Quick Facts

Income

The Town of Sahuarita saw a 13.1 percent growth in the working-age population between 2008 and 2012, and households earned a median income of $69,425. Additionally, Sahuarita has an unemployment rate of 5.8 percent.

Table 2-6: Town of Sahuarita Medium Income	
Town/Municipality	Median Household Income
Sahuarita	$69,425
Pima County	$46,433
State of Arizona	$50,256

Source: U.S. Census Bureau; 2010 Census; Sahuarita Economic Development Quick Facts

Housing

From a quality of life perspective, Sahuarita has it all: safe, quiet streets; affordable housing; modern schools; landscaped trails and parks; scenic beauty; neighborhood shopping; easy access to interstates and the airport. The Town of Sahuarita has three master planned communities and eleven small neighborhoods for its residents to call home.

Education

The Town of Sahuarita Workforce Assessment by the University of Arizona Eller College of Management Economic and Business Research Center concluded that Sahuarita's employed workforce displays higher levels of educational attainment overall than Pima County and Arizona as a whole. Sahuarita's employed labor force has concentrations significantly greater than those in Southern Arizona do in higher paying occupational categories and in important 'high-tech' occupations.

Table 2-7: Town of Sahuarita Education	
Town/Municipality	Population 25 years and over with a Bachelor's Degree
Sahuarita	21.7%
Pima County	17.4%
State of Arizona	16.0%

Source: U.S. Census Bureau; 2010 Census; Sahuarita Economic Development Quick Facts

Location

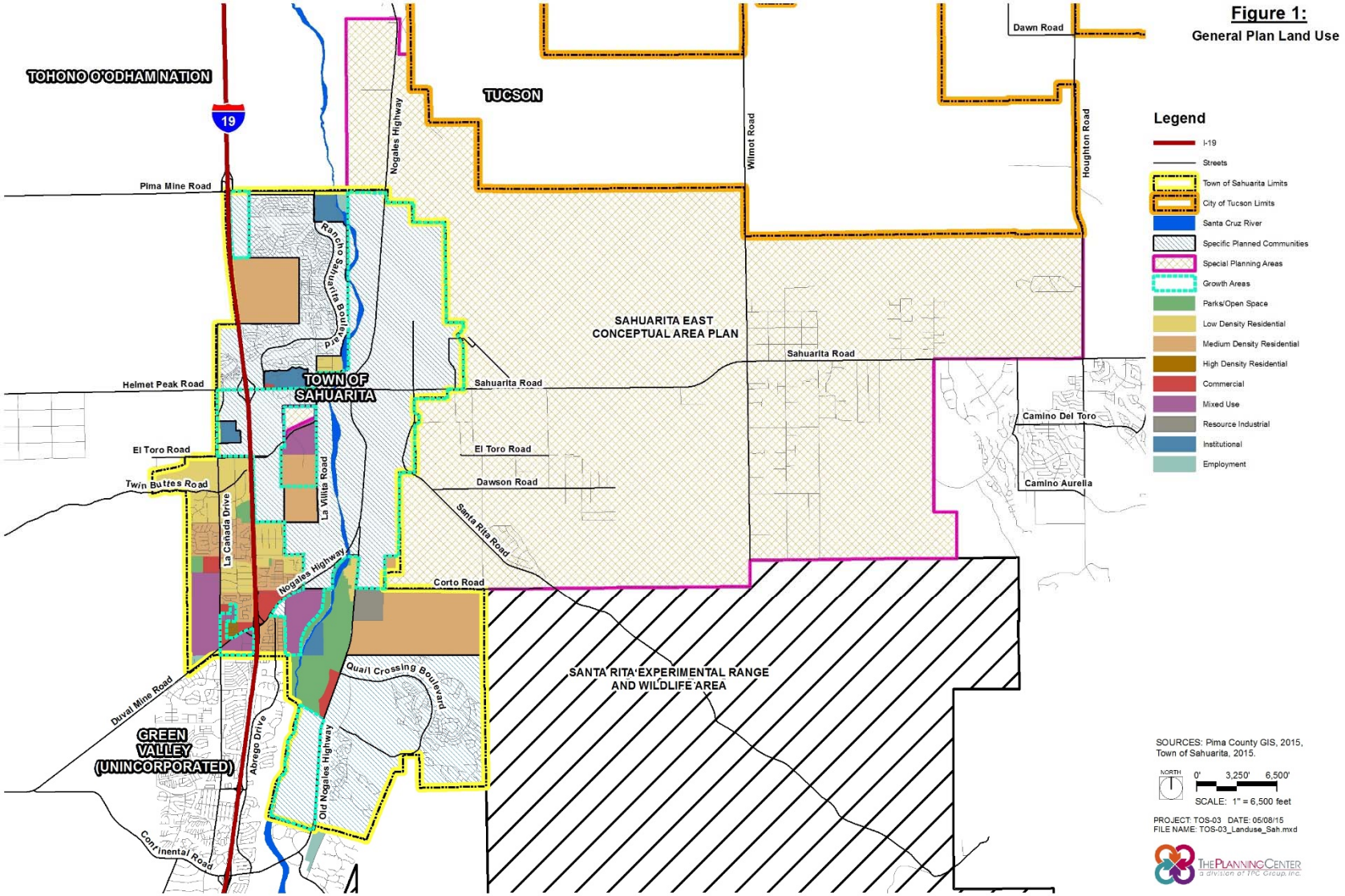


Figure 2-8: Town of Sahuarita General Plan Land Use

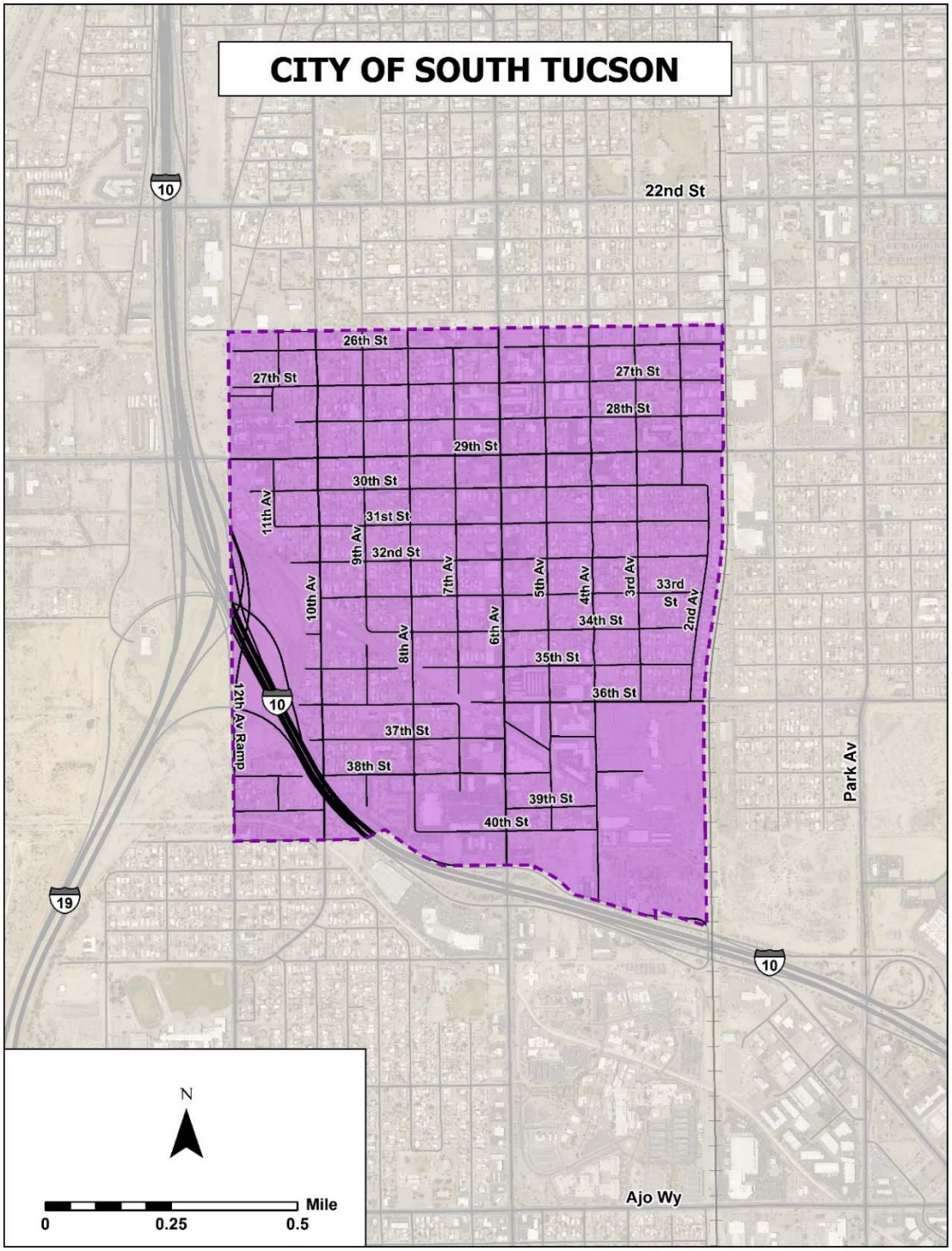
2.2.5 City of South Tucson

Surrounded by the City of Tucson, the City of South Tucson is a one square mile community just south of historical downtown Tucson nestled between the junction of Interstates 10 and 19. Rich in ethnic heritage, this small community services a population of which 83% are Mexican-American and 10% are Native American. Developed as a suburban community to Tucson, South Tucson enjoyed a colorful history after being incorporated in 1936, unincorporated in 1938, and reincorporated in 1940.

The City of South Tucson is located within a U.S. Department of Housing and Urban Development (HUD) –designated Empowerment Zone and Tucson Pima Enterprise Zone, both of which are dedicated to revitalizing dilapidated areas in the greater Tucson metropolitan area. The City of South Tucson has also been designated a rural 'Colonia' by the United States Department of Agriculture.

A Mayor, Six Council Members, and a City Manager govern the City of South Tucson. The local police and fire department have both full-time and volunteer personnel.

In 2000, the population of South Tucson was 5,490. Relatively small growth (0.42% through 2020) is projected for the future. South Tucson will continue to provide a declining percent of Pima County's overall resident population. This pattern is reflective of the strong growth throughout eastern Pima County and the City's inability to gain in available land mass. Similarly, South Tucson's small labor force is forecasted to parallel the Town's population growth by comprising a smaller share of the region's employment opportunities. The City of South Tucson updated their General Plan in 2002. Although not mandated to contain Growing Smarter elements due to their small size, this information was incorporated into the 2002 revision to provide consistency with other municipalities in the region.



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Source: Pima County Geographical Information Systems, 2016

Figure 2-9: City of South Tucson Land Ownership and Location

2.2.6 City of Tucson

The human history of the area on which the City of Tucson sits goes back as far as 10,000 B.C. with intermittent habitation by migratory Paleoindian and archaic hunters and gatherers. There is evidence of agricultural settlement as early as 1,000 B.C. The Hohokam people thrived in the area from 200 B.C. until the 1450's. The Pima and Tohono O'odham peoples are the descendants of that advanced civilization and have lived in the area ever since. Spanish explorers traveled through the area in 1540, starting a long history of Spanish colonization including the founding, in 1699, and construction of the Mission San Xavier del Bac completed in 1791. The modern day City of Tucson was founded in 1775 with the establishment of the Tucson Presidio. Over the next century, the City would become part of Sonora, Mexico during that country's fight for independence, then a part of the United States following the Gadsden Purchase. This period led to a decade in which the City of Tucson was capital of the Arizona Territory. The City was incorporated in 1877. In 1880, the Southern Pacific railroad reached Tucson and the population grew to 8,000. In 1912 Arizona joined the Union as the 48th state and Tucson continued to grow reaching a population of 120,000 by 1950, doubling to 220,000 by 1960, and reaching 400,000 by 1990.

Today the City of Tucson is Arizona's second largest city and serves as the seat for Pima County. It is the focal point for political, economic, and cultural activity in Southern Arizona. The 2010 census put the population of the City at 520,116 making it the 33rd largest city in the United States, and as of 2015, the estimated population was 531,641. The City of Tucson shares a border with the Town of Marana and the San Xavier district of the Tohono O'odham Nation, as well as several Census Designated Places such as Vail. Otherwise, the majority of its borders are surrounded by unincorporated Pima County. South Tucson, a one square mile enclave, lies within the City of Tucson. The neighboring towns of Oro Valley and Sahuarita have close economic, social and governmental ties to the City. Altogether, the City and the surrounding towns and communities make up the Tucson Metropolitan Statistical Area with a total 2010 census population of 1,010,025.

Tucson follows the council-manager form of local government. The six-member city council holds legislative authority and shares executive authority with the mayor, who is elected by the voters independently of the council. An appointed city manager is responsible for the day-to-day operations of the city.

The City encompasses an area of 236 square miles. It sits at an elevation of 2,634 feet above sea level, measured at the Tucson International Airport. It is situated on top of an alluvial plain, a flat area of land created over millennia by sediment washing down from the surrounding mountain ranges that include the Santa Catalina and Tortolita Mountains to the North, the Santa Rita mountains to the South, the Rincon Mountains to the East, and the Tucson Mountains to the West. The City is located along the Santa Cruz River, which was formerly a perennial river but now is a dry river that floods during seasonal rains. Tucson's natural environment is characteristic of the Sonoran Desert within which it resides with diverse habitats and conditions ranging from low land deserts to the highlands of the Santa Catalina and Rincon Mountains.

Tucson is located 118 miles from Phoenix, AZ, the state's capital city, and 60 miles from the U.S./Mexico international border. Two major transportation corridors serve Tucson. The first is Interstate 10, which passes through the City from the Northwest to the Southeast, connecting it to Phoenix, AZ via Westbound I-10 and to Las Cruses, NM and El Paso, TX via Eastbound I-10. The second is Interstate 19, which begins at its intersection with I-10 at the southern edge of Tucson connecting the City with Mexico through the town of Nogales, AZ. Tucson International Airport, the second busiest airport in the State of Arizona, sits just outside of the City's limits and approximately six miles from the City center. Tucson is also a hub for the Union Pacific Railroad, connecting the Los Angeles ports with the South/Southeast regions of the U.S. In addition to freight traffic, passenger rail service is provided by Amtrak with a station in downtown Tucson connecting the City to Los Angeles, New Orleans, and Chicago via various rail lines.

The University of Arizona calls the City of Tucson home, as does the Davis-Monthan Air Force Base. Both have large economic influence, as the second and third largest employers respectfully, as well as cultural influence on the City. The presence of the University and Air Force base draw high-tech industries to Tucson including Raytheon Missile Systems, the largest employer in the City, as well as Texas Instruments, IBM, Intuit, and Honeywell Aerospace leading to Tucson being recognized as a national leader in optics, astronomy, medical industries and aerospace and defense. Other large employers outside of the technology and defense industries include Walmart, Pima County's government, the Tucson Unified School District, U.S. Customs and Border Protection and the City of Tucson government. As of April 2016, Tucson had a civilian labor force of 477,600 with an unemployment rate of 5.0%.

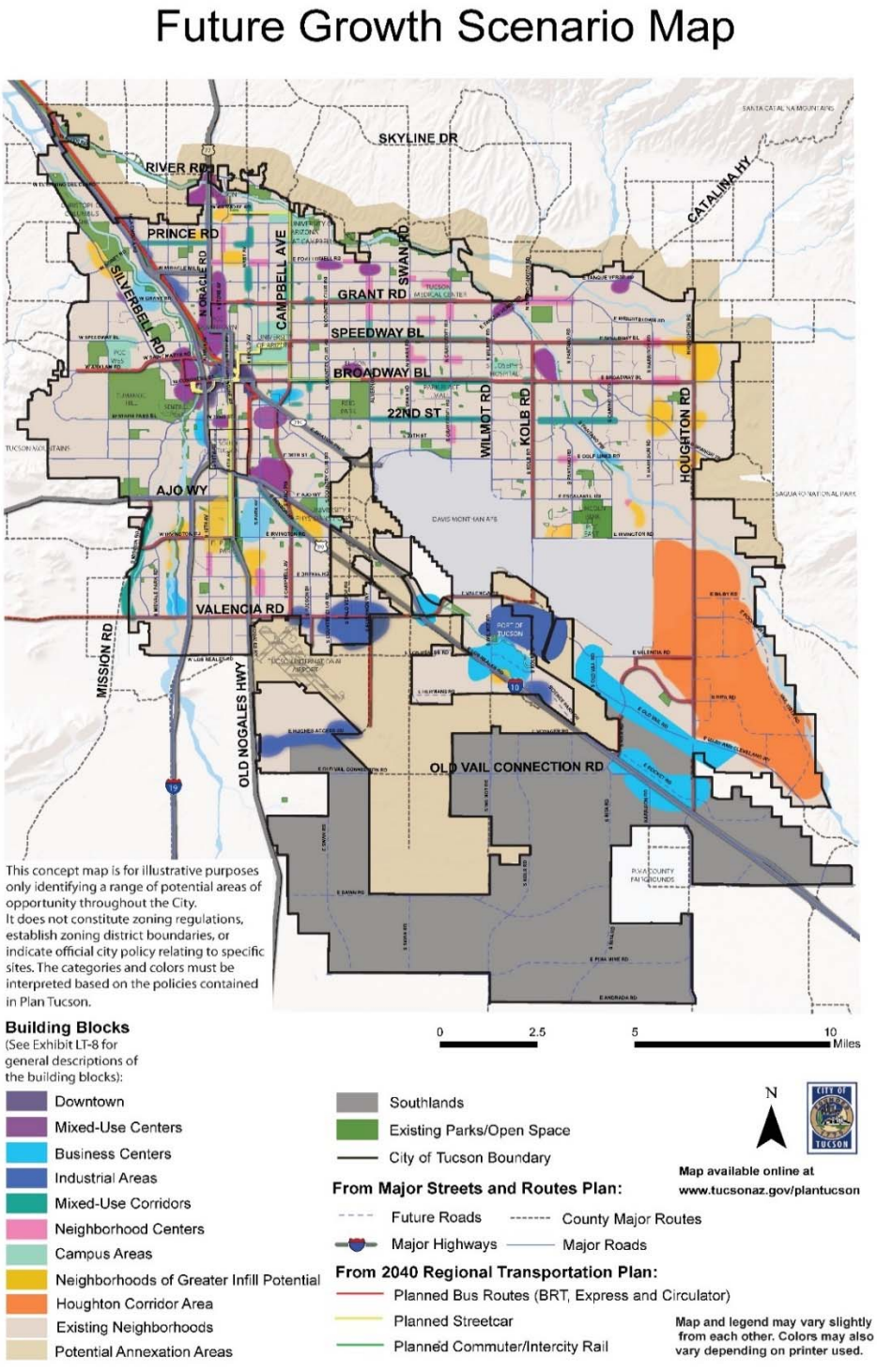

Figure 2-10: City of Tucson Generalized Distribution of Land Use & Future Growth

SECTION 3: PLANNING PROCESS

3.1 Planning Process

The 2017 update to the Plan was a countywide effort that included a revision and update of the previous plan, the integration of new components to the plan, and incorporation of new participants into the planning process. A multi-jurisdictional Planning Team was assembled to conduct the review of the 2012 plan, evaluate its efficacy over the last five years, and propose revisions for the 2017 plan. PCOEM served as the lead planning agency for the process, with support from the Arizona Department of Emergency and Military Affairs (ADEMA). The planning team elected not to use a consultant given that the 2012 plan would serve as the basis for revisions. PCOEM took the lead in recruiting participants, conducting Planning Team meetings, tracking progress, editing documents, and keeping the project on schedule. Jurisdictional Local Planning Teams were responsible for evaluating and updating the sections of the plan for their respective jurisdictions and supporting Pima County in the completion of the plan as a whole. Details regarding key contact information and promulgation authorities, the planning team selection, participation, activities, and public involvement are discussed in the following sections.

3.2 Planning Activities and Teams

The role of the Planning Team was to facilitate the coordination, research, and planning element activities to update the 2012 Plan. Four multi-jurisdictional planning team meetings were conducted over the period of May through October of 2016, beginning with the first meeting on May 12, 2016. A separate meeting was held with multi-jurisdictional planners and their Geographical Information System (GIS) representatives to work exclusively on maps and data. Representatives from each jurisdiction were required to participate in all Planning Team meetings, as the meetings were structured to take the jurisdictions through a systematic planning process. At each meeting, next-steps and procedures were presented and discussed, progress was reported, and action items assigned. Subsequent meetings built on the information discussed previously and on the individual assignments completed between meetings.

The Planning Team took on the following primary responsibilities:

- Conveying information and assignments to the jurisdictional Local Planning Teams (LPTs) of which several jurisdictions organized for specific plan parts or for mitigation ideas and members are noted below,
- Ensuring all requested assignments were completed fully and returned on a timely basis, and
- Arranging for review and official adoption of the final Plan.

To support the Planning Team, the Jurisdictional Local Planning Teams were tasked with:

- Convening meetings as needed to work through assignments from the Planning Team,
- Providing support and data,
- Developing and refining mitigation strategies,
- Assisting with the prioritization of hazards and plan objectives,
- Assisting the Planning Team representatives with assignments,
- Making planning decisions regarding Plan components, and
- Reviewing the Plan draft documents.

The planning process for Pima County's Multi-Jurisdictional Hazard Mitigation Plan followed FEMA's 4-phase Disaster Mitigation Act (DMA) planning process:

1. Organize Resources
2. Assess Risks
3. Develop the Mitigation Plan
4. Implement the Plan and Monitor Progress

Cultivating a well-rounded, representative Planning Team was the responsibility of the PCOEM. Using the list of Planning Team Participants from the 2012 Plan as a guide, the PCOEM identified a list of potential participants and contributors to the 2017 Update Planning Team. PCOEM initiated contact with and extended invitations to participate

to jurisdictional representatives and agencies from all incorporated communities within Pima County, the Pascua Yaqui Tribe and the Tohono O'odham Nation.

The participating members of the Planning Team are summarized in Table 3-1. Copies of invited individuals and attendance sheets are in Appendix C Planning Process Documents.

Table 3-1: Planning Team Participants

(participants in **bold** returning members)

Name	Jurisdiction / Organization	Planning Team Role
Ackerman, Char	Town of Oro Valley Police Department Emergency Management	Planning Team Member, Jurisdictional Point of Contact, Local Planning Team Lead
Austin, Susan (Wood)	AZ Department of Emergency and Military Affairs	State Planning Manager, Management level support for planning effort, Mitigation strategy development
Bear, Courtney	Pima County Office of Emergency Management	Lead Planner
Bowen, Sheila	Town of Sahuarita Public Works Director	Planning Team member, Jurisdictional Point of Contact and Local Planning Team Lead
Carbajal, Manny	Town of Marana	Planning Team member, Jurisdictional Point of Contact, Local Planning Team Lead
Espinoza, Sandra	Arizona Department of Emergency and Military Affairs	DEMA representative for Southern Arizona, Planning Team member
Glenn, Erik	Pima County Information Technology	Planning Team Member, GIS Lead for the County
Groseclose, Sgt. Brian	Sahuarita Police Department	Planning Team member, Jurisdictional Point of Contact
Horton, Jeff	Tucson Airport Authority	Planning Team member, Tucson Airport Authority representative
Johnson, Sgt. Steven	Marana Police Department	Planning Team Member, Jurisdictional Point of Contact
Matus, Andre	Pascua Yaqui Tribe / Pascua Pueblo Fire Department	Planning Team Member, Lead Jurisdictional Point of Contact, Local Planning Team Lead
McGlone, Sgt. Matt	Sahuarita Police Department	Jurisdictional Point of Contact and Lead Planner for Sahuarita
Moya-Flores, Griselda	Pima County Office of Emergency Management	Planning Team member, Administrative
Nicolas Siemsen	City of Tucson / Office of Emergency Management	Jurisdictional Point of Contact and Lead Planner for City of Tucson
Rodriguez, Bernice	Pascua Pueblo Fire Dept.	Planning Team Member, Local Planning Team Administration for Pascua Yaqui Tribe

An integral part of the planning process was working with other agencies and organizations, both within and outside of the participating jurisdiction's governance, to obtain specialized information and data for inclusion into the Plan or

to provide more public exposure to the planning process. In addition to the adopting jurisdictions, several agencies and organizations that operate within, or have jurisdiction over small and large areas of Pima County were invited to participate in the planning process. Some were invited to the first Planning Team meeting, while others were brought in as the Planning Team discovered a need for their assistance. Copies of the various meeting invitations are provided in Appendix B.

Those others agencies and organizations who assisted by providing data or otherwise contributing to this Plan are listed in Table 3-2. The specific jurisdiction with whom they collaborated is noted.

Table 3-2: Local Planning Team and Content Resources

(participants in **bold** returning members)

Name	Agency/Dept./Division	Role/Contribution
Abdelrasoul, Abdo	Town of Oro Valley	Local Planning Team Member GIS Support
Bender, Cheryl	American Red Cross	Sheltering and Community Organizations Active in Disaster
Bonser, Colby	Pima County Office of Sustainability and Conservation	Climate resource
Boyce, Karn	Town of Oro Valley Water Utility	Local Planning Team Member Buffelgrass Program
Boyer, Chuck	Town of Oro Valley IT Director	Local Planning Team Member
Brandhuber	Golder Ranch Fire Department	Local Planning Team Member for Oro Valley for wildfire expertise
Bradshaw, Gary	City of Tucson Fire Department	City of Tucson Representative
Canale, Brett	Marana GIS	Local Planning Team member
Casertano, Paul	Pima Association of Governments	Community description, Transportation and traffic
Chalmers, Seth	Pima County DOT	Local Planning Team member, Traffic and transportation for Pima County
Chavez, Kathy	Pima County Office of Sustainability	Local Planning Team Member
D'Entremont, Andy	Pima County Office of Emergency Management	Local Planning Team member
Drozd, Ken	NOAA	Climate and weather expert
Faas, Jim	Pima County Finance and Risk Management	Pima County finance information
Fontes, Antonio	Pascua Yaqui Tribe	Local Planning Team member, GIS representative for Pascua Yaqui Tribe
Geitner, Ian	Pascua Land Use	Land use planning for Pascua Yaqui Tribe
Groseclose, Sgt. Brian	Sahuarita Police Department	Planning Team member, Jurisdictional Point of Contact
Hamblin, Elisa	Town of Oro Valley Community Development and Public Works	Local Planning Team Member Long-range Principal Planner

Table 3-2: Local Planning Team and Content Resources

(participants in **bold** returning members)

Name	Agency/Dept./Division	Role/Contribution
Hammarstrom, Cptn. Mike	City of Tucson Police Dept.	Local Planning Team member, City of Tucson representative
Helfrich, Thomas	Pima County Flood Control District	Local Planning Team, Flood control
Hoppe, Jamie	Town of Oro Valley Community Development and Public Works	Local Planning Team Member Adopt-a-Wash Program
Horton, Jeff	Tucson Airport Authority	Planning Team member, Tucson Airport Authority representative
Huelle, Cheryl	Town of Oro Valley Community Development and Public Works	Local Planning Team Member Hazard Mitigation Project identification
Jacobs, Amanda	Town of Oro Valley Town Manager's Office	Local Planning Team Member Community Description
Jamarta, Julie	Pima Association of Governments	Population data and community description assistance
Karazs, Sarah	Arizona DOT	Environmental planning resource
Karlik, Jay	Rural/Metro Fire District / Fire Dept.	Local Planning Resource
Khawam, Yves	Pima County Development Services	Local Planning Team member, Code and enforcement resource
King, Chuck	Town of Oro Valley Community Development and Public Works Building Manager	Local Planning Team Member Ordinances, laws and codes
Kosiorowski, Joey	Green Valley Fire District	Local Planning Team member
Ladd, Keith	University of Arizona	Climate resource
Langdale, Paul	Arizona DOT	Environmental Planning
Lauber, Brian	Arizona Division of Forestry	Wildland fire information
Lee Muscarella, Lee	Golder Ranch Fire District Battalion Chief	Local Planning Team resource for Oro Valley
Lynn, Judy	Pima County Office of Emergency Management	Local Planning Team Member, Community Outreach, Public Information assistance
Mercer, Rita	Pima County Regional Wastewater Reclamation	Local Planning Team member, Wastewater, AZWARN
Miranda, Richard	Pima County Regional Wastewater Reclamation	Local Planning Team member, Wastewater, AZWARN
Moore, Mark	Town of Oro Valley Water Utility	Local Planning Team Member Water authority input on hazards and mitigation actions

Table 3-2: Local Planning Team and Content Resources

(participants in **bold** returning members)

Name	Agency/Dept./Division	Role/Contribution
Nassi, Richard	Pima Association of Governments-Transportation	Community description, Transportation and traffic
Orchard, Lynn	Pima County Regional Flood Control	Advisory information for flood hazard and notifications
Padilla, Robert	Pima County Natural Resources/Parks & Rec	Local Planning Team member, Parks and Rec information
Porter, Scott	Pima County Environmental Quality	Local Planning Team member, environmental resource
Ramsey, Aimee	Town of Oro Valley Community Development and Public Works Assistant Director	Local Planning Team Member General support
Riley, Kara	Oro Valley Police Department	Local Planning Team Member Public information and notice
Robinson, Julie	Pima County Office of Sustainability	Local Planning Team member, Climate resource
Rodriguez, Jose	Town of Oro Valley Community Development and Public Works Managing Engineer	Local Planning Team Member Hazard mitigation actions and projects development
Rutherford, Tony	Mountain Vista Fire District	Local Planning Team Member, wildfire hazard and mitigation projects
Saxe, Greg	Pima County Regional Flood Control	Local Planning Team member, Flood Hazard lead
Selover, Nancy	Arizona State University- Arizona State Climate Office	Climate expert
Shepp, Eric	Pima County Regional Flood Control	Local Planning Team member for Pima County, Flood information source
Smith, Allen	City of Tucson Police Dept.	City of Tucson representative
Thum, Gabe	Pima Association of Governments-Transportation Safety	Planning and demographics
Todnem, Mike	Oro Valley	Local Planning Team member
Valenzuela, Louis	Pima County Health Dept.	Local Planning Team, Health Department representative
West, Gary	Northwest Fire Department	Local Planning Team member
Wittenberg, Dan	Kinder Morgan	Industry representative
Youberg, Ann	State of Arizona- AZ Geological Survey	Geological expertise, Landslide specialist

3.3 Public and Stakeholder Involvement

Public involvement and input to the planning process was encouraged cooperatively among all of the participating jurisdictions using several venues throughout the course of the pre-draft planning. This Plan will remain on the County website on a continual basis.

The pre-draft public involvement strategy for the Plan development included press releases, and public web notices. The 2012 Plan was posted to the County website and made available for public review and comment. The local jurisdictions placed announcements on their websites linking the reader to the Plan on the County website. The post-draft strategy included posting the draft plan to the County website, with website links from local jurisdictions, and requesting public comment. Documentation of the outreach can be found in this Plan's appendices.

Tribal Definition of "Public"

The Pascua Yaqui Tribe has formulated the following statement to define "public" for the purposes of this planning effort to satisfy the Tribal Planning requirements:

"All residents of the Pascua Yaqui Reservation, as its boundaries may be revised from time to time."

Table 3-3: Past Public and Stakeholder Involvement

Jurisdiction	Activity or Opportunity
Pima County	• Maintained the county website that included the current Plan and provided contact information for continued comment and input. • Sought and managed a mitigation grant for Buffelgrass reduction. • Developed brochures regarding local threats in conjunction with the PCOEM website. • Attended community events and engage with the public on mitigation and preparation activities. • Conducted Emergency Management meetings with local emergency management professionals on a quarterly basis, and discussed hazard mitigation events. • Worked with Pima Regional Flood Control on Community Rating System requirements such as planning and exercising. • Maintained social media presence and focus on mitigation measures that citizens can take before monsoon and fire seasons.
City of Tucson	• City of Tucson Office of Emergency Management webpage was dedicated to preparedness and mitigation topics. • Performed annual "Operation Splash" outreach efforts to raise awareness of the dangers of driving through flooded washes and roadways. • Performed annual "Operation Freeze" outreach efforts to raise awareness of the dangers of cold and freezing weather. • Used the "Don't Get Swept Away, Find a Safer Place to Play" campaign to encourage people to avoid flooded washes and other storm water infrastructure during the monsoon season. • The Tucson Office of Emergency Management regularly used social media sites to share preparedness and mitigation information to the public. • Declaration signed by the Mayor and Council of September Preparedness Month, with public preparedness outreach at public events, via social media, on television, etc. • Regular water conservation outreach efforts from Tucson Water Department via bill inserts, social media, television, etc. • Weekly preparedness and safety tips via the Tucson Fire Department posted online and aired on television. • Provided preparedness and mitigation brochures and pamphlets to each of the six City Council ward offices for their constituents, along with an orientation for Council staff on the mission of emergency management including mitigation efforts.

Table 3-3: Past Public and Stakeholder Involvement

Jurisdiction	Activity or Opportunity
Town of Oro Valley	• Provided Water Conservation Messaging in Quarterly Town Newsletter. • Developed Media Release regarding pipe safety during cold weather. • Banned fireworks during dry months. • Signed a Town Proclamation in recognition of Beat Back Buffelgrass Day. • News release recognizing the Town of Oro Valley as having a NOAA Stormready designation. • Offered SKYWARN Weather Spotter Training in the Town of Oro Valley. • Signed a Town Proclamation declaring September National Preparedness Month. • Town of Oro Valley webpage was dedicated to water information and tips. • Provided hazard awareness information to residents through newsletters, social media, PSAs, website, brochures, neighborhood meetings, community events, and other. • Conducted presentations to the public about hazards and disaster preparedness. • Provided floodplain related information to targeted properties in high-risk areas. • Provided staff support and technical guidance to homeowners, businesses, and HOAs about flood mitigation projects on private property. • Expanded public participation in the Adopt a Street/Wash program.
Town of Marana	• Provided information to the public, business and first responders by participating in the Local Emergency Planning Committee (LEPC) for hazardous materials preparedness. • Provided floodplain related hazard and mitigation information to targeted properties in high-risk areas. • Provided flood hazard outreach to residents of the Town of Marana, located within the flood plain. • Created brochures for building within the flood plain. • Created a Town-wide Spill Control Plan, with flow chart to help Town employees and residents follow a simple plan for hazardous material spills. • Acquired a Small Quantity Generator (SQG) designation from the City of Tucson - Household Hazardous Waste (HHW) Facility for proper disposal of small quantities of hazardous waste. • Implemented Mandatory Storm Water Management Awareness Training for all Town employees, as mandated by (Small MS4 Permit) - (Marana SWMP) 6.3.6 Employee Training • Provided a library of pamphlets in the Marana Municipal Complex (MMC) Lobby area for all interested parties to peruse and take for reference. • During the 2016 General Plan meeting, the Town Emergency Management Coordinator distributed brochures on hazard mitigation and individual preparedness as part of public outreach.
Pascua Yaqui	• Continued mitigation activities in correlation to the Pascua Yaqui Tribe Improvement Projects program. • Referenced the plan on the Pascua Yaqui Intranet/Intranet and on Yaqui Radio Station PSAs. • The Pascua Yaqui Tribe continued to use the plan for reference for profiling of cultural sites for economic development. • The Pascua Yaqui Department of Public Safety, who oversees mitigation planning, has supported the plan by referencing the plan with other tribal departments for grants and infrastructure improvement opportunities. In 2016, the plan was referenced in the development of accreditation for the Tribal Health Department. • During Tribal Recognition Days, an information booth was set up to promote mitigation opportunities and hazard reduction.

Table 3-3: Past Public and Stakeholder Involvement	
Jurisdiction	**Activity or Opportunity**
Town of Sahuarita	• The Sahuarita Strategic Plan for Emergency Preparedness and the Sahuarita Emergency Operations Plan were posted on the website. • "Be Prepared" brochures were available at Town Hall to interested constituents. • Copies of Strategic Plan for Emergency Preparedness and Sahuarita Emergency Operations Plan maintained on town website.

Table 6-1 summarizes opportunities for continued public engagement and dissemination of information each jurisdiction plans to pursue when relevant and appropriate.

3.4 Reference Documents and Resources

Additional reference material, such as other plans, studies, reports, and technical information, was obtained during the planning process and reviewed for incorporation or reference in the updated plan. The majority of the additional reference material pertained specifically to the risk assessment and the capabilities assessment. To a lesser extent, the community descriptions and mitigation strategy also benefitted from additional document and technical information research. Table 3-4 provides a reference listing of the primary resource documents and technical resources reviewed and used in the Plan. Detailed bibliographic references for the risk assessment are provided in each hazard risk profile in Section 4 as footnotes.

Table 3-4: Resource documents reviewed and incorporated in this plan	
Resource	**Description of Reference and Its Use**
AZ Department of Commerce	Reference for demographic and economic data for the county. Used for community descriptions
AZ Department of Administration	Reference for demographic and employment data for the county used in the community descriptions.
AZ Department of Emergency and Military Affairs	Resource for state and federal disaster declaration information for Arizona. Also a resource for hazard mitigation planning guidance and documents.
AZ Department of Water Resources	Resource for data on drought conditions, statewide drought management, and land subsidence all used in risk assessment.
AZ Geological Survey	Resource for earthquake, fissure, landslide/mudslide, subsidence, and other geological hazards. Used in the risk assessment.
AZ Model Local Hazard Mitigation Plan	Guidance document for preparing and formatting hazard mitigation plans for Arizona.
AZ State Department of Forestry and Fire Management	Source for statewide GIS coverage (ALRIS) and statewide wildfire hazard profile information. Used in the risk assessment for wildland fire.
AZ Drought Monitoring Technical Committee	Source for statewide drought information including monthly drought monitor reports.
AZ Wildland Urban Interface Assessment (2004)	Source of wildfire hazard profile data and urban interface at-risk communities. Used in the risk assessment.
Bureau Net (2017)	Source for NFIP statistics for Arizona.
Census Bureau	Source for 2010 and 2015 Census demographics
Federal Emergency Management Agency	Guidance (How-To series) for floodplain and flooding related NFIP data (mapping, repetitive loss, NFIP statistics), and historic hazard incidents. Used in the risk assessment and mitigation strategy.
HAZUS-MH	Based data sets within the program were used in the vulnerability analysis.

Table 3-4: Resource documents reviewed and incorporated in this plan

Resource	Description of Reference and Its Use
National Climatic Data Center	Online resource for weather related data and historic hazard event data. Used in the risk assessment.
National Weather Service	Source for hazard information, data sets, and historic event records. Used in the risk assessment.
National Wildfire Coordination Group	Source for historic wildfire hazard information. Used in the risk assessment.
Pima Co Hazard Mitigation Plan (2012)	FEMA approved hazard mitigation plan that is the subject of the plan update process.
Arizona State Climatologist	Reference for weather characteristics for the county. Used for community descriptions and risk assessment.
National Fire Protection Association NFPA 1600: Standard on Disaster/ Emergency Management and Business Continuity Programs (2016)	Used to establish the classification and definitions for the asset inventory. Used in the risk assessment.
State of Arizona Hazard Mitigation Plan (2013)	The state plan was used a source of hazard information and the state identified hazards were used as a starting point in the development of the risk assessment.
USACE Flood Damage Report (1978)	Source of historic flood damages for 1978 flood. Used in the risk assessment.
USACE Flood Damage Report (1994)	Source of historic flood damages for 1993 flood. Used in the risk assessment.
US Forest Service	Source for local wildfire data. Used in the risk assessment.
US Geological Survey	Source for geological hazard data and incident data. Used in the risk assessment.
Western Regional Climate Center	Online resource for climate data used in climate discussion

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SECTION 4: RISK ASSESSMENT

4.1 Section Changes

For the 2017 revision, the Planning Team spent considerable time discussing hazards and the distinction between human-caused and natural hazards. Because of these discussions and upon consideration of the hazards in the sphere of mitigation of natural hazards, several significant changes have been made to the Hazard Risk Profiles. Table 4-1 compares the hazards of previous plans to those chosen by the current Planning Team for 2017. In general, human-caused hazards have been removed from the 2017 plan.

One of the key elements to the hazard mitigation planning process is the risk assessment. In performing a risk assessment, a community determines "what" can occur, "when" (how often) it is likely to occur, and "how bad" the effects are, are generally categorized into the following measures:

Hazard Identification and Screening

Hazard Profiling

Assessing Vulnerability to Hazards

The risk assessment for Pima County and participating jurisdictions was performed using a countywide, multi-jurisdictional perspective, with much of the information gathering and development being accomplished by the Planning Team. This integrated approach was employed because many hazard events are likely to affect numerous jurisdictions within the County and are not often relegated to a single jurisdictional boundary. The vulnerability analysis was performed in a way such that the results reflect vulnerability at an individual jurisdictional level and at a countywide level. For the majority of the hazards, quantitative vulnerability was removed and a qualitative vulnerability created by each of the jurisdictions for the hazards that they identified as priorities in their area.

4.2 Hazard Identification

Hazard identification is the process of answering the question; *"What hazards can and do occur in my community or jurisdiction?"* For this Plan, the list of hazards identified in the 2012 Plan were reviewed by the Planning Team with the goal of refining the list to reflect the hazards that pose the greatest risk to the jurisdictions represented by this Plan.

Table 4-1: Comparison of Plan Hazards

2007 Hazards for Plan	2012 Hazards for Plan	2017 Hazards for Plan
• Dam Failure • Disease • Drought • Extreme Heat • Flood • Hail • HAZMAT • Lightning • Subsidence • Thunderstorm • Tornado • Tropical Cyclone • Wildfire • Winter Storm	• Disease • Drought • Earthquake • Extreme Heat • Flood • HAZMAT • Levee Failure • Severe Wind • Subsidence • Wildfire • Winter Storms	• Drought • Earthquake • Extreme Cold • Extreme Heat • Flood • Landslide • Severe Wind • Wildfire

The review included an initial screening process to evaluate each of the listed hazards based on the following considerations:

- Experiential knowledge on behalf of the Planning Team with regard to the relative risk associated with the hazard;
- Documented historic context for damages and losses associated with past events (especially events that have occurred during the last plan cycle);
- The ability/desire of Planning Team to develop effective mitigation for the hazard under current DMA 2000 criteria;
- Compatibility with the state hazard mitigation plan hazards; and
- Duplication of effects attributed to each hazard.

Each jurisdiction evaluated and rated the hazards using the Calculated Priority Risk Index (CPRI) and met to discuss results amongst the jurisdictions after they had chosen hazards for their jurisdiction to address. Because of planning discussions, four hazards were deleted and one hazard was added as seen in Table 4-1. Additionally, Winter Storm was updated and revised to Extreme Cold. Below is a summary of those decisions for adding or removing a particular hazard by the main Planning Team:

- Disease was removed as a hazard in 2017 because the mitigation actions chosen during the last planning cycle were all planning or response actions. A lengthy discussion on whether or not disease is natural or human-caused also factored in the decision. Ultimately, since the Pima County Health Department has plans for disease outbreaks that include prevention and mitigation actions, it would be duplicative effort to keep Disease in this Plan.

- Hazards Materials were removed because it is normally a human-caused disaster and there are other plans, procedures and guidelines for hazardous materials in Pima County. The Pima County Local Emergency Planning Committee handles mitigation, prevention, preparedness, response and recovery with participants from local government agencies, business and academia.

- Levee failure was removed because none of the jurisdictions chose it as a priority hazard and most of the actions were taken due to following established rules and regulations. To describe flood issues in Pima County accurately, the Levee hazard was removed and pertinent information moved to the Flood hazard.

- Subsidence was removed because none of the Planning Team representatives felt that this was something that could be mitigated separately from the Drought hazard. In addition, the Arizona Department of Water Resources has found that land subsidence rates within the Phoenix and Tucson areas have decreased between 25% and 90% compared to the 1990s[1]. This reduction is credited to increased management including reduced groundwater pumping, increased recharge.

- Landslide was added as a hazard after discussions with the Arizona Geological Survey and the Pima County Department of Transportation in one of the first planning meetings. Unincorporated Pima County felt that landslides are a hazard that can be addressed locally through mitigation actions.

- Winter Storm was revised to become Extreme Cold. There were several discussions at planning meetings about the confusion between Winter Storm, Extreme Cold, Severe Wind and Flooding. Initially it was decided that Winter Storm would stay in, but only the City of Tucson rated it as a hazard worth addressing. Upon looking at their mitigation action, it was clear it was an action for Extreme Cold. The decision was made that jurisdictions could run the CPRI for Extreme Cold and decide if they would like to address it as a priority hazard.

Individual jurisdictions also prioritized hazards and removed some from their chosen focus. They did this at the Local Planning Team level or individually by consulting with knowledgeable individuals in their jurisdictions. Below is a summary of changes for the 2017 Plan:

[1] AZ Department of Water Resources, Land Subsidence Report #3, 2017: http://www.azwater.gov/AzDWR/Hydrology/Geophysics/documents/ADWRLandSubsidenceMonitoringReport_Number3_Final.pdf

- When reviewing their hazards, the Town of Oro Valley has identified that current resource allocation for winter storm hazards are focused primarily on preparedness or response type activities that are part of routine and annual operations.
- The Pascua Yaqui Tribe removed Drought as a hazard for being no longer necessary as their Tribal Land Department and the Bureau of Indian Affairs resources determined that they do not have sustainable water resources and at this time, resources can be focused on a more addressable hazard. They also removed Earthquake as they felt it was covered by the Arizona Geological Survey and Pima County as a whole. They removed Severe Wind as building codes are enforced by their Tribal Buildings Inspections group and as a result improved construction techniques that have reduced their vulnerability to the hazard.
- Sahuarita removed Wildfire as it did not rank high on the hazard and risk analysis and they are a part of the Pima County Community Wildfire Protection Plan (PCCWPP). They felt that latter was sufficient for addressing the hazard in their community.

The table below summarizes federal and state disaster declarations that included Pima County. If a hazard is not listed, that means there were no events reported for that hazard.

Table 4-2: Pima County Declared Disaster Costs (1991 – 2016)

INCIDENT		DECLARATION DATE		STATE DECLARATION	STATE	FEDERAL
TYPE	DISASTER AREA	STATE	FEDERAL	TERMINATED	EXPENDITURES	EXPENDITURES
Flooding	Statewide Flood All Counties except La Paz, Mohave	08-Jan-93		15-Nov-02	$ 30,072,157.03	$ 104,069,362.11
Flooding	Pima County Flash Flood Emergency Pima County	16-Aug-99		23-Feb-00	$ -	
Severe Wind, Flooding	Gila Bend/Ajo Storm Emergency Maricopa & Pima County	17-Aug-01		19-Feb-02	$ 14,237.94	
Wildfire	Aspen Fire Pima & Pinal County	19-Jun-03	14-Jul-03	09-Jun-11	$ 675,568.52	$ 5,363,459.27
	Mediterranean Fruit Fly Emergency La Paz, Pima, Santa Cruz & Yuma	23-Sep-04		16-Sep-05	$ 197,421.08	
	Border Security Emergency Cochise, Pima, Santa Cruz & Yuma	15-Aug-05		19-May-09	$ 1,492,758.44	
Flooding	Flash Flood Emergency Pima County	16-Sep-05		07-Feb-08	$ 256,948.47	
	Glassy-Winged Sharpshooter Inf. Cochise, Yuma, Pima, Pinal, Maricopa & Santa Cruz	23-Jun-06		19-May-09	$ 567,257.48	
Severe Wind, Flooding	Monsoons & Flooding Pinal, Pima, Gila, Graham, Greenlee, Navajo	08-Aug-06	07-Sep-06		Est. $ 2,409,278.00	$ 12,141,752.40
Flooding	January 2008 Severe Precipitation Emergency - Pima County	19-Feb-08		28-Jan-11	$ 231,798.65	
Winter Storm	January 2010 Severe Winter Storm				Est.	Est.
	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
				Totals	$ 40,415,320.61	$ 135,785,477.78

Source: AZDEMA Emergency Declarations 1966 to Present, 2017 https://dema.az.gov/emergency-management/operationscoordination/recovery-branch/infrastructure

4.3 Vulnerability Analysis Methodology

General

The following sections summarize the methodologies used to perform the vulnerability analysis portion of the risk assessment. For this Plan, the entire vulnerability analysis was either revised or updated to reflect new hazard categories, the availability of new data, or differing loss estimation methodology. Individual jurisdictions discuss their vulnerably to chosen hazards in the appropriate section.

Calculated Priority Risk Index (CPRI) Evaluation

The first step in the vulnerability analysis (VA) is to assess the perceived overall risk for each of the plan hazards using the Calculated Priority Risk Index (CPRI). The CPRI value is obtained by assigning varying degrees of risk to four categories for each hazard, and then calculating an index value based on a weighting scheme. Table 4-3 summarizes the CPRI risk categories and provides guidance regarding the assignment of values and weighting factors for each category. Table 4-4 summarizes the CPRI results for each jurisdiction and unincorporated Pima County. In addition to Table 4-4, each hazard section has a CPRI table where the jurisdictions in bold have chosen that hazard for the 2017 Plan.

Table 4-3: Calculated Priority Risk Index Categories and Risk Levels

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	▪ Extremely rare with no documented history of occurrences or events. ▪ Annual probability of less than 0.001.	1	45%
	Possibly	▪ Rare occurrences with at least one documented or anecdotal historic event. ▪ Annual probability that is between 0.01 and 0.001.	2	
	Likely	▪ Occasional occurrences with at least two or more documented historic events. ▪ Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	▪ Frequent events with a well-documented history of occurrence. ▪ Annual probability that is greater than 0.1.	4	
Magnitude/ Severity	Negligible	▪ Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses are treatable with first aid and there are no deaths. ▪ Negligible quality of life lost. ▪ Shut down of critical facilities for less than 24 hours.	1	30%
	Limited	▪ 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 and there are no deaths. ▪ Moderate quality of life lost. ▪ Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	▪ 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 one death.	3	

Table 4-3: Calculated Priority Risk Index Categories and Risk Levels

		▪ Shut down of critical facilities for more than 1 week and less than 1 month.		
	Catastrophic	▪ Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses result in permanent disability and multiple deaths. ▪ Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self-explanatory.	4	15%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	More than 24 hours	Self-explanatory.	1	
Duration	Less than 6 hours	Self-explanatory.	1	10%
	Less than 24 hours	Self-explanatory.	2	
	Less than one week	Self-explanatory.	3	
	More than one week	Self-explanatory.	4	

Table 4-4: Hazards To Be Mitigated By Each Jurisdiction 2017

Jurisdiction	Drought	Earthquake	Extreme Cold	Extreme Heat	Flood	Landslide	Severe Wind	Wildfire
Unincorporated Pima County	x			x	x	x	x	x
Marana					x			x
Oro Valley	x			x	x			x
Pascua Yaqui Tribe				x	x			x
Sahuarita	x			x	x			
South Tucson	No data provided							
Tucson	x	x	x	x	x		x	

Asset Inventory

A detailed asset inventory was performed for the 2012 Plan to establish an accurate baseline data set for assessing the vulnerability of each jurisdiction's assets to the hazards previously identified. The Planning Team did not feel it was value added to update the inventory from the 2012 version, as the resource of a full time intern or a consultant to work on the data was no longer available. Pima County OEM obtained the critical infrastructure dataset from the Department of Homeland Security, but was unable to use the data in HAZUS. The Pima County Geographical Information System

team member was unable to integrate the data in a meaningful way. The only hazard that contains this information is the Flood Hazard Section 4.4.5 and a detailed explanation of the data is there.

Loss Estimations

The hazards profiled in this Plan revision may not include quantitative exposure and loss estimates. The vulnerability of people and assets 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. Loss estimations for Flood to meet National Flood Insurance Program requirements and are updated in the 2017 revision.

Development Trend Analysis

The updated analysis will focus on the potential risk associated with projected growth patterns and their intersection with the Plan identified hazards.

Specifically for the Pascua Yaqui Tribe, a new subdivision of 30 homes is in development. As this is a HUD project, the new homes will have safe zones around them for the wildfire urban interface. They are also working with their Land and Development, Facilities Management, and Housing Department to make sure the development has adequate drainage and infrastructure to reduce flood hazards. The Housing Department has increased the standard for windows and insulation and other construction materials to reduce the exposure to extreme temperatures with energy efficient design and construction. Cultural and sacred sites are of high priority to the Pascua Yaqui Tribe and special attention is needed when considering hazard mitigation of these areas. Because of their cultural importance, these sites require special attention and protection. Normally, the Tribe does not share the location of these sites and areas. For this reason, these sites and areas will not be included in this Plan. The Pascua Yaqui Tribe will ensure within its internal planning efforts that these sites and areas are included in their mitigation activities.

4.4 Hazard Risk Profiles

The following sections summarize the risk profiles for each of the Plan hazards identified in Section 4.1. For each hazard, the following elements are addressed to present the overall risk profile:

- **Description**
- **History**
- **Probability and Magnitude**
- **Vulnerability**
  - **CPRI Results**
  - **Loss Estimations**
  - **Development Trends**

Much of the 2017 Plan data has been updated, incorporated and/or revised to reflect current conditions and Planning Team changes. Historic discussions for each hazard are limited to state and county impacts; however, jurisdictions may discuss historical events in their vulnerability statements.

The Environmental Risk and Vulnerability tables were an Emergency Management Accreditation Program (EMAP) requirement, so it has been removed from each section since the County is not seeking EMAP accreditation at this time.

4.4.1 Drought

Description

Drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. Drought is a temporary aberration from normal climatic conditions, thus it can vary significantly from one region to another. Drought is different from aridity, which is a permanent feature of climate in regions where low precipitation is the norm, as in a desert.[1]

Drought is a complex natural hazard on which human factors, such as water demand and water management, can exacerbate the impact. The following are three commonly used definitions[1]:

- Meteorological drought is usually defined based on the degree of dryness, as compared to some "normal" or average, and the duration of the dry period.
- Hydrological drought usually occurs following periods of extended precipitation shortfalls that affect water supplies such as stream flows, reservoir and lake levels or groundwater.
- Agricultural drought links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, sol water deficits, reduced ground water or reservoir levels needed for irrigation, and so forth.

The effects of drought increase with duration as more moisture-related activities are impacted. Non-irrigated croplands are most susceptible to precipitation shortages. Rangeland and irrigated agricultural crops many not respond to moisture shortage as rapidly, but yields during periods of drought can be substantially affected. During periods of severe drought, lower moisture in plant and forest fuels create an increased potential for devastating wildfires. In addition, lakes, reservoirs, and rivers can be subject to water shortages that affect recreational opportunities, irrigated crops, and availability of water supplies for activities such as fire suppression and human consumption, and natural habitats of animals. Socioeconomic effects include higher unemployment and lower land values. Insect infestation can also be particularly damaging impact from severe drought conditions.

History

Arizona has been in a state of long-term drought for approximately 21 years according to the 2015 Arizona Department of Water Resources 2015 Arizona Drought Preparedness Annual Report[2]. Figure 4-1 depicts the most recent precipitation data from NCDC regarding average statewide precipitation variances from normal.

1 National Weather Service. (2008, May). *Drought Public Fact Sheet*. Retrieved 2016, from http://www.nws.noaa.gov/os/brochures/climate/DroughtPublic2.pdf

2 ADWR's 2015 Arizona Drought Preparedness Annual Report, http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/documents/2015ADPReport.pdf

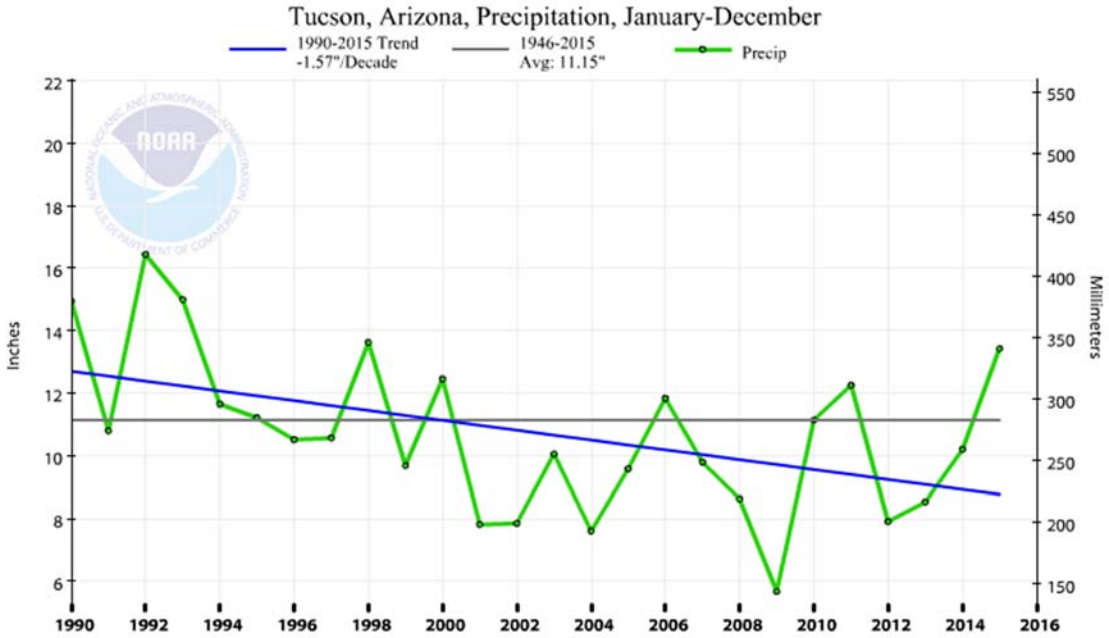


Figure 4-1: Tucson average precipitation variances based on 1990-2015 trend

Probability and Magnitude

There is no commonly accepted return period or non-exceedance probability for defining the risk from drought (such as the 100-year or 1% annual chance of flood). The magnitude of drought is usually measured in time and the severity of the hydrologic deficit. There are several resources available to evaluate drought status and even project expected conditions for the very near future.

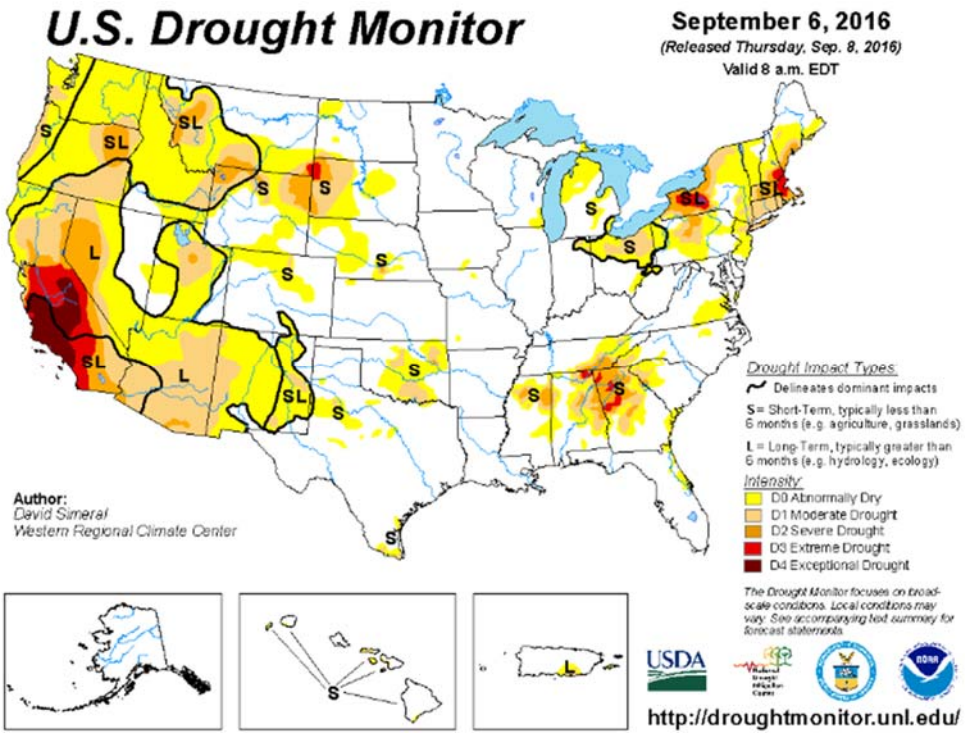
The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning[1]. The NIDIS maintains the U.S. Drought Portal[2], which is a centralized, web-based access point to several drought related resources including the U.S. Drought Monitor (USDM) and the U.S. Seasonal Drought Outlook (USSDO). The USDM, shown in Figure 4-2, is a weekly map depicting the status of drought and is developed and maintained by the National Drought Mitigation Center. The USSDO, shown in Figure 4-3, is a six-month projection of potential drought conditions developed by the National Weather Service's Climate Prediction Center. The primary indicators for these maps for the Western U.S. are the Palmer Hydrologic Drought Index and the 60-month Palmer Z-index. The Palmer Drought Severity Index (PSDI) 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 consistent enough to characterize the risk of drought on a nationwide basis[3] and neither of the Palmer indices are well suited to the dry, mountainous western United States.

Due to climate variability, there is a likelihood of continuously higher temperatures and below normal precipitation, all aiding in drought conditions. The local vulnerability depends on duration, intensity, geographic extent, and regional water supply demands by humans and vegetation.

[1] National Integrated Drought Information System, 2007, *National Integrated Drought Information System Implementation Plan*, NOAA.

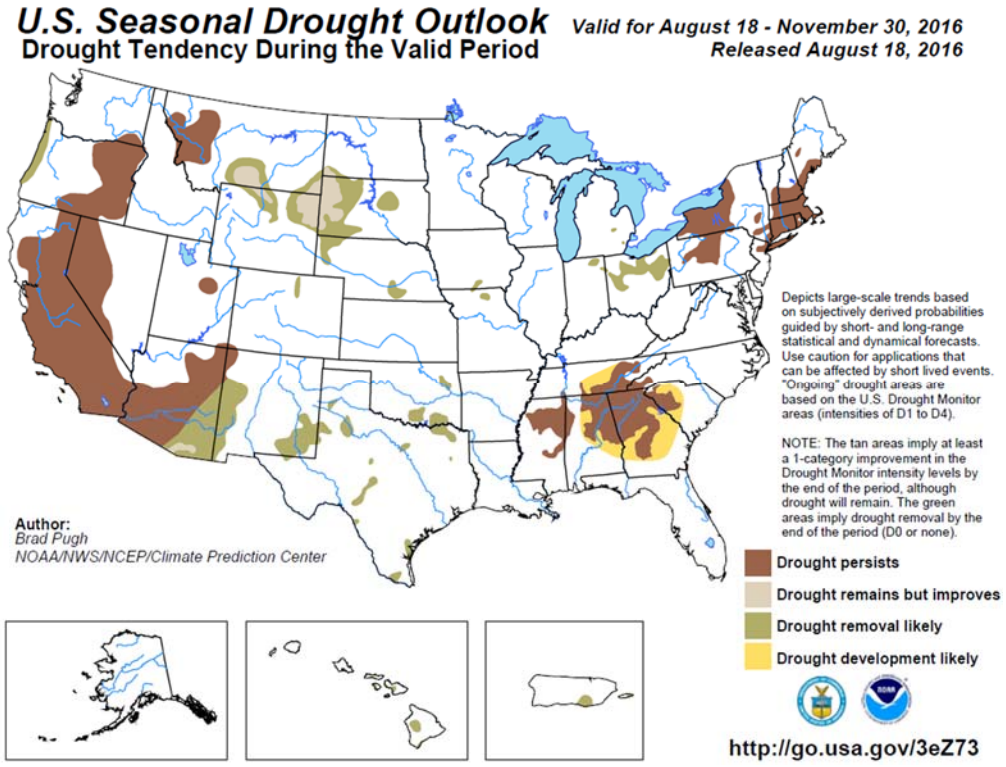
[2] NIDIS U.S. Drought Portal website is located at: https://www.drought.gov/drought/home

[3] Federal Emergency Management Agency, 1997, *Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy.*



Source: United States Drought Monitor, 2016: http://droughtmonitor.unl.edu/

Figure 4-2: U.S. Drought Monitor for September 2016



Source: Source NOAA, 2016: http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.pdf

Figure 4-3: U.S. Seasonal Drought Outlook, August to November 2016

In 2003, Governor Janet Napolitano created the Arizona Drought Task Force (ADTF), led by ADWR, which developed a statewide drought plan. The plan includes criteria for determining both short and long-term drought status for each of the 15 major watersheds in the state using assessments that are 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 the State Drought 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 drought actions within their drought plans. The State Drought Monitoring Technical Committee defers to the USDM for the short-term drought status and uses a combination of the Standardized Precipitation Index (SPI), evaporation and streamflow for the long-term drought status. Figures 4-4 and 4-5, present the most current short and long-term maps available for Arizona as of the writing of this plan.

The current drought maps are in general agreement that Pima County is currently experiencing an abnormally dry to extreme drought condition for the short term and in a moderate drought condition for the long term. The consensus of the Monitoring Technical Committee is that several years of above normal precipitation would be needed before the drought status is removed[1]. Figure 4-2 indicates that the drought conditions are projected to persist or intensify for Pima County over the next few months.

Vulnerability

Table 4-5: CPRI Results for Drought for 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	Likely	Catastrophic	12-24 hours	<24 hours	2.50
Oro Valley	**Highly likely**	**Critical**	**>24 hours**	**>1 week**	**3.25**
Pascua Yaqui Tribe	Likely	Limited	>24 hours	>1 week	2.50
Sahuarita	**Highly likely**	**Critical**	**>24 hours**	**>1 week**	**3.25**
Tucson	**Highly likely**	**Negligible**	**>24 hours**	**>1 week**	**2.65**
Unincorporated Pima County	**Highly likely**	**Limited**	**>24 hours**	**> 1week**	**2.95**
				County-wide average CPRI =	**2.85**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

The Town of Oro Valley is vulnerable to drought. As a result, the Oro Valley Water Utility continuously plans for current or projected drought conditions through water supply, drought, water conservation plans, and public outreach activities. The Water Utility collaborates with other local municipalities on regional drought preparedness and planning. The Oro Valley Water Utility Drought Preparedness Plan monitors climate and environmental indicators or triggers to gauge conditions that would affect natural recharge[2]. Fluctuations of these triggers above and below specified limits will identify the state or severity of current drought conditions and the corresponding actions that will be required of water users to help mitigate the effects upon potable water resources. Any two of these triggers will indicate the stage of the drought and the actions to be taken by the Utility and its customers. Additionally, the Water Utility has a water conservation ordinance in place relating to reduced water production capabilities and water outages.[3]

[1] AZ Department of Water Resources, 2007
http://www.azwater.gov/azdwr/StatewidePlanning/Drought/documents/THafferICG102507.pdf

[2] Oro Valley Drought Preparedness Plan

[3] Oro Valley Town Code Article 15-18

At this time, the Town of Sahuarita does not own or operate a water company. Within the Town of Sahuarita limits, there currently are six independent privately owned water companies and smaller areas served by on-site wells. The list of providers includes:

- Community Water of Green Valley
- Farmers Water
- Las Quintas Serenas Water
- Quail Creek Water
- Sahuarita Village Water
- Sahuarita Water

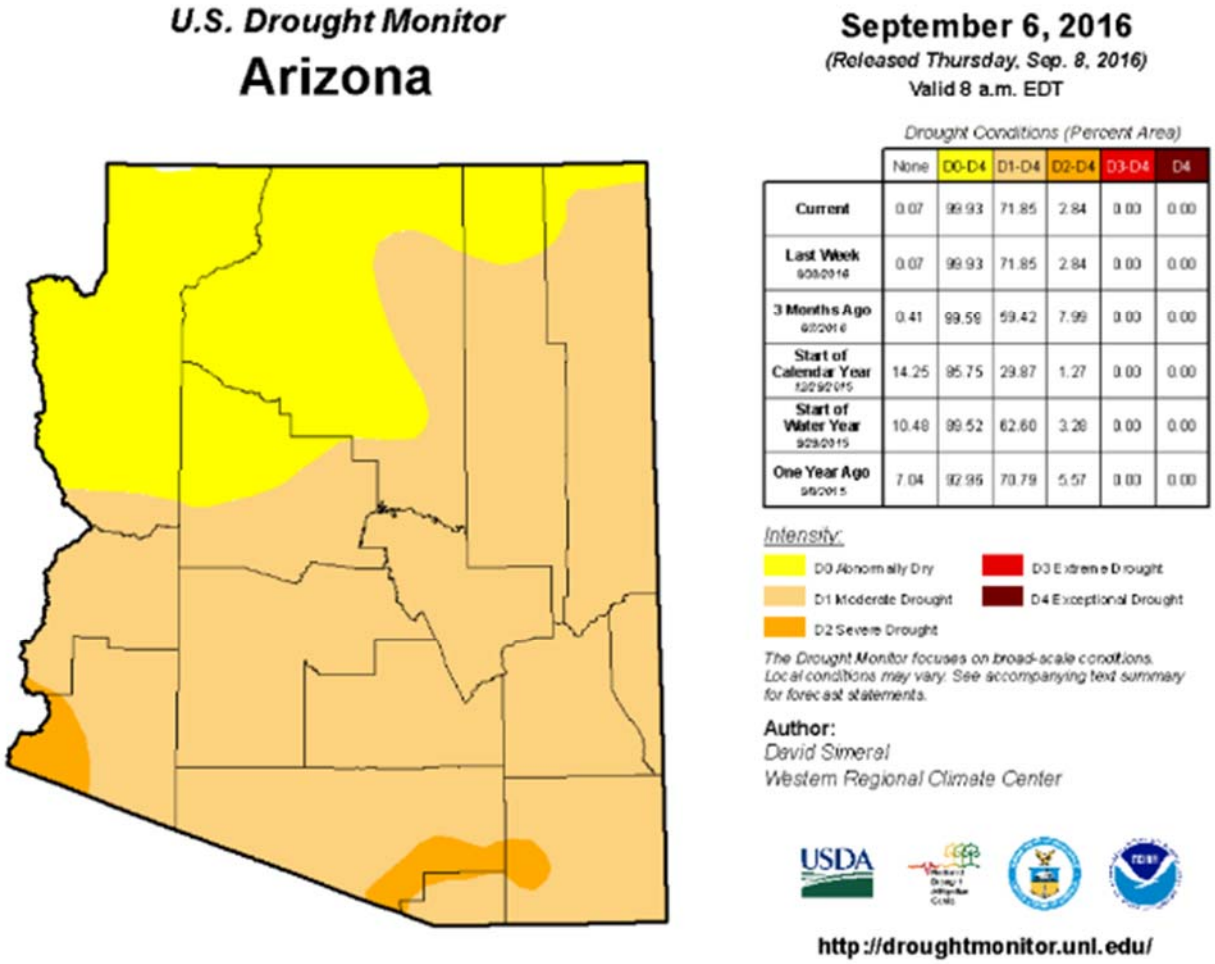
Recognizing that all water companies are vulnerable to drought, the water companies have worked with each other and the Town to develop an area wide drought plan. The drought plan takes into account Arizona Department of Water Resources goal of safe-yield. Including obtaining an assured water supply certificate for many of the master plan communities.

The Tucson Water Department utilized the area's ground water resources to supply water to its customers (citizens and businesses) within the City via a large system of wells for decades. Over a decade of drought, leading to lack of replenishment of the ground water table, has stressed the water supply and lead to measurable subsidence (drop in elevation) in areas of the City as ground water tables are drained.

While the Tucson Water Department has begun to use its allotment of Colorado River Water to replenish water tables, and while they continue to undertake many water conservation programs for residents and business owners, continued periods of drought place stress on the water system leading to increased vulnerability for water shortages in the future.

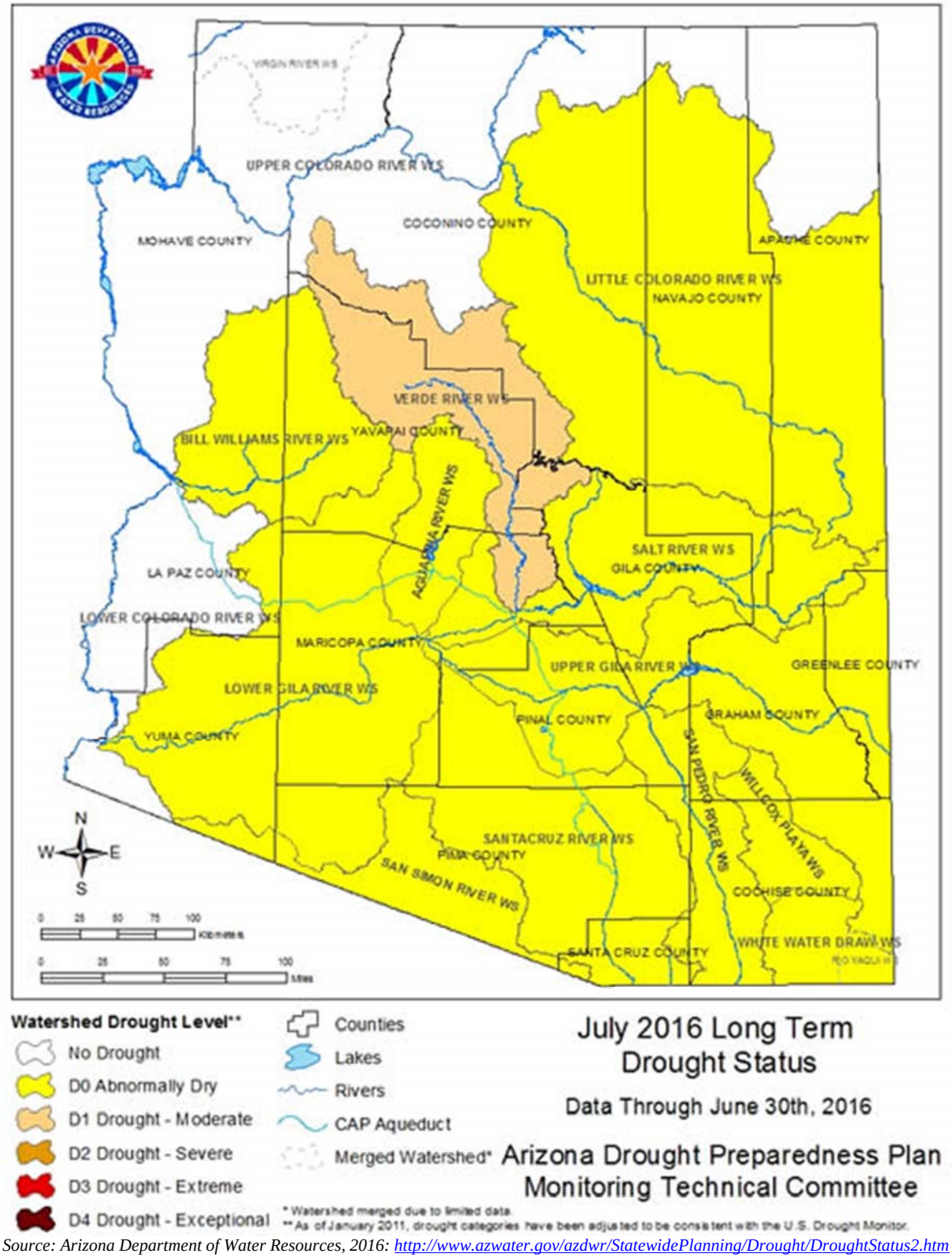
Unincorporated Pima County is vulnerable to drought for the same reasons as the other jurisdictions. Pima County has a Drought Response Plan that is based on "the varying conditions related to water resource supply and distribution system capabilities."[1] Actions within the plan will provide for maximum beneficial use of water resources for the interest of the public health, safety and welfare. The plan is broken up into different stages based on the severity of the drought stage.

[1] Pima County Drought Management, 2016: https://webcms.pima.gov/government/drought_management/



Source: Unites States Drought Monitor, 2016: http://droughtmonitor.unl.edu/data/pngs/current/current_az_trd.png

Figure 4-4: Arizona Short Term Drought Status for September 2016



Source: Arizona Department of Water Resources, 2016: http://www.azwater.gov/azdwr/StatewidePlanning/Drought/DroughtStatus2.htm

Figure 4-5: Arizona Long Term Drought Status for June 2016

Loss Estimations

No standardized methodology exists for estimating losses due to drought and drought does not generally have a direct impact on critical and non-critical facilities and building stock, except perhaps water supply systems. A direct correlation to loss of human life due to drought is improbable for Pima County. Instead, drought vulnerability is primarily measured by its potential impact to certain sectors of the County economy and natural resources including:

- Crop and livestock agriculture
- Municipal and industrial water supply
- Recreation/tourism
- Wildlife and wildlife habitat

Sustained drought conditions will also have secondary impacts to other hazards such as fissures, flooding, subsidence and wildfire. Extended drought may weaken and dry the grasses, shrubs, and trees of wildfire areas, making them more susceptible to ignition. Drought also tends to reduce the vegetative cover in watersheds, and hence decrease the interception of rainfall and increase the flooding hazard. Subsidence and fissure conditions are aggravated when lean surface water supplies force the pumping of more groundwater to supply the demand without the benefit of recharge from normal rainfall.

According to the 2015 annual report of the Pima County Local Drought Impact Group, the following drought impacts were noted:

- Decrease in ephemeral stream flows
- At Cienega Creek, groundwater levels in three wells have dropped since the drought began. Stream reaches are also shorter and the surface water volume is lower.
- Despite the warm, wetter summer weather patterns in eastern Pima County, water utilities continue to see a change in the peak high demand day. Usually occurring in mid- to late-June, the peak high water use day occurred in August and the peak was lower than in previous years.

From 1995 to 2010, Pima County farmers and ranchers received $1.6 million in disaster related assistance funding from the U.S Department of Agriculture (USDA) for crop and livestock damages[1]. Over $1.3 million of those funds were received during the period of 2000 to 2005, which corresponds to the most severe period of the current drought cycle for Pima County.

Other direct costs such as increased pumping costs due to lowering of groundwater levels and costs to expand water infrastructure to compensate for reduced yields or to develop alternative water sources, are a significant factor but very difficult to estimate due to a lack of documentation. There are also the intangible costs associated with lost tourism revenues, and impacts to wildlife habitat and animals. Typically, these impacts are translated into the general economy in the form of higher food and agricultural goods prices and increased utility costs.

Development Trends

Population growth in Pima County will also require additional surface and ground water to meet the thirsty demands of potable, landscape, agricultural, and industrial uses. It is unlikely that significant growth will occur in the ranching and farming sectors given the current constraints on water rights, grazing rights, and available rangeland.

Pima County maintains a drought management website[2] with drought related information and updates, and also facilitates the Pima County Local Drought Impact Group (LDIG), which is comprised of water providers and local, state, and federal agencies. Pima County has also developed a Drought Response Plan and Water Wasting Ordinance [3] that is administered and enforced through the Pima County Health Department for unincorporated areas of the county.

[1] Environmental Working Group's Farm Subsidy Database, 2011, http://farm.ewg.org/progdetail.php?fips=04019&progcode=total_dis&yr=mtotal

[2] Pima County, 2011, Drought Management Website: http://www.pima.gov/drought/index.html

[3] A copy can be seen at: http://www.pima.gov/drought/PDFs/Drought_Ordinance.pdf

Drought planning should be a critical component of any domestic water system expansions or land development planning. The ADTF is also working cooperatively with water providers within the State to develop System Water Plans that are comprised of three components:

- *Water Supply Plan* – describes the service area, transmission facilities, monthly system production data, historic demand for the past five years, and projected demands for the next five, 10 and 20 years.
- *Drought Preparedness Plan* – includes drought and emergency response strategies, a plan of action to respond to water shortage conditions, and provisions to educate and inform the public.
- *Water Conservation Plan* – addresses measures to control lost and unaccounted for water, considers water rate structures that encourage efficient use of water, and plans for public information and education programs on water conservation.

The following are the major water providers that operate within Pima County and have developed System Water Plans with specific recommendations and requirements during times of drought:

- Tucson Water
- Marana
- Metro Water
- Flowing Wells Irrigation District
- Oro Valley
- Community Water Company of Green Valley

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4.4.2 Earthquake

Description

An earthquake is a sudden motion or trembling caused by an abrupt release of accumulated strain along faults that can be found near or far from the Earth's tectonic plates. These rigid tectonic plates move slowly and continuously over the Earth's interior, where they move away, past or under each other at rates varying from less than a fraction of an inch up to five inches per year. While this sounds small, at a rate of two inches per year, a distance of 30 miles would be covered in approximately one million years[1]. The tectonic plates continually bump, slide, catch, and hold as they move past each other which causes stress that accumulates along faults. When this stress exceeds the strength of the rocks, an earthquake occurs, immediately causing sudden ground motion and shaking. Secondary hazards may also occur, such as surface fault ruptures, ground failure, landslides, liquefaction, and tsunamis. While the majority of earthquakes occur near the edges of the tectonic plates, many damaging earthquakes also occur in the interior of plates.

Ground motion is the vibration or shaking of the ground during an earthquake caused by the radiation of seismic waves. The severity of vibration generally increases with the amount of energy released and decreases with distance from the causative fault or epicenter of the earthquake. Additional factors, such as soft soils or the presence of topographic ridges can further amplify ground motions. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. Seismic waves include P (primary) waves and S (secondary) waves. P waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion), with particle motion in the same direction as wave travel. They move through the earth at approximately 15,000 mph. S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side-to-side (horizontal motion) due to particle motion at right-angles to the direction of wave travel. Unreinforced buildings are more easily damaged by S waves. Surface waves include Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

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 location. Magnitude is the measure of the amplitude of the seismic wave and is expressed by a logarithmic scale that represents the amount of energy released from the movement of the fault. An increase in the Magnitude scale by one whole number represents a tenfold increase in measured amplitude of the earthquake. The Modified Mercalli Intensity (MMI) scale is a measure of how strong the shock is felt and the type of damage that it caused by the tremor at a particular location.

Another way of expressing an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. If an object is dropped while standing on the surface of the earth (ignoring wind resistance), it will fall towards earth and accelerate faster and faster until reaching terminal velocity. The acceleration due to gravity is often called "g" and is equal to 9.8 meters per second squared (980 cm/sec/sec). This means that every second something falls towards earth, its velocity increases by 9.8 meters per second, per second. Peak ground acceleration (PGA) measures the rate of change of motion relative to the rate of acceleration due to gravity. For example, acceleration of the ground surface of 244 cm/sec/sec equals a PGA of 25.0%. PGA is commonly estimated for an area and applied to building and infrastructure design. PGA, and similar calculations, are important input factors in determining the amount of shear stresses a structure can withstand.

One of the secondary hazards from earthquakes is surface faulting, the differential movement of two sides of a fault at the earth's surface. Linear structures built across active surface faults, such as railways, highways, pipelines, and tunnels, are at high risk to damage from 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).

Earthquake-related ground failure, due to liquefaction, is also a secondary hazard. 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, causing deformations. Liquefaction causes lateral spreads (horizontal movement

[1]Federal Emergency Management Agency, 1997, *Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy.*

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 or tip).

History

Seismic activity occurs on a regular basis throughout the State of Arizona, although most go undetected. Although rare, damaging earthquakes affecting Pima County have been recorded in the past as follows:

- The earliest recorded earthquake affecting Arizona, and possibly the largest, occurred in 1830. With an estimated Modified Mercalli Intensity (MMI) of IX recorded at San Pedro, AZ, approximately 25 miles west of Tucson, the earthquake would have caused massive damage to built structures[1].
- In 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[2]. 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 VIII and M7.6 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"[3]. With the increase in development, if such an earthquake occurred today it would cause extensive damage in southeastern Arizona[4].

The main faults of concern in Pima County are as follows and shown in Figure 4-6. The three main Quaternary faults are the Pitaycachi, Santa Rita and the Huachuca faults.

Probability/Magnitude

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, Figure 4-7 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 including the geographic area affected (colored areas on map below), the probability of an earthquake of each level of severity (e.g., 2% chance in 50 years), and the severity (PGA) as indicated by color.

Note that Figure 4-7 expresses a 2% probability of exceedance and, therefore, there is a 98% chance that the peak ground acceleration displayed will not be exceeded during 50 years. The 50-year return period use 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 (0.10 g) is the approximate threshold of damage to older (pre-1965) dwellings or dwellings not made resistant to earthquakes. The 0.10 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.

Figure 4-8 provides a more detailed view of the 2%, 50-year PGA map for Pima County. As demonstrated by this map, the central portion of Pima County has a PGA that ranges between 0.06g and 0.10g. The eastern third of the county is within the 0.10g to 0.12g range. The western portion of the county ranges from 0.08g to 0.16g with the

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[1] Arizona Division of Emergency Management, *State of Arizona Multi-Hazard Mitigation Plan*

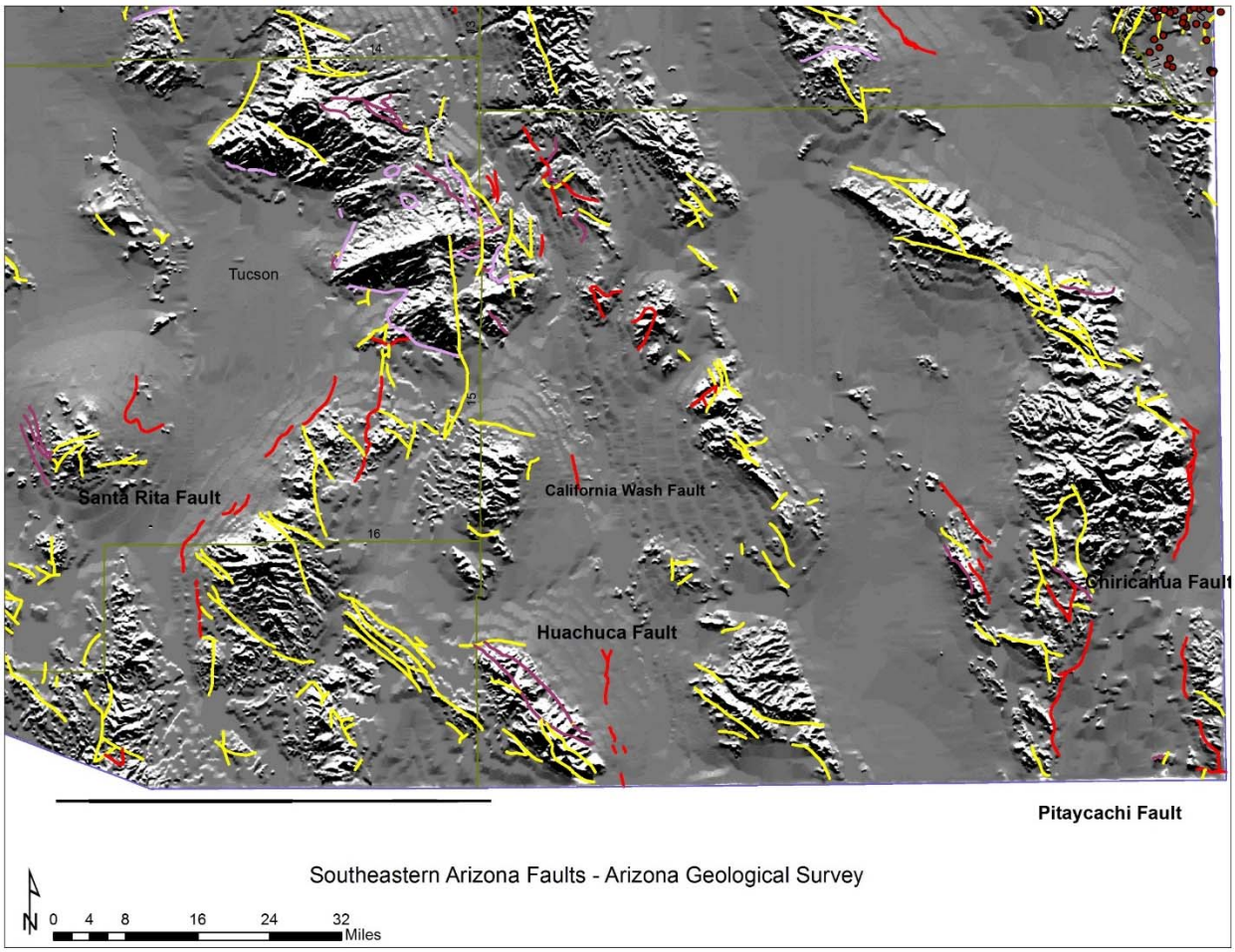
[2] DuBois, S.M., and Smith, A.W., 1980, *The 1887 earthquake in San Bernardino Valley, Sonora; historic accounts and intensity patterns in Arizona*: Arizona Bureau of Geology and Mineral Technology Special Paper no. 3, 112 p.

[3] Arizona Division of Emergency Management, *State of Arizona Multi-Hazard Mitigation Plan;* 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; D.B. Bausch and D.S. Brumbaugh, 1994, *Seismic hazards in Arizona:* Flagstaff, AZ Earthquake Information Center, 49 p., 2 sheets, scale 1:1,000,000.; US Geological Survey (USGS): September 12, 2003, "Earthquake History of Arizona." http://wwwneic.cr.usgs.gov/neis/states/arizona/arizona_history.html

[4] Jenny, J.P. and S.J. Reynolds, 1989. "Geologic Evolution of Arizona" in Arizona Geological Society Digest, No. 17.

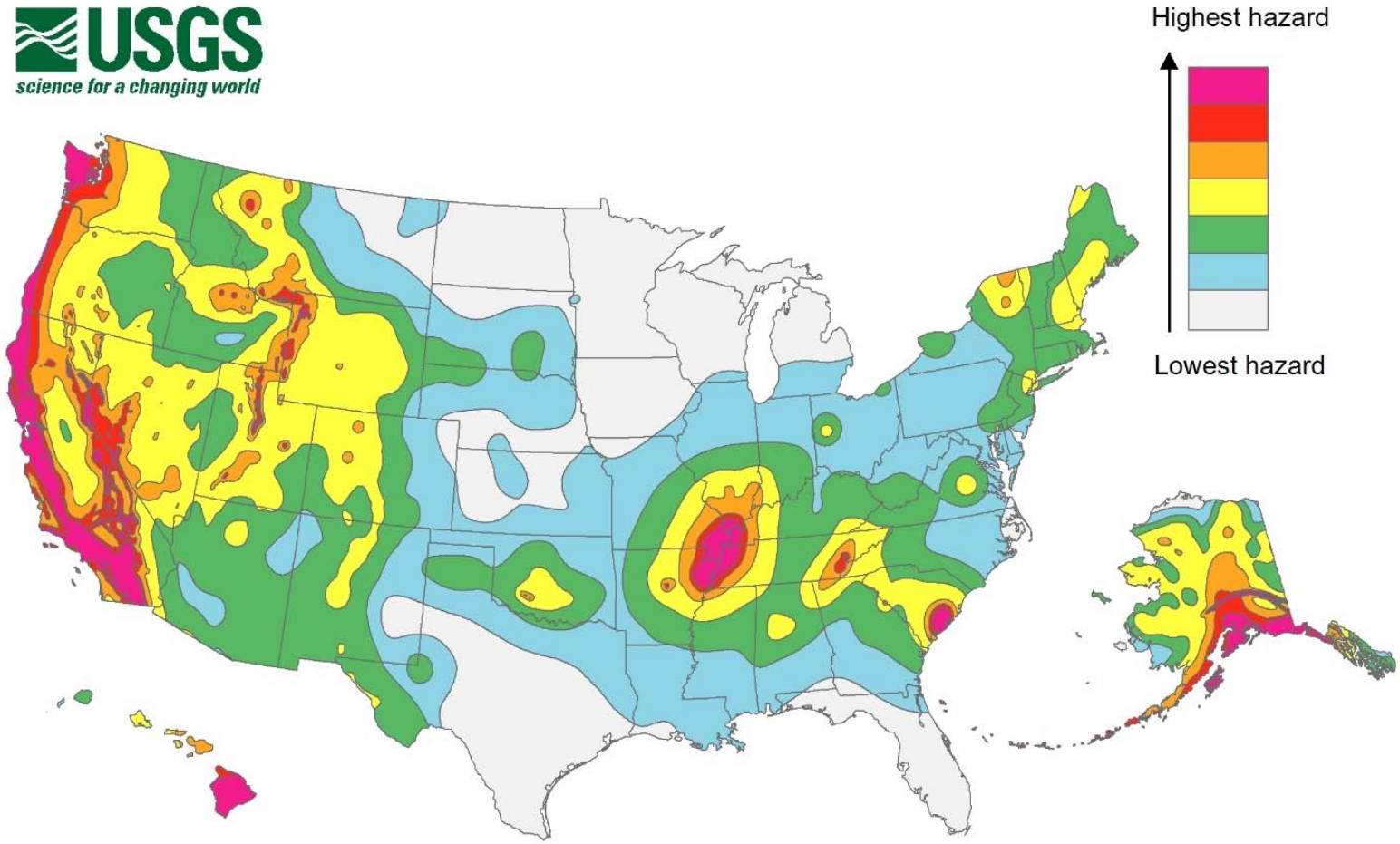
highest PGA values occurring along the Yuma County and Mexico border. Overall, PGA values for Pima County are low in comparison with other counties within the State, and especially in areas of high population.

The possible effects of climate variability on earthquake probability should be low since earthquakes are non-climatic in nature.



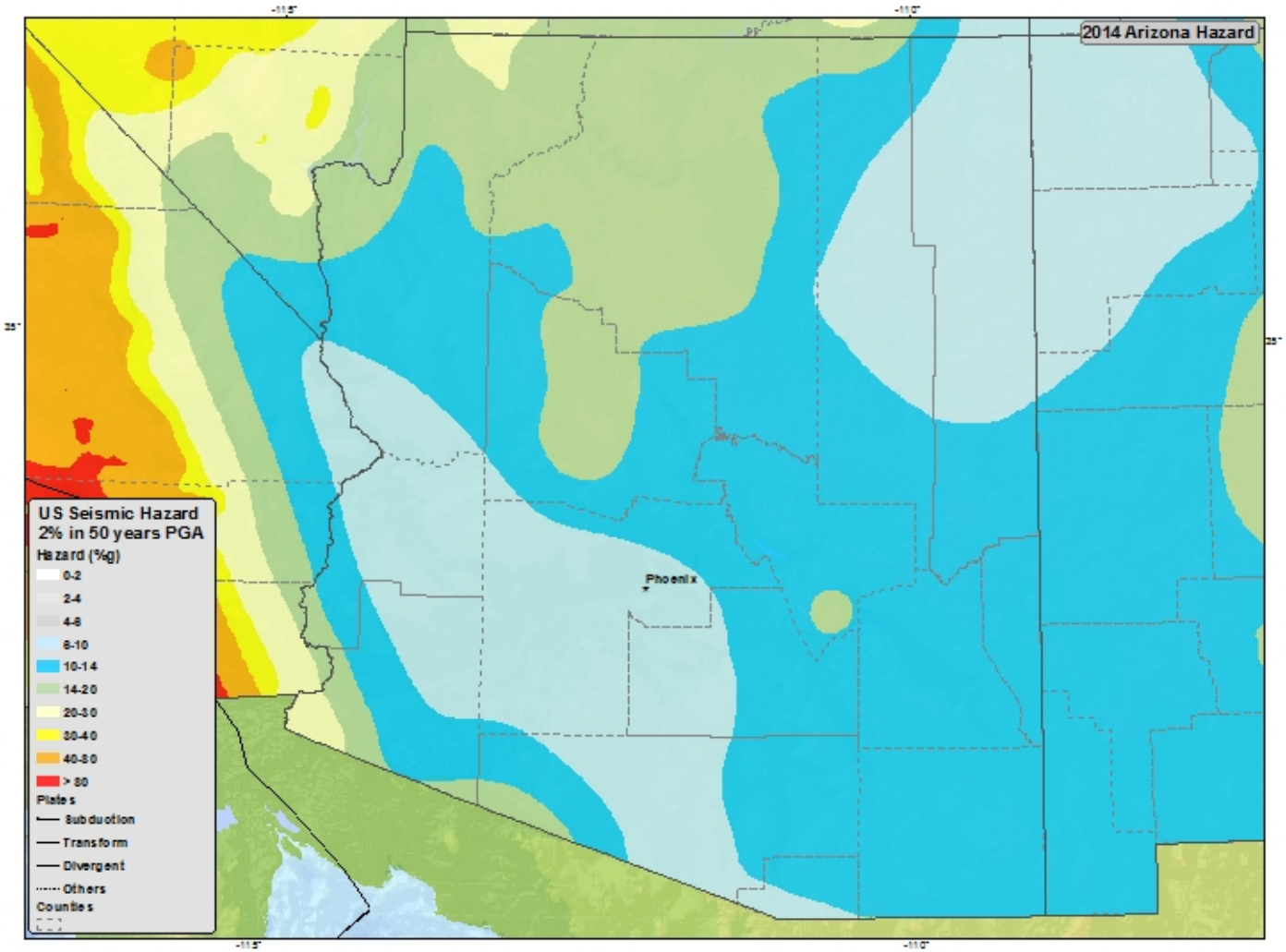
Source: Arizona Geological Society, 2017

Figure 4-6 Southeastern Arizona Earthquake Fault Systems



Source: United States Geological Survey Simplified 2014 hazard Map (PGA, 2% in 50 years), 2016: https://earthquake.usgs.gov/hazards/hazmaps/conterminous/2014/images/HazardMap2014_lg.jpg

Figure 4-7: USGS Simplified 2014 Earthquake Hazard Map



Source: United States Geological Survey 2014 Seismic Hazard Map: https://earthquake.usgs.gov/earthquakes/byregion/arizona-haz.php

Figure 4-8: PGA for a 2% Chance in 50 Years' Recurrence

In general, the risk of seismic hazard in the urbanized portions of Pima County are relatively low; however, denser populations, existence of high rise buildings, existence of unreinforced masonry buildings, and the lack of earthquake awareness among its population elevate the risks associated with seismic activity.

The rate of seismicity in Pima County has historically been low, with the area's most recent quakes originating in San Luis in 1976 (M 6) and Baja, Mexico in 2010 (M 7.2). The largest impact of an earthquake on the 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 Tucson metropolitan area could also be significantly affected by a major quake in the Yuma or Northern Arizona Seismic Belt (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. It should also be noted that although the small earthquakes occurring in Pima County are of low seismic risk to buildings, the repeated shaking could eventually cause structural damage. In unstable areas, small earthquakes may also trigger landslides and boulders rolling off mountain slopes[1].

Vulnerability

Table 4-6: CPRI Results for Earthquake for 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	Possible	Critical	12-24 hours	> 1 week	2.50
Oro Valley	Possible	Critical	< 6 hours	< 6 hours	2.50
Pascua Yaqui Tribe	Possible	Limited	< 6 hours	< 6 hours	2.20
Sahuarita	Possible	Limited	< 6 hours	> 1 week	2.50
Tucson	**Possible**	**Critical**	**< 6 hours**	**<6 hours**	**2.50**
Unincorporated Pima County	Possible	Limited	< 6 hours	> 1 week	2.50
				County-wide average CPRI =	**2.45**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

Only the City of Tucson chose Earthquake as a hazard to mitigate. Other jurisdictions gave it the same rating as 2.50, but it was not a priority for mitigation for those Local Planning Teams. The rating of 2.50 by several others was purely coincidental.

While earthquakes are not a regular occurrence in and around the City of Tucson, with the last documented earthquake occurring more than a century ago, there is nonetheless a recognized and documented history of large earthquakes in the vicinity that have caused damage within the City. The lack of earthquake awareness and preparedness over the last century as Tucson has built up and out, for example, the lack of building codes to protect buildings from seismic damage puts the City in a vulnerable position if an earthquake were to occur. It is understood, because of the risk assessment process, that an earthquake that a century ago may have only tipped over water towers and startled horses would today be likely to cause widespread damage and injury within the City.

Loss Estimations

The 2012 Plan estimated seismic related losses to general residential and commercial buildings using the HAZUS-MH® program. The 2012 Plan residential and commercial loss estimates for earthquake will be carried forward with this 2017 Plan for the next 5-year cycle. By the end of that period, FEMA will have updated the HAZUS database to reflect current building counts.

The earthquake hazard assessment utilized the HAZUS-MH software model including the following data: 100-, 250-, 500-, 750-, 1000-, 1500-, 2000-, and 2500- year return period USGS probabilistic hazards. Developed for FEMA by the National Institute of Building Sciences (NIBS), HAZUS-MH integrates earthquake hazard modeling with GIS technology to determine the following annualized loss estimates for each jurisdiction:

[1] Jenny, J.P. and S.J. Reynolds, 1989. "Geologic Evolution of Arizona" in Arizona Geological Society Digest, No. 17.

- The aggregated population at risk at the census block level,
- The aggregated exposure and building count at the census block level for residential and commercial occupancies, and,
- The critical infrastructure at risk.

The earthquake risk assessment performed for Pima County did not explore the potential for collateral hazards such as liquefaction or landslide. However, losses associated with these ground failures would have been negligible given the level of shaking expected for Pima County (i.e., not enough strong shaking to trigger significant ground failure). In 2017 Plan, Landslide was added as a hazard for unincorporated Pima County.

The annualized loss estimates developed represent the average of all eight of the modeled return periods (100-year through 2,500-year events). The largest potential annualized losses to jurisdictions in Pima County include the City of Tucson and the unincorporated portions of Pima County. Together these jurisdictions account for $2.6 million in residential losses and $273,000 in commercial losses equating to 84% and 88% respectively of the total losses countywide.

Development Trends

In general, the earthquake risk in the identified growth areas of the Pima County jurisdictions is at the borderline of the 10% g PGA, which as previously stated, is the approximate threshold of damage for older (pre-1965) dwellings or dwellings not made resistant to earthquakes. Throughout the county, new development is typically regulated to comply with current building codes that will provide for more stable seismic designs of new construction.

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4.4.3 Extreme Cold

Description

Tucson's desert climate is generally prone to mild winters. The average overnight low temperature in the coldest months, December and January, hovers just above the 39°F mark. During the rest of the cooler parts of the year, in late fall and early spring, low temperatures tend to hover in the 40-50°F range.

This tendency for mild winters has led to infrastructure design that is not resistant to, nor built with the capacity for, extended cold periods. Additionally, the tendency for mild winters means that the people, residences, pets, as well as plants and wildlife in the Tucson area are not prepared for cold weather. It is for this reason that temperatures that would be considered typical in other parts of the country where cold winters are the norm are instead considered extreme cold in Tucson.

While on average winters in Tucson are mild, it is not unusual to see brief periods where overnight lows drop below freezing or even reach Hard Freeze warning levels as described by the National Weather Service. While rare in Tucson, very cold temperatures (colder than 20°F) can also occur during the winter months. The coldest temperatures often occur after winter storms move past the region, precipitation ends, and skies clear allowing for rapid cooling at night.

Since many water lines and inlets to residences and businesses are above ground and exposed to the elements, and since the populace of Tucson is not well aware of the need to protect these pipes with proper insulation, these extreme cold temperatures can result in frozen and burst pipes. This can cause extensive water damage to homes, business, and government buildings.

Additionally, during extreme cold in Tucson the populace seeks to keep warm by heating their home. However, due to the typically mild winters, natural gas distribution systems to and within the City of Tucson have not been built to handle peaks loads during extreme cold events. This has led to instances of large scale heating fuel outages during spells of extreme cold, putting at risk residents of Tucson, especially those vulnerable populations with access and functional needs.

Finally, the culture in Tucson is to expect mild winters and therefore the populace is under-informed regarding the potential for and possible impacts of extreme cold. This has and can lead to damage to homes, crops, and injuries or deaths to people or their pets.

History

While extreme cold is not the norm in Tucson, events have occurred with some regularity over the last decade. A few examples follow[1]:

- In January of 2007 extreme cold hit Tucson for several days in a row, with the low temperature at the Tucson International Airport hitting 17°F on January 15th. The prolonged extreme cold weather led to substantial damage in the community due to damaged water pipes.

- In February 2011, record cold temperatures dropped into the mid to upper teens across the Tucson area for several nights in a row, with minimal daytime heating, and high winds which combined resulting in two fatalities. A woman in her late 30's was found dead in an alley near East Speedway and North Campbell Ave. A second woman was also found dead near the intersection of East Grant and North Craycroft. Another person was also found lying out in the cold nearly frozen and was taken to the hospital with non-life threatening injuries. The cold also lead to numerous burst water pipes. A water pipe at a main Metro Water location froze, leaving almost 30 residences and businesses without water on the northwest side. More than 200 customers in Tucson reported frozen or burst water pipes. At least 2000 residents and businesses were without water at some point for a day. AAA saw a 20% increase in local calls, mostly about dead car batteries. Davis-Monthan Air Force Base had several buildings damaged by flooding due to frozen fire sprinkler pipes, which resulted in the buildings being closed for safety reasons. The intersection of Grant Road and Stone Ave. was also closed due to a burst water main that was causing slick road conditions. Reid Park Zoo was also closed due to numerous broken water pipes. Due to cold temperatures along the natural gas route from El Paso to Tucson, Southwest Gas could not meet natural gas demand,

[1] [1] National Centers for Environmental Information (NCEI), 2016, https://www.ncdc.noaa.gov/stormevents/

which resulted in about 14,000 Tucson customers being without heat. Pima County and the City of Tucson collaborated to open a warming shelter for residents without heat. Untold numbers of plants, trees, and shrubs were also killed by the record cold, including many saguaro cacti.

- In January 2013, cold low temperatures persisted across much of southeast Arizona for several nights. Most of the damage consisted of broken water pipes. Low temperatures in the teens or lower 20s for several nights caused numerous pipes to burst in the Tucson metropolitan area. The Tucson International Airport dropped to 15 degrees on the morning of January 15th. Most of the frozen pipes exposed to the cold were on the roofs or sides of homes. In addition, citrus fruits were damaged by the hard freeze, which meant that local food banks could not glean unpicked fruit to supplement their food donations. Total damage was estimated at $100,000. Additionally, two house fires were indirectly related to the cold weather. A mobile home caught fire when the owner attempted to thaw frozen pipes with a propane torch. Another home caught fire after residents placed a heat lamp and blankets on a patio overnight to keep pets warm. No one was injured in either fire.

Probability and Magnitude

Despite the generally mild winters in Tucson, over the last decade the National Weather Service averages two published hard freeze warnings in Tucson each year. One the extreme end of the spectrum during the 2010/2011 winter season seven hard freeze warnings were published. Thus, the probability of extreme cold weather is actually highly likely on an annual basis. While any of these hard freeze events have the potential to cause infrastructure damage, damage to the environment, and, most importantly loss of life, the most extreme cold events noted above impact Tucson with a high magnitude due to the nature of the typical building techniques, the design of utility infrastructure in the region, as well as the culture in Tucson where the residents expect mild winters and are mostly unprepared for extreme cold[2].

Vulnerability

Table 4-7: CPRI Results for Extreme Cold 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	**Possibly**	**Limited**	**6-12 hours**	**<24 hours**	**2.15**
Oro Valley	**Possibly**	**Limited**	**< 6 hours**	**<1 week**	**2.25**
Pascua Yaqui Tribe					
Sahuarita	**Possibly**	**Limited**	**12-24 hours**	**<1 week**	**2.10**
Tucson	**Highly Likely**	**Critical**	**>24 hours**	**>1 week**	**3.25**
Unincorporated Pima County	**Likely**	**Limited**	**12-24 hours**	**< 1 week**	**2.55**
				County-wide average CPRI =	**3.27**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

Loss Estimations

There is no standardized method for estimating losses associated with extreme cold events and none is made for this Plan. From a historical perspective, both human and infrastructure losses could be expected with any significant extreme cold event especially regarding loss of human life for those exposed to the cold weather for long periods, and damage to water supply infrastructure. This is especially true in Tucson since extreme cold events are rare and the general population is not likely to be prepared for such an event.

2 2 National Centers for Environmental Information (NCEI), 2016, https://www.ncdc.noaa.gov/stormevents/

Development Trend Analysis

While extreme cold is a yearly threat, it is unlikely to affect future development. Enforcement and/or implementation of modern building codes to regulate new developments, in particular the proper installation and protection of water supply lines, in conjunction with public education on how to respond to hazardous cold conditions is probably the best way to mitigate against such losses.

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4.4.4 Extreme Heat

Description

Extreme temperatures can occur within any area and can often have adverse impacts on the health and welfare of a community or region. These extreme temperatures can affect people, pets, plants and infrastructure throughout the area. Extreme heat is considered a risk to Pima County residents.

Extreme heat is either high temperature above the 95th percentile for the date or the combination of very high temperatures and exceptionally humid conditions that exceed regionally based indices for perceived risk. According to the National Weather Service, heat is one of the leading weather-related killers in the United States. Heat is responsible for hundreds of fatalities and even more heat-related illnesses[1]. 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 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.

Extreme heat affects individuals who work outdoors, as well as the homeless who have no access to shade or cooling, particularly at night. Hikers and others involved in outdoor recreation frequently succumb to extreme heat when they run out of water. Extreme heat can stress the elderly and people with compromised immune systems or other health issues, leading to heart attacks and respiratory distress. Many of the elderly and those in poverty either have no air conditioning or have insufficient resources to use air conditioning during a heat wave. In the southwest deserts, air conditioning in the summer is exactly as critical as home heating in the winter is for those in the northern tier of states. Other vulnerable populations during a heat wave include infants, young children, and those with functional or access needs.

In addition to the loss of life, extreme heat can affect infrastructure. Power lines are de-rated based on the ambient air temperature, which provides cooling. High temperatures and calm conditions can lead to overheating of power lines as well as power transformers, resulting in widespread power outages. Transportation systems also suffer from extreme heat or cold. Rail lines can buckle in extreme heat as the metal expands. Thermal expansion and contraction causes pavements to crack, leading to moisture penetration and pavement breakdown. Extreme heat also threatens pavement markings and signage, shortening their life and requiring more frequent replacement.

History

Extreme temperature events occur in Pima County on a regular basis, but the damaging events typically occur during the summer months. The following are heat-related statistics:

- According to the Arizona Department of Health Services, a total of 737 heat-related deaths have occurred in Pima County over the period of 2001-2013. The highest total was 116 in 2005 when an extended heat wave occurred in central Arizona[2].

[1] National Weather Service, 2016: http://www.nws.noaa.gov/os/heat/index.shtml

[2] Arizona Department of Health Services, 2015: http://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/extreme-weather/pubs/heat-related-deaths-updated-may-2015.pdf

- Deaths of illegal immigrants in the desert areas along the Arizona-Mexico border are also attributed to extreme heat. In 2001 and 2002, 79% of the 125 heat fatalities among illegal AZ immigrants took place in Pima County[3].
- In Arizona, the average cost for the hospital treatment of a heat related illness in 2008 was $7,500 per person, thus totaling $11,000,000 in treatment costs only[4].
- August 14-16, 2015 extreme heat caused 36 heat related illnesses, including 12 in metropolitan Tucson, 12 in western Pima County and 12 on the Tohono O'odham Nation. Temperatures reached 115 between August 14 and 16 in south central and southwestern Arizona. Record high temperatures were set at Tucson, Ajo, Organ Pipe National Monument, and Picacho Peak State Park. High electricity demand caused power outages in the Tucson area[5].
- In June 2016, National Weather Service issued widespread excessive heat warnings due to "rare, dangerous, and deadly" temperatures expected[6]. Temperatures were at record-breaking highs and tied the mark as the third highest temperature recorded in Tucson at 115 degrees. The heat wave was responsible for several death across the region[4].

Probability and Magnitude

There are no recurrence or non-exceedance probabilities developed for extreme temperature events in Arizona or Pima County. Table 2.1 provides example normal and extreme temperature ranges for various weather stations within the county. In general, extreme temperatures vary from normal by 10 to over 30°, with highs that exceed 110° and the trend (though not linear) is toward increased number of days with high temperatures at or above 105°F and 110°F.

One 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. Figure 4-9 is a quick reference chart 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. In addition, strong winds, particularly with very hot, dry air, can be extremely hazardous.

Climate variability may have a strong impact on extreme temperatures and extreme heat in particular. The Centers for Disease Control says that rare extreme heat events that may occur once every 20 years could start occurring every two to four years in certain parts of the country including Arizona[7]. Events could become more severe and last longer as well as being more common.

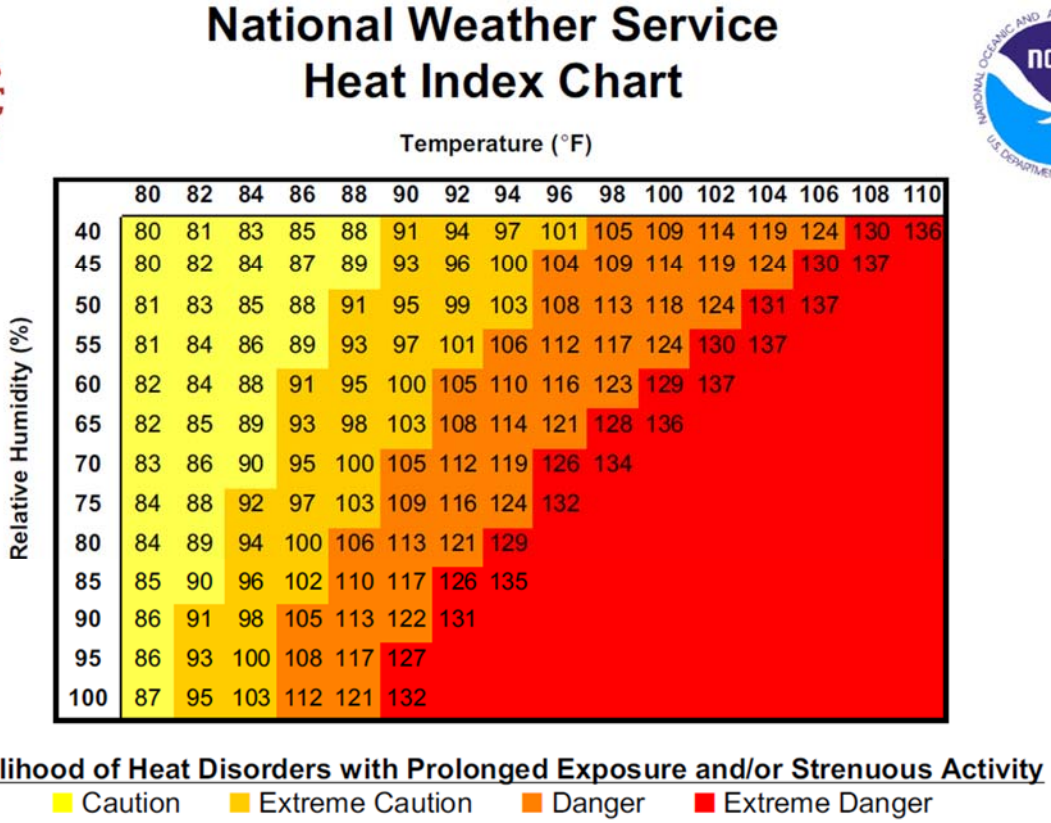
[3] Heat Fatalities in Pima County, Arizona, http://climateknowledge.org/heat_waves/Doc7003_Keim_Heat_Pima_Health%26Place_2007.pdf

[4] Arizona Department of Health Services, 2010: http://azdhs.gov/documents/director/public-information-office/news-releases/2010/100519%20Heat%20death%20report%20(2).pdf

[5] National Centers for Environmental Information (NCEI), 2016

[6] National Weather Service, 2016.

[7] Centers for Disease Control, Climate Change and Extreme Heat Events, retrieved 2017: https://www.cdc.gov/climateandhealth/pubs/ClimateChangeandExtremeHeatEvents.pdf



Source: NWS, 2016 http://www.weather.gov/media/unr/heatindex.pdf

Figure 4-9: National Weather Service Heat Index Chart

Vulnerability

Table 4-8: CPRI Results for Extreme Heat for 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	Likely	Limited	> 24 hours	> 1 week	2.50
Oro Valley	**Likely**	**Critical**	**> 24 hours**	**> 1 week**	**2.80**
Pascua Yaqui Tribe	**Highly Likely**	**Limited**	**> 24 hours**	**< 1 week**	**2.85**
Sahuarita	**Highly Likely**	**Critical**	**> 24 hours**	**< 1 week**	**3.15**
Tucson	**Highly Likely**	**Critical**	**> 24 hours**	**< 1 week**	**3.15**
Unincorporated Pima County	**Highly Likely**	**Critical**	**12-24 hours**	**< 1 week**	**3.30**
				County-wide average CPRI =	**2.96**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

The Town of Oro Valley is vulnerable to extreme heat. Extreme heat events occur on a regular basis, typically in the

summer months resulting in threats to public health and safety. In recent years, temperatures in the summer months have been the warmest on record. Fluctuation in temperatures may also lead to higher uses of electricity, gas, or water that can lead to outages or interruptions in service. Oro Valley has susceptible populations in children and the elderly. Tourism brings people from areas not familiar to the desert climate that can leave them vulnerable to extreme heat.

The Pascua Yaqui Tribe's vulnerability to extreme temperature is mainly heat related. The Tribe operates two casinos and one golf course that receive numerous heat-related emergency calls annually. As with other jurisdictions, the elderly and young are also vulnerable to the temperature extremes.

Sahuarita, like other neighboring communities, is vulnerable to heat and heat related emergencies. Sahuarita is home to golf courses and pre-planned communities where outdoor activities are emphasized. Sahuarita has many senior communities and elder care facilities as well as areas for young families. As the elderly and young are more vulnerable to heat, the Town chose extreme temperature as one of its hazards.

As a high-desert climate, Tucson is a place of extremes. The City sees very high summer temperatures annually, and just months later will experience sub-freezing winter temperatures. While this is the norm, over the last decade the range of extremes has grown with recent summer temperatures breaking multiple records in one month and winter temperatures dropping to a point that the community, and infrastructure owners, are not prepared for.

During the summertime, extreme heat is generally handled well by the community – however, is widely understood that this is dependent on the reliable delivery of electric power so that residents and businesses can cool their homes and buildings. The potential for electrical system failure during the summer due to storms, wildfires, or overuse/stress on the system are realities that Tucson as a City is beginning to address more thoroughly in our planning processes as it is recognized that a long-term power outage during an extreme heat wave would leave a large portion of the City vulnerable.

During the wintertime, on the other hand, extreme cold temperatures are something the City is less accustomed to and prepared for. Local building practices and codes do not take in to account the protection of water pipes from extremely cold weather, and local natural gas supply infrastructure was not built to take into account the demand for heating fuels when temperatures drop well below freezing during periods of record breaking cold. This type of cold weather has, and can again, lead to wide spread failure to deliver heating fuel and failure of water delivery systems, again leaving large populations within the City vulnerable.

Unincorporated Pima County residents and visitors are vulnerable to extreme heat like the jurisdictions. Full-time citizens of Pima County are generally prepared for the hot climate; however, the homeless and visitors can be overcome due to exposure and lack of awareness. The Pima County Health Department maintains a "Beat the Heat" campaign and various other departments get involved during heat emergencies. Like others, unincorporated Pima County is vulnerable to electrical outages that moves the emergency from individuals outdoors to those indoors as well including the vulnerable elderly and young.

Loss Estimations

Losses due to extreme heat primarily occur in the form of death and illness for people and animals as mentioned at the beginning of this section. Arizona Department of Health Services tracks data and monitors trends and other factors to determine if a statistical significance exists. History would indicate that multiple deaths due to extreme heat are highly likely, especially for illegal immigrants that attempt to cross the Arizona deserts during the summer months. Homeless, low income, elderly, young and access and functional needs populations are particularly vulnerable to extreme heat due to the increased exposure to the natural elements and decreased ability to compensate in the form of cooling apparatus.

Development Trends

Growth in Pima County has significantly increased the population and infrastructure exposed to extreme heat. There is also an increased demand on resources for electric power during the summer months. The primary intersect of extreme high temperature hazards and future development of the county is in the general increase in population and commensurate infrastructure development required.

Over the decades as the metropolitan area has dramatically grown in size, the "urban heat island" effect has developed. This has caused temperatures in the center of metropolitan areas to become much warmer than those in rural areas have. The concrete and asphalt of urban areas retains the heat of the day, and releases it slowly as compared to the surrounding desert terrain, which cools much quicker at night. As development continues to occur within Tucson and its surrounding area, heat conditions will continue to increase.

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4.4.5 Flood

Description

For the purpose of this Plan, the hazard of flooding addressed in this section will pertain to floods that result from precipitation/runoff related events. Other flooding due to dam or levee failures is addressed separately. The three seasonal atmospheric events that tend to trigger floods in Pima County are:

- *Tropical Storm Remnants*: Some of the worst flooding tends to occur when the remnants of a hurricane that has been downgraded to a tropical storm or tropical depression enter the State. These events occur infrequently and mostly in the early autumn and usually bring heavy and intense precipitation over large regions causing severe flooding.
- *Winter Rains*: Winter brings the threat of low intensity; but long duration rains covering large areas that cause extensive flooding and erosion, particularly when combined with snowmelt.
- *Summer Monsoons*: A third atmospheric condition that brings flooding to Arizona is the annual summer monsoon. In mid to late summer, the monsoon winds bring humid subtropical air into the State. Solar heating triggers afternoon and evening thunderstorms that can produce extremely intense, short duration bursts of rainfall. The thunderstorm rains are mostly translated into runoff and in some instances, the accumulation of runoff occurs very quickly resulting in a rapidly moving flood wave referred to as a flash flood. Flash floods tend to be localized and cause significant flooding in local watercourses.

Damaging floods in the County include riverine, sheet, alluvial fan, and local area flooding. Riverine flooding occurs along established watercourses when the banks full capacity of a watercourse is exceeded by storm runoff or snowmelt and the overbank areas become inundated. Sheet flooding occurs in regionally low areas with little topographic relief that generate floodplains over a mile wide, Alluvial fan flooding is generally located on piedmont areas near the base of the local mountains, such as the Tortolita Fan, that are characterized by multiple, highly unstable flow paths that can rapidly change during flooding events. Local area flooding is often the result of poorly designed or planned development wherein natural flow paths are altered, blocked or obliterated, and localized ponding and conveyance problems result. Erosion is also often associated with damages due to flooding.

Another major flood hazard comes as a secondary impact of wildfires in the form of dramatically increased runoff from ordinary rainfall events that occur on newly burned watersheds. Denuding of the vegetative canopy and forest floor vegetation, and development of hydrophobic soils are the primary factors that contribute to the increased runoff. Canopy and floor level brushes and grasses intercept and store a significant volume of rainfall during a storm event. They also add to the overall watershed roughness that generally attenuates the ultimate peak discharges. Soils in a wildfire burn area can be rendered hydrophobic. Hydrophobic soils, in combination with a denuded watershed, will significantly increase the runoff potential, turning a routine annual rainfall event into a raging flood with drastically increased potential for soil erosion and mud and debris flows.

History

Flooding is clearly a major hazard in Pima County. Pima County has been part of 13 disaster declarations for flooding, with none of those declarations occurring in the past five years. There have been numerous other non-declared events of flooding incidents occurring in the last five years. The following incidents represent examples of major flooding that has affected the County:

- During August and September of 1983, nearly seven inches of rain fell, saturating the soil around the Tucson metropolitan area. These conditions were exacerbated when a surge of moisture from Tropical Storm Octave, which was located off the central Baja California coast, moved northeast across the area. The result over a four-day period were torrential rains ranging from five to nine inches, causing flooding in Tucson and southeast Arizona. Bridges in the area, including all spanning the Santa Cruz River except one, were damaged or partially washed away. Additional damage occurred along the other watercourses throughout the area. Several buildings fell into Rillito Creek due to bank erosion and extensive damage occurred to agriculture in Marana. Cost estimates (using 1984 dollars) to repair and mitigate flood damage were estimated at $105.7 million. Four deaths in Eastern Pima County were attributed to the flood.
- In late December 1992 - early January 1993, a series of winter storms produced record-breaking precipitation amounts and severe weather across much of Arizona. Heavy rains combined with melting snowpack caused heavy flooding of both local washes and regional rivers within Pima County. Nearly every community and

city within the county was impacted by the storms at some level. Most of the heavy damage was associated with the Gila, San Pedro, and Santa Cruz Rivers. According to the USACE Flood Damages Report, the total public and private damages from the 1993 floods were estimated to exceed $12 million in Pima County alone. The flooding prompted a federal disaster declaration (FEMA-977-DR-AZ) for almost the entire state[1].

- On August 14, 2005 and August 23, 2005, intense heavy rains caused significant damage to public infrastructure throughout Pima County. The severe runoff resulted in damages to numerous roads, traffic lights, water well fields, berms, crossings, and police vehicles. After over an inch of rain fell across a large portion of the Tucson Metro Area, some locations with more than two inches, several roads became flooded, closed, and impassable. In addition to all the flooded roadways, several trailer homes located in the southern portion of the Tucson Metro Area, were flooded and surrounded by rising water. Rescue teams evacuated several people from these homes. Brawley wash was out of its banks and flooding roadways causing them to be impassable. Over $260,000 in damages were estimated[2].

- In late July and early August 2006, several areas of the state were struck by severe storms and flooding during the period of July 25 to August 4, 2006. Tropical moisture poured into Southeast Arizona, saturating the ground at most locations. As rainfall continued, additional runoff quickly filled rivers and washes, exceeding bank full capacities and flooding homes and businesses as well as nearby roads. Some roadways were washed away due to the strong floodwaters. Lots of flash flooding occurred throughout the Tucson Metro Area due to saturated grounds and extremely heavy rainfall. Numerous roads were closed due to flooding throughout the entire Metro Area for many hours. A USGS stream gage was destroyed by floodwaters in Rincon Creek. Additionally, there were numerous swift water rescues and car stranded in flooded roadways. It was estimated that nearly 100 vehicles were flooded. Several rivers running through the Tucson Metro Area flooded on July 31, 2006. The Rillito River flooded with water over the cement banks near Dodge Boulevard. Additionally, the Rillito River was over bank full just east of the Swan Road Bridge. River Road near La Cholla Road was flooding from the Rillito River. Sabino Creek was out of its banks and houses were flooded near Sabino Canyon and Bear Canyon. Below is a listing of some of the damage, but not all, caused by the flooding and an estimate for the cost of repairs:

  - Sabino Canyon Recreation area road and facility damaged, $100,000
  - Forty homes and businesses flooded, $1,200,000
  - One home destroyed due to flooding, $150,000
  - Water main broke near the Mt. Lemmon highway, $20,000
  - Catalina Highway road washed away, $50,000
  - Agricultural irrigation system damaged, $500,000
  - Cement plant flooded, $400,000
  - Gravel pit flooded, $30,000
  - General infrastructure damage, $500,000.

  The flooding prompted a federal disaster declaration (FEMA-1660-DR-AZ) for Gila, Graham, Greenlee, Pima, and Pinal Counties. Total disaster expenditures exceeded $13.6 million (ADEM, 2010; PCRFCD, 2011).[3]

- On February 19, 2008, a state of emergency was declared for Pima County for flooding and damages due to 8.5 inches of precipitation that fell in and around Mt. Lemmon within Pima County in less than a 24-hour period. Damages to roads left residents stranded in their homes, limited access to food and medical assistance and damaged potable water supply lines, which affected transmission and distribution of potable water to homes. The rainfall and snowmelt created conditions that threatened the health and safety of residents and exceeded the capabilities of Pima County. Several people in Tucson needed to be rescued from flowing washes. Damages were estimated to exceed $770,000[4].

[1] US Army Corps of Engineers, Los Angeles District, 1994, *Flood Damage Report – State of Arizona – Floods of 1993*

[2] National Centers for Environmental Information (NCEI), 2010

[3] Arizona Division of Emergency Management, Pima County Regional Flood Control District

[4] National Centers for Environmental Information (NCEI), 2010

- On January 21, 2010, sixteen hikers were trapped on Sabino Canyon Trail at approximately 11 AM after the stream rose above its banks, covering low water crossings. The San Simon and Vamori Washes in the Tohono O'odham Nation rose 1-2 feet out of their banks during the evening of January 21. Several other washes flowed out of their banks, resulting in barricaded roadways near Saguaro National Park East and West, including East Tucson and Avra Valley. A motorist was trapped in the Canada del Oro Wash near Rancho del Lago at approximately 7 AM on January 22 requiring a swift water rescue. Storm-wide damages were estimated at $300,000 (NCDC, 2011). A presidential disaster was declared (FEMA-1888-DR-AZ) for several counties and Indian tribes in the state including Pima County.
- In July 2010, torrential rainfall across portions of eastern Pima County resulted in numerous reports of flash flooding in the Tucson metro area. Flash flooding was observed on Tanque Verde Creek with a peak depth of 11.69 feet at Tanque Verde Guest Ranch. Approximately 30 homes on Barbary Coast Road, Gold Dust Road, and Kitt Carson were flooded. Numerous swift water rescues were performed in the Tucson metro area, near the county fairgrounds, in the Recon Valley area, and on the Old Spanish Trail in the Hilton Head Ranch area. Damages were estimated to exceed $500,000[5].
- Between 2011 and April 2016 there were 39 flash flooding events with two deaths and damage amounting to $2.366 million dollars. September 15, 2011 the 5h highest rainfall total on record occurred at Tucson International Airport with 2.84", and up to 3.00" at nearby locations. Over 3 feet of water covered the roads near the airport causing over 30 roads to be closed and two flights had to be diverted to Phoenix. Six swift water rescues were performed and six people were rescued from their homes as rivers exceeded their banks. In Sahuarita, a wash overflowed into a community flooding 15 homes. A homeless man was swept away by the Santa Cruz River. Damage was estimated at $1 million in Tucson and $500K at Sahuarita[6].
- On September 8, 2014, moisture associated with Tropical Depression Norbert caused extensive street flooding on the east side of Tucson requiring numerous swift water rescues. One woman drove into Alamo Wash and drowned when her vehicle was swept downstream under a bridge[3].
- Heavy rain in the Corona de Tucson area of Vail on July 7, 2014 caused widespread flash flooding, closed roads, and caused property damage. According to the Pima County Regional Flood Control District's (PCRFD) ALERT system precipitation gauges, the area experienced storms with total rainfall ranging from 1.5 to over 2 inches, with rainfall intensities of up to two inches in less than an hour reported in portions of the watershed. The high intensity of the storm over a relatively short duration caused the floodwaters to rise and fall quickly, catching many by surprise[7].
- On July 9, 2014 an intense, localized storm with rainfall intensities of 2 inches per hour or greater affected Why, Arizona. Several Structures were damaged during the event[6]. Historic and real-time rainfall and streamflow data, along with descriptions of floods are available on the Pima County Regional Flood Control website at: http://webcms.pima.gov/government/flood_control/

Probability and Magnitude

For the purposes of this Plan, the probability and magnitude of flood hazards in Pima County jurisdictions are based on the 1% probability floodplains (also known as the 100-year flood, as the flood has a 1% chance of being equaled or exceeded in any single year) delineated on FEMA Flood Insurance Rate Maps (FIRMs)[8]. FEMA completed a map modification program to update the FIRMs for the County into a digital FIRM (DFIRM) format. The Pima County Regional Flood Control District (PCRFCD) is responsible for keeping these up-to-date as revisions are made. Floodplain GIS base files were obtained from the PCRFCD and are the basis for the flood hazard depictions in this Plan.

5 National Centers for Environmental Information (NCEI), 2011

6 National Centers for Environmental Information (NCEI), 2016

7 Pima County Regional Flood Control District, 2016

8 FEMA 100 Year Flood Zones, http://www.arcgis.com/home/item.html?id=e9aa2179f31b4b9cbe5c7f8b1b91cea3, 2016

Vulnerability

Table 4-9: CPRI Results for Flood 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	**Likely**	**Catastrophic**	**12-24 hours**	**< 24 hours**	**3.05**
Oro Valley	**Likely**	**Catastrophic**	**< 6 hours**	**< 24 hours**	**3.35**
Pascua Yaqui Tribe	**Likely**	**Limited**	**< 6 hours**	**< 24 hours**	**2.75**
Sahuarita	**Highly Likely**	**Catastrophic**	**12-24 hours**	**> 1 week**	**3.70**
Tucson	**Highly Likely**	**Critical**	**6-12 hours**	**< 6 hours**	**3.25**
Unincorporated Pima County	**Highly Likely**	**Critical**	**< 6 hours**	**< 24 hours**	**3.50**
				County-wide average CPRI =	**3.27**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

The different types of weather in Pima County described above produces distinctively different types of floods. Flood producing storms in Pima County typically fall into one of two types: summer monsoon thunderstorms and winter mesoscale storms.

Summer monsoon storms are highly convective systems that produce intense rainfall over relatively small areas. Monsoon storms are more likely to trigger flood events on smaller watercourses, particularly later in the monsoon season when antecedent soil moisture is higher. Monsoon storm flooding is short-lived and may affect an area suddenly as a flash flood. These floods tend to be of shorter duration. Furthermore, monsoon rainfall may affect just one watershed. In most years, the annual peak flow will occur on different days at different gauging stations. However, the July 31, 2006 event, which produced debris flows in the Santa Catalina Mountains significant flooding on the Santa Cruz downstream of the Rillito occurred after several days of rainfall in the Santa Catalina Mountains.

Flash floods are generally associated with summer monsoon thunderstorms. Several factors make flash floods a challenging hazard to mitigate.

1) Real-time precipitation gages may miss storm cells that are small enough in aerial extent although large enough in volume to cause flash flooding.
2) Extreme rainfall intensities can generate runoff that reaches peak flow in periods measured in minutes, providing little or no ability to provide the public with a warning about any specific event.
3) The leading edge of the flood may extend miles below the storm event that created it, flooding an area that may have received no rainfall and may not have even been cloudy, thus catching individuals completely unaware of the threat.

Winter mesoscale storms generally originate in the Pacific Ocean and produce bands of precipitation over a period of days. Though characterized by low rainfall intensity, these long duration storms yield the high volumes of water necessary to produce significant flow events on the major watercourses. Precipitation characteristics create floods that build slowly and may last for days. These include Tropical Storms**.** In general, the largest floods on the Santa Cruz River have occurred because of tropical storms that come up from the Sea of Cortez in the fall, but do not produce significant flooding in most years. In October 1983, tropical storm Octave produced the flood of record on the Santa Cruz River. Between 6 ½ to 7 ½ inches of rain fell across the area in five days. The flooding stretched to Clifton/Morenci, Wilcox, Safford and Nogales. More than a dozen people died. While high rainfall depths and extended duration certainly produce conditions conducive for flooding, saturated soils that have limited capacity to absorb rainfall also play a role. They may also include frontal systems that can provide more sustained flow durations, even as flood peaks tend to remain low. In rare occasions winter frontal systems have produced rain on snow in January to March.

In addition to flash flood largely associated with mountain front drainage, sheet flow flooding is a phenomenon unique to watersheds with low topographic relief and a severe lack of adequate flow conveyance through channels. The lack of defined drainage channels often deceives the public into thinking that there are no flood hazards in the area. Sheet flow flooding may develop quickly but where slopes are particularly shallow, the duration of sheet flow flooding may extend more than 24 hours. Private roadways not designed for all weather access are common in these areas of the County. As a result and in combination with the widespread nature of sheet flow flooding, during times of flooding residents and emergency services ability to gain safe or reliable access to and from the affected area may be limited.

Alluvial fans create a special type of floodplain that has characteristics that are similar to sheet flow floodplains. Alluvial fans occur below mountain fronts and consist of an accumulation of sediment carried out of the mountains via riverine flow. At the margin of the mountain front, flow containment is lost and floodwaters spread out across the alluvial fan. Alluvial fans may have better defined channels or flow corridors but they are not large enough to convey large storm events and, due to their location below the break in slope, channels often aggrade and lose capacity. Since alluvial fans often consist of poorly consolidated alluvium, the loss of channel capacity in existing channels leads to the creation of new channels or the reestablishment of old channels. This characteristic of alluvial fans leads to significant uncertainty with respect to the location and severity of flood flows. The combination of severe, directed flow at uncertain locations, unconsolidated soils and the likelihood of flash floods in this environment results in potentially extreme flood and erosion hazards.

Historically, flood events of limited aerial extent occur at least every few years in Pima County. These floods may not affect many people but the effects of these floods may be severe for those affected. Floods on the major watercourses occur approximately once every ten years. Historically, these floods had a significant impact on the community; however, flood and erosion hazard improvements within the urban core have largely limited the hazards to the public from large flood events on the major watercourses. In addition, improved regulation of development through elevating structures above the base flood, protecting structures from erosion hazards and protection of natural floodplains has ensured that new development is more flood resilient than was previously the case in unincorporated Pima County.

This section contains a map and data table for unincorporated areas known to flood frequently and where warning is required per the NFIP (see Figure 4-10 and 4-11). Figure 4-12 and 4-13 are Special Studies Floodplains map showing locally mapped floodplains. These are mapped either by a developer or by unincorporated Pima County. Table 4-11 contains data for these Special Studies Floodplains areas including exposure estimates. The PCRFCD works closely with the PCOEM to add locally identified special studies flood-prone areas.

While bank protection installed by the PCRFCD along major watercourse has reduced erosion and overbank flooding in much of the urbanized incorporated areas of the County some development pre-exists floodplain regulation and infrastructure is at risk. This area includes:

- The Forty Niner's Country Club Subdivision on Tanque Verde Creek geologic floodplain,
- The alluvial fan areas of Lee Moore, Franco and Flato washes particularly in the Summit neighborhood south of Sahaurita Road,
- The broad floodplains of Avra Valley and the Black Wash, as well as
- Numerous canyon washes impacted by fires within National Forests in the upper watershed and encroachment in the foothills residential areas.

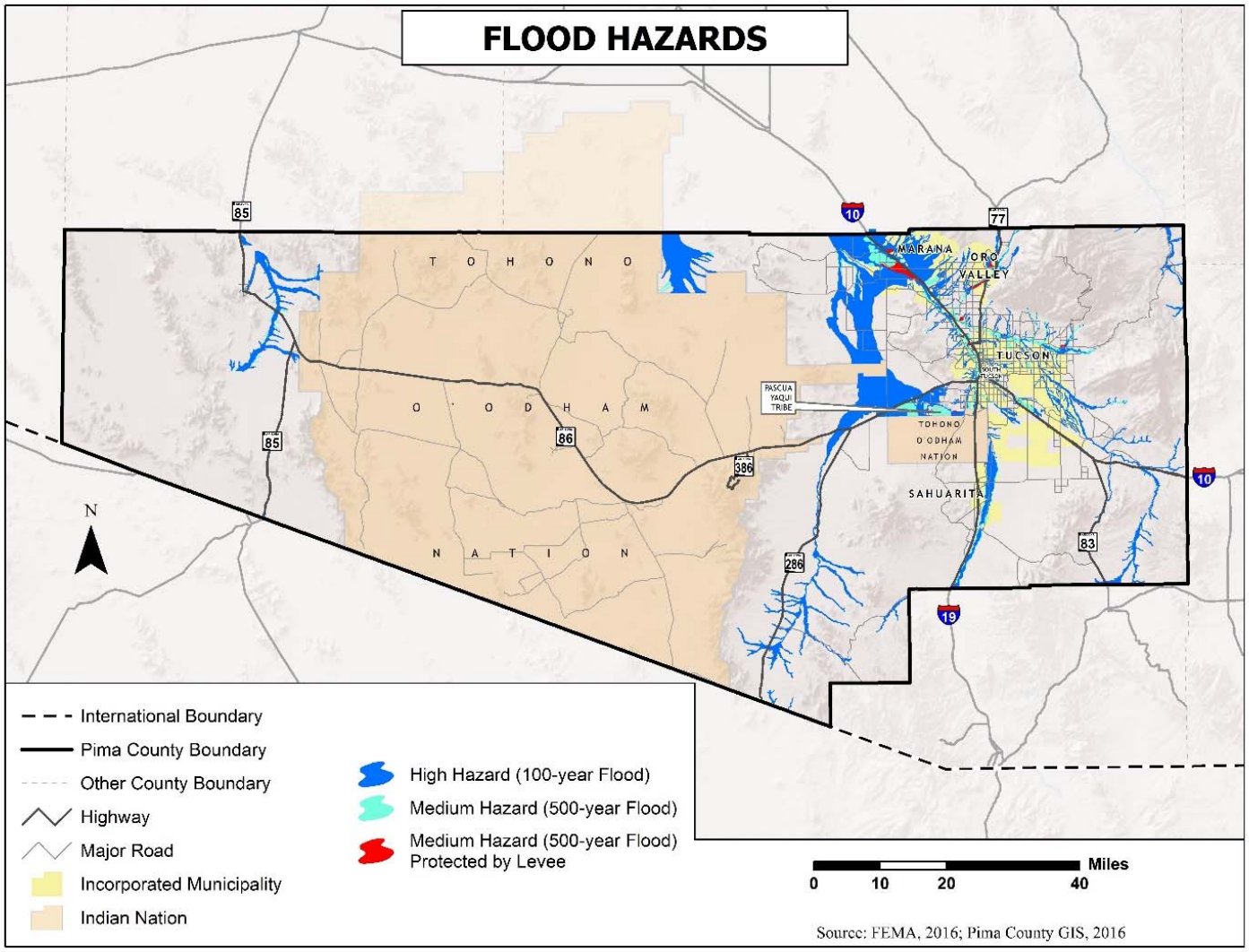

Figure 4-10: Pima County Flood Hazards

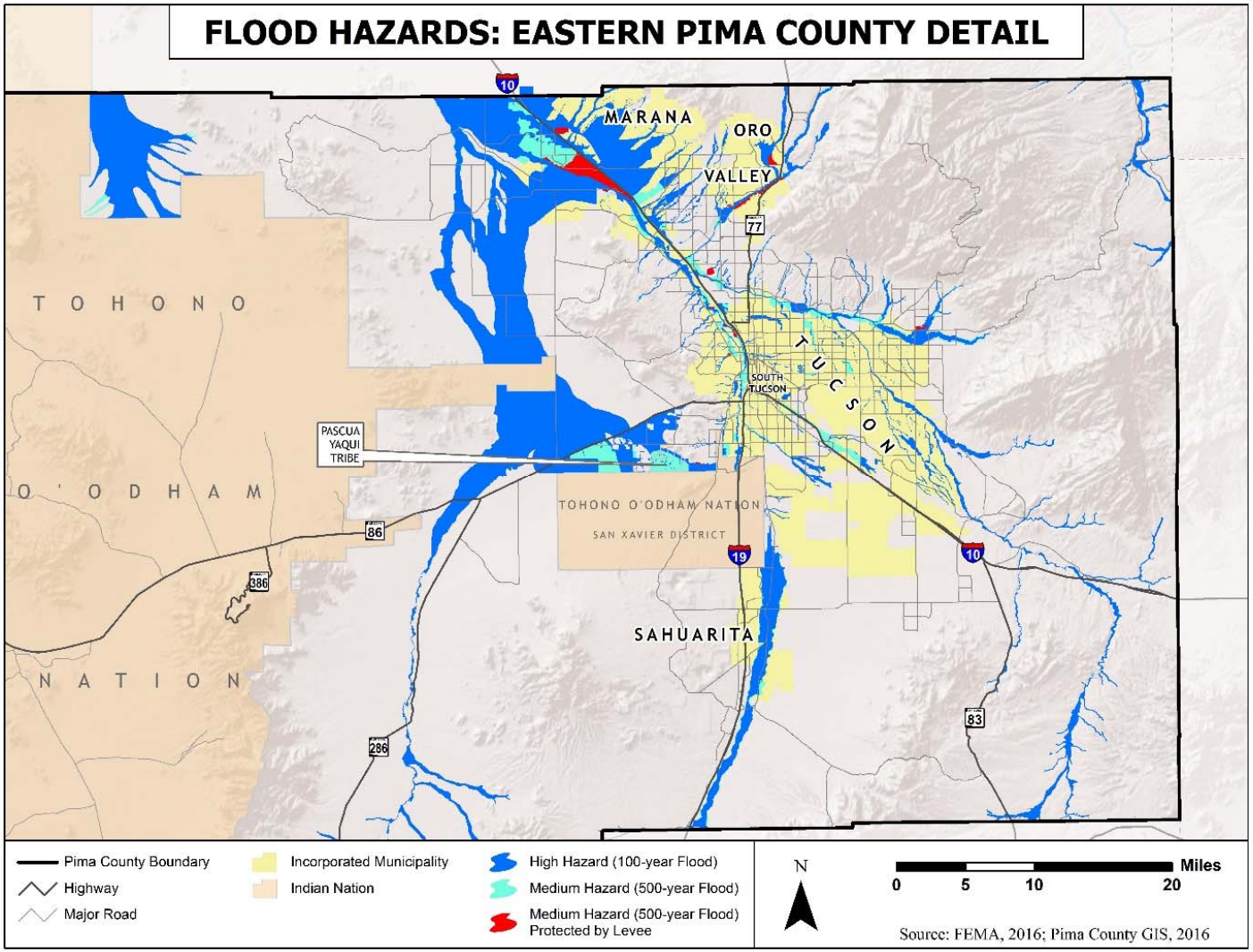

Figure 4-11: Eastern Pima County Flood Hazards Detail

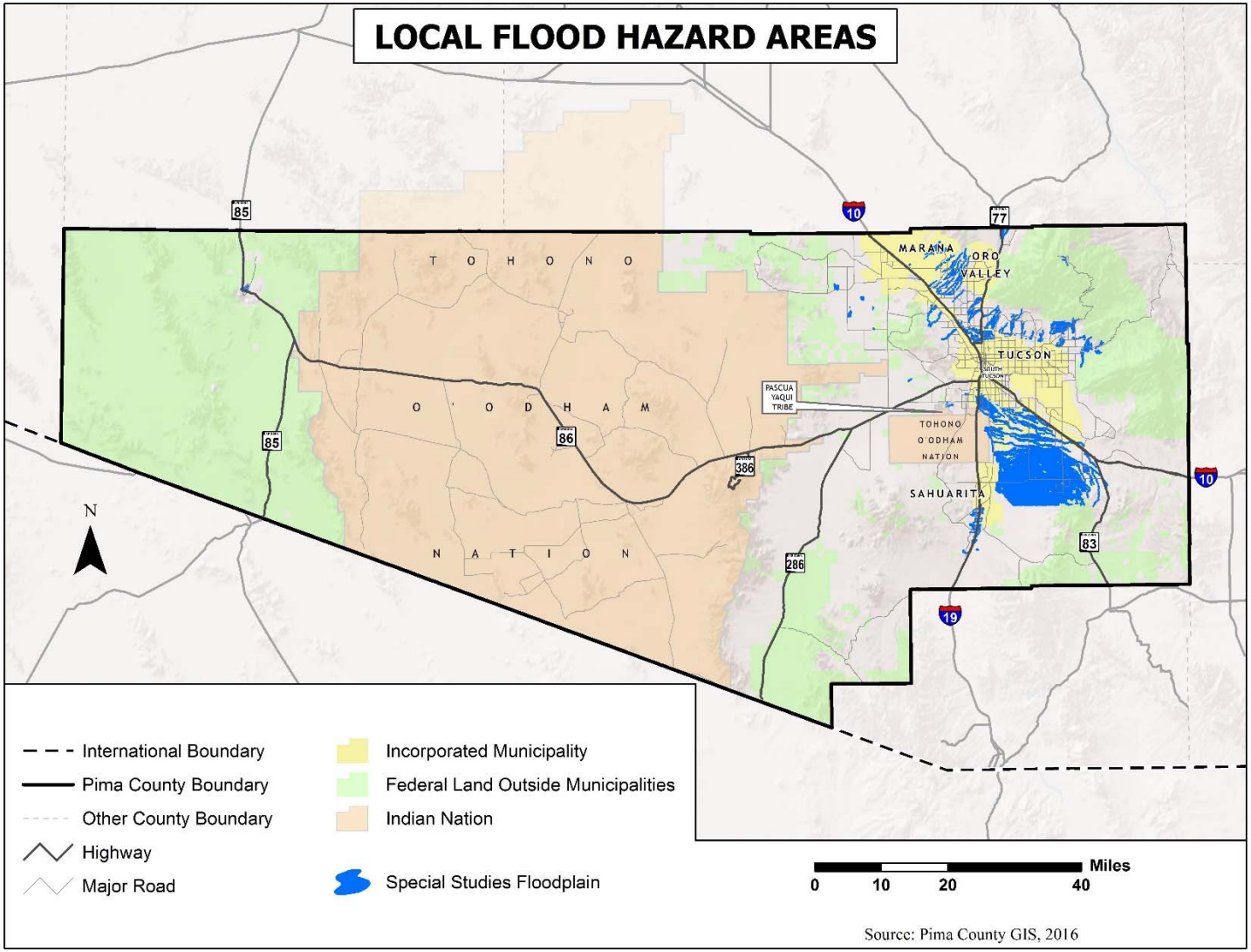

Figure 4-12: Local Flood Hazard Areas Pima County

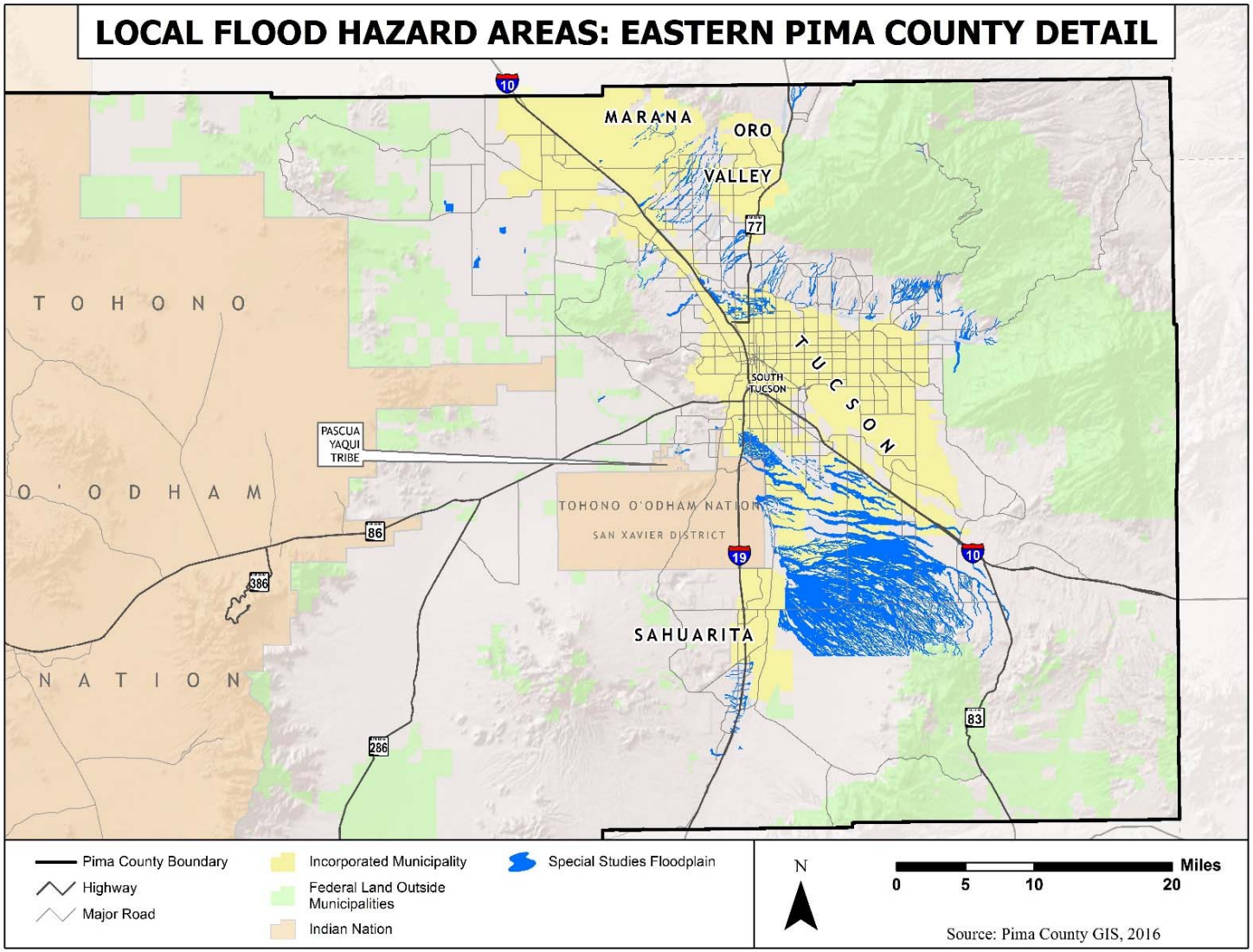

Figure 4-13: Local Flood Hazard Areas Eastern Pima County Detail

The Town of Marana has significant concerns regarding flooding. There are several flooding sources within Marana that can cause hazards to property or roadways. They include runoff from the Tortolita Mountains, runoff from the Tucson Mountains, and overbank flow from the Santa Cruz River. Two additional flooding sources include the Rillito River and the Canada del Oro Wash, are contained within their banks during the base flood (commonly known as the "100 year flood") but are susceptible to hazardous erosive failures. Areas include:

- Santa Cruz River: Major regional storm events, such as significant rainfall in the Catalina Mountain watershed, can send enough Stormwater runoff into the Canada del Oro or Rillito River systems that will direct floodwaters to the Santa Cruz River potentially causing the closure of the Ina Road bridge for structural precautions, the closure of the Sanders Road bridge due to overtopping, the capturing of the El Rio Open Space preserve, and evacuation due to overbank flows of the Berry Acres subdivision in far north Marana. Major storm systems south of Tucson, potentially all the way from Mexico, within the Santa Cruz watershed can also cause these issues. Some areas of Continental Ranch adjacent to the Santa Cruz River and the Town's airport could be impacted by Santa Cruz flood events above the base flood.

- Tortolita Mountain Alluvial Fan: The Tortolita Mountain watershed consists of several major washes that leave the mountain system whose floodplains overlap in a broad alluvial floodplain. Higher on the alluvial fan and closer to the mountains, the washes are well defined and the floodplains are more certain. The lower you travel on the floodplain the more the floodplain broadens out into overlapping sheet flow areas. Tangerine Road in its current condition is susceptible to flooding and road closures due to at-grade dip crossings. At the end of the alluvial fan lies the Central Arizona Project Canal system that has a protective berm on its upstream side and over chute pipe outlets to carry floodwaters across the canal at various locations. This berm/over chute system interrupts the sheet flow characteristics of the lower alluvial fan and reconcentrates the floodwaters at the pipe outlet locations. Localized flooding and road closures occur downstream of the over chutes. A similar situation occurs where the Tortolita Fan runoff is intercepted by the Union Pacific Railroad and Interstate 10. These facilities are raised higher than the adjacent ground, impounding water on their upstream sides and create focused flooding issues where culverts or interchange openings allow focused floodwaters through. There are also some areas of the interstate and railroad that can be outright overtopped. Should there be a rainfall event significant enough to cause runoff by the sandy soils of the Tortolita Fan; the water will go through the series of impoundments and discharges noted above through the Central Arizona Project Canal, Union Pacific Railroad, and Interstate 10 to arrive at northwest Marana. These floodwaters then either sheet flow or are carried in the bar ditch and irrigation canal system in a northwesterly pattern throughout northwest Marana. Property damage and road closures occur until the flood waters recede.

- Tucson Mountain floodplain: The Tucson Mountain watershed consists of several washes that leave the mountain system but unlike the Tortolita Fan, the washes remain well confined due to the rockier nature of the terrain and the closer proximity of the mountain range to the Santa Cruz River. The Town has not experienced major property damage from Tucson Mountain runoff but several roads both east and north of the mountain range are subject to closure during major rain events in the watershed. FEMA mapping categorizes the Town's airport as being in a sheet floodplain from the Tucson Mountains but the mapping does not appear to consider the raised Central Arizona Project canal immediately east of the airport.

- Canada del Oro wash and Rillito River: Both of these systems contain the base flood for their watersheds. However, property and roadways adjacent and crossing these systems could be susceptible to flooding from events above the base flood. A segment of the Canada del Oro wash west of Thornydale road that is not armored with bank protection. That segment could experience erosive failure. Prior to development of this area, the Town will require the bank protection to be put in place. The most hazardous aspect of these systems however is where they come together at the Santa Cruz River just west of Interstate 10. No part of this confluence is bank protected. A sand and gravel pit within the confluence area that has been mined well below the bed of the river. If the berm protecting the sand and gravel pit were to fail, the resulting pit capture could cause a headcut eastwards and erode away the adjacent portion of Interstate 10, the Union Pacific Railroad, a major Tucson Electric Power transmission line, transcontinental high-pressure gas pipeline, and a transcontinental fiber optic line.

The Town of Oro Valley is susceptible to flood hazards on a relatively frequent basis due to tropical storm remnants, winter rains, and summer monsoons. Localized events are the most common and frequent types of flooding in Oro Valley, however, there are infrequent occasions of more widespread or regional flooding events. Examples of larger flood events affecting the Town of Oro Valley include:

- July 4, 2012. Estimated hundred-year event occurred that caused flooding to the Lomos de Oro wash. There were limited damages because of a FEMA funded mitigation project (2006) to add gabions and other flood protections.
- September 8, 2014. Hurricane Norbert. Several localized areas across the Town received between 3.5-4.5 inches of rain in an hour's time. This flooded streets, overflowed normal wash channels, led to swift water rescues, and flooded homes and yards. There was significant storm recovery need to include debris and sediment clean up, repairs to impacted public infrastructure, and clean-up by individual homeowners and businesses. Additionally, short and long-term mitigation measures were identified, prioritized, and completed. The storm led to a SBA declaration for the State of Arizona.
- August 7-10, 2015. The four (4) Pima County Flood Control ALERT rain gauges located in Oro Valley measured over one (1) inch of rain, with one measuring over three (3) inches of rain in a short amount of time. These back-to-back storms produced a lot of rain, sediment, debris, and flooded dip crossings.
- August 31, 2015. This storm had limited rainfall, but caused wind damage due to microburst, power outages, and damages to public infrastructure.
- August 1-2, 2016. Significant rainfall amounts over consecutive days across the metro region, including Oro Valley. Due to saturated ground conditions, there was concern for regional impacts with any additional precipitation.
- August 17, 2016. This storm brought heavy rain, flooded roadways, high winds, microburst, lightning caused fires, and power outages due to downed power poles. This storm resulted in damages to both public and private infrastructure.

There may also be other cascading events associated with a flood such as damages to infrastructure, severe wind (microbursts), downed power poles, power outages, uprooted trees, flooded homes, and other related damages.

The Pascua Yaqui flood vulnerability is mainly related to the main body of land for the tribe that is located in the Black Wash flood plain. The Black Wash gathers waters from washes from the Tohono O'odham and Pima County, runs through the jurisdiction and then back into Pima County. The flooding affects the residences as well as the business and gaming communities by cutting off critical services from citizens. In 2015, a monsoon flood event washed out critical communications infrastructure including phone and data lines.

The Town of Sahuarita is vulnerable to flooding mainly due to its proximity to the Santa Cruz River. Several large washes run through the Town and upstream rain events can overwhelm wash channels. Sahuarita Road runs from SR83 to the east to just west of I-19 through the town. Sahuarita Road has numerous low-level wash crossings that are vulnerable to flood events and can cut off citizens from emergency services. Numerous modular housing areas have structures with increased vulnerability to flooding when washes back up as well.

Flooding in Tucson is a yearly expectation during the summer monsoon and often during the winter weather patterns as well. The community is generally fairly well prepared for these storms and their short-term flash flooding effects. Although every year damage is done to roadways and other infrastructure and people become stuck, and sometimes injured or killed, while trying to cross flooded washes that cross roadways. The flood vulnerability may come from two other sources. First, the potential for the track of tropical storm/hurricane remnants from the Pacific Ocean, usually via the Gulf of California, has led to widespread and large-scale rainfall causing severe flooding of large drainages such as the Santa Cruz River. These storms usually coincide with the tail end of the monsoon events. Second, there is a history of large scale flooding events from El Niño weather patterns occurring during Tucson's winter rainy season. These weather patterns can again greatly increase overall rainfall over a short period of the season leading to flooding. They can also create cascading events such as a heavy snowpack on the mountains that border Tucson, followed by a warm tropical rainstorm that leads to heavy snowmelt and flooding of waterways and washes within the City.

While mitigation projects throughout the city have been underway since the record flooding in 1983, caused by remnants of Tropical Storm Octave, there are still large lengths of waterways and washes that are vulnerable to erosion, bank degradation, and other flooding threats. Numerous bridges and roadways are vulnerable to substantial infrastructure damage during large-scale floods.

Loss Estimations

The estimation of potential exposure to high and medium flood hazards was accomplished by intersecting the human and facility assets with the flood hazard limits depicted on the Flood Hazard Maps (See Maps 6-1 and 6-2). Population and residential building figures are from the 2010 Census; counts at the block level were intersected with those flood hazard areas using a more complex dasymetric technique from FEMA's HAZUS-MH software. This technique uses land cover information derived from satellite imagery to remove the areas in Census blocks that are largely without population or housing (e.g. vacant land, agricultural areas, etc.).

Replacement costs for the critical facilities and infrastructure identified in this Plan were taken from work done for the 2012 Plan, with an across-the-board 7% increase applied (due to the change in the Consumer Price Index for the West Region from 2012 to 2016). Replacement costs for the residential buildings were developed using a hybrid approach: the mean residential building replacement cost per block was taken from HAZUS-MH and was then multiplied by the total building count for each block as given in the 2010 Census.

Loss estimates to all facilities located within the high and medium flood hazard areas were then calculated from the replacement costs using a simple ratio. (Most of the assets located within high hazard flood areas will be subject to three feet or less of flooding.) Using the FEMA tables, it is assumed that all structural assets located within the high hazard areas will have a loss-to-exposure ratio of 0.20 (or 20%). A loss-to-exposure ratio of 0.05 (5%) is assumed for assets located in the medium hazard areas. Locally defined floodplains are assumed to have a loss-to-exposure ratio of 0.20 (20%). Table 4-12 summarizes the critical facility, population, and residential housing unit exposure and loss estimates for the high and medium flood hazards.

Each jurisdiction is responsible for identifying their critical facilities and infrastructure. ***Critical facilities and infrastructure*** are systems, structures and infrastructure within a community whose incapacity or destruction would *have a debilitating impact on the defense or economic security of that community* and/or *significantly hinder a community's ability to recover following a disaster*.

The following criteria were used to define critical facilities and infrastructure for this analysis:

1. **Communications Infrastructure:** Telephone, cell phone, data services, radio towers, and internet communications, which have become essential to continuity of business, industry, government, and military operations.
2. **Electrical Power Systems:** Generation stations and transmission and distribution networks that create and supply electricity to end-users.
3. **Gas and Oil Facilities:** Production and holding facilities for natural gas, crude and refined petroleum, and petroleum-derived fuels, as well as the refining and processing facilities for these fuels.
4. **Banking and Finance Institutions:** Banks, financial service companies, payment systems, investment companies, and securities/commodities exchanges.
5. **Transportation Networks:** Highways, railroads, ports and inland waterways, pipelines, and airports and airways that facilitate the efficient movement of goods and people.
6. **Water Supply Systems:** Sources of water; reservoirs and holding facilities; aqueducts and other transport systems; filtration, cleaning, and treatment systems; pipelines; cooling systems; and other delivery mechanisms that provide for domestic and industrial applications, including systems for dealing with water runoff, wastewater, and firefighting.
7. **Government Services:** Capabilities at the federal, state, and local levels of government required to meet the needs for essential services to the public.
8. **Emergency Services:** Medical, police, fire, and rescue systems.

Other assets such as public libraries, schools, businesses, museums, parks, recreational facilities, historic buildings or sites, churches, residential and/or commercial subdivisions, apartment complexes, and so forth, are typically not classified as critical facilities and infrastructure unless they serve a secondary function to the community during a disaster emergency (e.g. - emergency housing or evacuation centers).

In summary, nearly $230 million in critical facility related losses are estimated for high and medium flood hazards, for all the participating jurisdictions in Pima County. An additional $1.03 billion in high and medium flood losses to 2010 Census residential housing units is estimated for all participating Pima County jurisdictions. Regarding human vulnerability, a total population of 37,951 people, or 3.9% of the total population, is potentially exposed to a high hazard flood event. A total population of 44,024 people, or 4.6% of the total population, is potentially exposed to a medium hazard flood event. This exposure is based upon FEMA floodplains. Exposure loss estimates for locally defined floodplains and levees is provided below in Table 4-11.

It is noted that the loss and exposure numbers presented above represent a comprehensive evaluation of the County as a whole. It is unlikely that a storm event would occur that would flood all of the delineated high and medium flood hazard areas at the same time. Accordingly, actual event based losses and exposure are likely to be only a fraction of those summarized above. Furthermore, any flood event that exposes assets or population to a medium hazard will also expose assets and populations to the high hazard flood zone. That is, the 100-year floodplain would be entirely inundated during a 500-year flood in the localized area of impact.

Table 4-10: Pima County Exposure and Loss Estimates Due to Flooding

Flood Hazard Exposure/Loss	Marana	Oro Valley	Pascua Yaqui Tribe	Sahuarita	South Tucson	Tucson	Unincorp Pima County	Total
Total Critical Facilities	**270**	**132**	**17**	**74**	**20**	**1,552**	**1,374**	**3,439**
Facilities in High Hazard Areas	99	7	0	23	0	71	91	291
Percentage of Total Facilities	36.7%	5.3%	0.0%	31.1%	0.0%	4.6%	6.6%	8.5%
Estimated Replacement Cost (x $1,000)	$418,998	$9,896	$0	$140,530	$0	$199,014	$234,820	$1,003,258
Estimated Structure Loss (x $1,000)	$83,800	$1,979	$0	$28,106	$0	$39,803	$46,964	$200,652
Facilities in Medium Hazard Areas **Not Protected by Levees** *	36	0	13	0	0	71	14	134
Percentage of Total Facilities *	13.3%	0.0%	76.5%	0.0%	0.0%	4.6%	1.0%	3.9%
Estimated Replacement Cost (x $1,000) *	$102,348	$0	$95,391	$0	$0	$242,089	$35,197	$475,025
Estimated Structure Loss (x $1,000) *	$5,117	$0	$4,770	$0	$0	$12,104	$1,760	$23,751
Facilities in Medium Hazard Areas **Protected by Levees** *	4	3	0	0	0	18	9	34
Percentage of Total Facilities *	1.5%	2.3%	0.0%	0.0%	0.0%	1.2%	0.7%	1.0%
Estimated Replacement Cost (x $1,000) *	$1,818	$20,876	$0	$0	$0	$8,640	$76,770	$108,104
Estimated Structure Loss (x $1,000) *	$91	$1,044	$0	$0	$0	$432	$3,838	$5,405
Total Population	**34,718**	**40,806**	**3,691**	**25,267**	**5,612**	**523,012**	**337,676**	**970,782**

Population in High Hazard Areas	2,914	563	279	803	3	16,013	17,376	37,951
Percent Exposed	8.4%	1.4%	7.6%	3.2%	0.1%	3.1%	5.1%	3.9%
Population in Medium Hazard Areas **Not Protected by Levees** *	8,413	97	3,370	754	0	22,668	6,379	41,681
Percent Exposed *	24.2%	0.2%	91.3%	3.0%	0.0%	4.3%	1.9%	4.3%
Population in Medium Hazard Areas **Protected by Levees** *	784	649	0	0	0	62	1,529	3,024
Percent Exposed *	2.3%	1.6%	0.0%	0.0%	0.0%	0.0%	0.5%	0.3%
Total Residential Building Count	**14,615**	**20,205**	**896**	**10,626**	**2,116**	**231,414**	**157,525**	**437,397**
Estimated Replacement Cost (x $1,000)	**$3,636,438**	**$5,710,908**	**$146,861**	**$2,673,610**	**$364,907**	**$66,121,087**	**$36,203,274**	**$114,857,085**
Structures in High Hazard Areas	1,155	283	66	281	1	7,622	7,083	16,491
Percentage of Total Structures	7.9%	1.4%	7.4%	2.6%	0.0%	3.3%	4.5%	3.8%
Estimated Replacement Cost (x $1,000)	$273,173	$79,888	$10,669	$69,088	$117	$2,204,333	$1,363,762	$4,001,030
Estimated Structure Loss (x $1,000)	$54,635	$15,978	$2,134	$13,818	$23	$440,867	$272,752	$800,206
Structures in Medium Hazard Areas **Not Protected by Levees** *	3,221	46	815	316	0	10,633	2,755	17,786
Percentage of Total Structures *	22.0%	0.2%	91.0%	3.0%	0.0%	4.6%	1.7%	4.1%
Estimated Replacement Cost (x $1,000) *	$704,812	$13,161	$134,904	$71,172	$0	$2,801,127	$580,502	$4,305,678
Estimated Structure Loss (x $1,000) *	$35,241	$658	$6,745	$3,559	$0	$140,056	$29,025	$215,284
Structures in Medium Hazard Areas **Protected by Levees** *	290	329	0	0	0	20	573	1,212
Percentage of Total Structures *	2.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.4%	0.3%
Estimated Replacement Cost (x $1,000) *	$67,848	$94,766	$0	$0	$0	$5,827	$125,144	$293,585
Estimated Structure Loss (x $1,000) *	$3,392	$4,738	$0	$0	$0	$291	$6,257	$14,679

** Medium hazard area figures ONLY include critical facilities, population, or structures outside of high hazard areas (but within medium hazard areas)*

Sources: U.S. Federal Emergency Management Agency, 2016; Pima County GIS, 2016; Pima County Office of Emergency Management, 2012; U.S. Bureau of the Census, 2010; FEMA, HAZUS-MH v3.1, 2016.

Table 4-11: Pima County Exposure and Loss Estimates Due to Flooding in Local Flood Hazard Areas

Flood Hazard Exposure/Loss*	Marana	Oro Valley	Pascua Yaqui Tribe	Sahuarita	South Tucson	Tucson	Unincorporated Pima County	Total
Total Critical Facilities	**270**	**132**	**17**	**74**	**20**	**1,552**	**1,374**	**3,439**
Facilities in Local Flood Hazard Areas	0	0	0	1	0	23	27	51
Percentage of Total Facilities	0.0%	0.0%	0.0%	1.4%	0.0%	1.5%	2.0%	1.5%
Estimated Replacement Cost (x $1,000)	$0	$0	$0	$145	$0	$103,425	$247,040	$350,610
Estimated Structure Loss (x $1,000)	$0	$0	$0	$29	$0	$20,685	$49,408	$70,122
Total Population	**34,718**	**40,806**	**3,691**	**25,267**	**5,612**	**523,012**	**337,676**	**970,782**
Population in Local Flood Hazard Areas	168	11	1	105	0	9,248	10,519	20,052
Percent Exposed	0.5%	0.0%	0.0%	0.4%	0.0%	1.8%	3.1%	2.1%
Total Residential Building Count	**14,615**	**20,205**	**896**	**10,626**	**2,116**	**231,414**	**157,525**	**437,397**
Estimated Replacement Cost (x $1,000)	**$3,636,438**	**$5,710,908**	**$146,861**	**$2,673,610**	**$364,907**	**$66,121,087**	**$36,203,274**	**$114,857,085**
Structures in Local Flood Hazard Areas	83	4	0	47	0	4,119	4,717	8,970
Percentage of Total Structures	0.6%	0.0%	0.0%	0.4%	0.0%	1.8%	3.0%	2.1%
Estimated Replacement Cost (x $1,000)	$22,166	$968	$0	$9,627	$0	$956,007	$949,042	$1,937,810
Estimated Structure Loss (x $1,000)	$4,433	$194	$0	$1,925	$0	$191,201	$189,808	$387,561

** Local Flood Hazard Areas are selected Special Studies Floodplains defined by Pima County, not by FEMA*
Source: Pima County GIS, 2017; Pima County Office of Emergency Management, 2012; U.S. Bureau of the Census, 2010; FEMA, HAZUS-MH v3.1, 2016.

Development Trends

For most Pima County jurisdictions, adequate planning and regulatory tools are in place to regulate future development. Challenges with new growth will include the need for master drainage planning and additional floodplain delineations to identify and map the flood hazards within the growth areas where no mapping currently exists. In anticipation of development, Pima County assures that subdivisions are protected. Studies of watersheds and high flood hazard areas are identified before development, so that they are avoided as much as possible and prospective developers are aware of any remaining issues such as all-weather accessibility.

Future flood hazards are more likely to be significant outside of the urban core where much of the existing development pre-dates regulation that is more stringent or where the regulation of hazards including road access is currently limited. However, events of greater magnitude than the base flood due to climate variability may increase flood related hazards throughout Pima County.

The PCRFCD has been actively creating new floodplain delineations outside of FEMA designated floodplains and continually strives to improve floodplain development to create a more flood resilient community. Because of mapping efforts, the aerial extent of local floodplains within Pima County exceeds the extent of federally mapped floodplains. In addition to elevating structures above the base flood, the PCRFCD has recently made great strides forward in protecting structures from erosion hazards using setbacks from regulatory washes and protecting building foundations for structures placed in regulatory floodplains. Robust protection of natural floodplain functions and the acquisition of flood prone land further removed development pressure on some of the most hazardous areas further increasing flood resilience of Pima County.

The vegetation characteristics of Pima County's arid environment, combined with anthropomorphic alterations to the landscape, create conditions that promote the lateral migration of watercourses. Erosion along major watercourses has been some of the most dramatic flood damage in recent history. For this reason, Pima County does not allow new construction within erosion hazard areas unless structural protections are in place. Furthermore, the PCRFCD's CIP has focused on providing bank protection and open space along major watercourses.

Natural floodplains benefit the community by reducing flood and erosion hazards, improving water quality, increasing groundwater recharge and providing biological corridors for plants and wildlife to thrive, all providing a public health, safety, and economic benefit to the citizens of Pima County. To the greatest extent possible, the PCRFCD promotes maintaining the natural functions of floodplains over structural measures to control flooding.

National Flood Insurance Program Participation

Participation in the NFIP is a key element of any community's local floodplain management and flood mitigation strategy. Pima County and the six other incorporated jurisdictions participate in the NFIP. Joining the NFIP requires the adoption of a floodplain management ordinance that requires jurisdictions to follow established minimum standards set forth by FEMA and the State of Arizona, when developing in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by the 100-year flood, and that new floodplain development will not aggravate existing flood problems or increase damage to other properties. As a participant in the NFIP, communities also benefit from having Flood Insurance Rate Maps (FIRM) that map identified flood hazard areas and can be used to assess flood hazard risk, regulate construction practices and set flood insurance rates. FIRMs are also an important source of information to educate residents, government officials and the private sector about the likelihood of flooding in their community. Table 4-13 summarizes the NFIP status and statistics for each of the jurisdictions participating in this Plan.

Table 4-12: NFIP Statistics as of July 31, 2016

Jurisdiction	Community ID	NFIP Entry Date	Current Effective Map Date	Number of Policies	Amount of Coverage (x $1,000)	Floodplain Management Role
Pima County	040073	2/15/1983	6/16/2011	2,392	$552,626	Managed through PCRFCD
Marana	040118	8/1/1984	6/16/2011	323	$85,207	Provides floodplain management for the town
Oro Valley	040109	12/4/1979	6/16/2011	182	$51,057	Provides floodplain management for the town
Pascua Yaqui Tribe	---	---	---	---	---	Not a Participant in the NFIP
Sahuarita	040137	6/30/1997	6/16/2011	41	$11,239	Provides floodplain management for the town
South Tucson	040075	1/31/1979	6/16/2011	1	$105	City defers floodplain management to PCRFCD
Tucson	040076	8/2/1982	6/16/2011	1,771	$386,249	Provides floodplain management for the city

Source: http://bsa.nfipstat.com/reports/1011.htm (7/31/2016); "Current Effective Map Date" is from FEMA Community Status Report in NFIP (2/16/2011 – and current))

Repetitive Loss Properties

Repetitive Loss (RL) properties are those NFIP-insured properties that since 1978, have experience multiple flood losses. FEMA tracks RL properties and in particular to identify Severe RL (SRL) properties. RL properties demonstrate a record of accomplishment of repeated flooding for a certain location and are one element of the vulnerability analysis. RL properties are also important to the NFIP, since structures that flood frequently put a strain on the National Flood Insurance Fund.

Per data provided to the County by FEMA on May 31, 2016 there are seven unmitigated Repetitive Loss Properties in unincorporated Pima County. One of these has been mitigated however; documents have yet to be submitted to FEMA to have it removed from the list. There are no SRL properties.

Table 4-13: Repetitive Loss Property Statistics by Jurisdiction

Jurisdiction	No. of Properties	No. of Properties Mitigated	Total Payments
Oro Valley	1	0	$41,805
Tucson	4	0	$173,829
Unincorporated Pima County	7	3	$664,067

Source: FEMA, 2016 for Unincorporated Pima County

4.4.6 Landslide

Description

Landslide is the generic term used to describe the downslope movement of earth materials due to gravity. 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. Landslides may be triggered by earthquakes, extreme precipitation, flooding, or otherwise removing support from the slope. Debris flows, a common type of landslide in Arizona, often occur in areas disturbed by wildfires. 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. Pima County is located in the Basin and Range Province.

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 translational landslides are the most common type of

landslides in Pima County. These landslides typically occur on steep upper slopes of mountain ranges; the material may be deposited at the base of slopes where failures occur, or transported to valley floors and alluvial fans at canyon mouths. Some of the fastest urban growth areas in Pima County are along the mountain fronts; these are vulnerable to debris flows as evidenced by geologic deposits and by recent events[1].

Cascading events are a hazard with landslides. The nature of cascading events associated with landslides stems from the mass, volume, water content, soil and 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).
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

History

In 2006, extreme precipitation caused ~1,000 debris flows in four mountain ranges in southern Arizona[2,3]. Debris flows in the Santa Catalina Mountains north of Tucson occurred in nine canyons; debris flows exited or nearly exited the mouths of five of those canyons flowing into developed areas[4]. Costs to repair infrastructure destroyed in Sabino Canyon was ~ $1.5 million while damage in other areas were not documented. While the 2006 debris flows illustrate how damaging large landslide events can be, the Pima County Department of Transportation consistently has to repair damage to roadways from individual landslides, particularly rockfalls along the Santa Catalina Highway according to the Pima County Department of Transportation. Landslides are an ongoing issue within Pima County.

Probability and Magnitude

High-intensity and/or long-duration precipitation may cause landslides by oversaturating hillslope soils. Disturbances to slopes, particularly from wildfires, changes hydrologic conditions making slopes more susceptible to failure from rainfall runoff generated by commonly occurring storms (high-frequency, low-magnitude storms). Removal of substrate support (soil or rock) from the slopes where highways and roads are built can also result in landslides. 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, with varying effects depending on location. Future climate variability could increase the frequency and number of landslide events if that variability leads to an increase in erosional weather factors.

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 environments[5].

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1 Youberg, A.M., Webb, R.H., Fenton, C.R., and Pearthree, P.A., 2014, Latest Pleistocene–Holocene debris flow activity, Santa Catalina Mountains, Arizona; Implications for modern debris-flow hazards under a changing climate: Geomorphology, v. 219, p. 87-102.

2 Pearthree, P.A., Youberg, A., 2006, *Recent Debris Flows and Floods in Southern Arizona*, Arizona Geology, Vol. 36, No. 3

3 Magirl, C.S., Webb, R.H., Griffiths, P.G., Schaffner, M., Shoemaker, C., Pytlak, E., Yatheendradas, S., Lyon, S.W., Troch, P.A., Desilets, S.L.E., Goodrich, D.C., Unkrich, C.L., Youberg, A., and Pearthree, P.A., 2007, Impact of recent extreme Arizona storms: Eos, Transactions American Geophysical Union, v. 88, no. 17, p. 191-193.

4 Webb, R.H., Magirl, C.S., Griffiths, P.G., and Boyer, D.E., 2008, Debris Flows and Floods in Southeastern Arizona from Extreme Precipitation in Late July 2006: Magnitude, Frequency, and Sediment Delivery. U.S. Geological Survey Open-File Report 2008-1274, 95 p.

5 US Geological Survey, 2009, Landslides Hazards Program, online at http://landslides.usgs.gov/

County-owned facilities most vulnerable to landslides are roadways and bridges/culverts along known debris flow areas on the Catalina Highway up Mount Lemmon within the Coronado National Forest.

Table 4-14: CPRI Results for Landslide

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	Unlikely	Limited	12-24 hours	<24 hours	1.55
Oro Valley	Possible	Limited	<6 hours	<6 hours	2.20
Pascua Yaqui Tribe	Unlikely	Negligible	<6 hours	<6 hours	1.45
Sahuarita	Unlikely	Negligible	>24 hours	<6 hours	1.00
Tucson	Unlikely	Negligible	<6 hours	<6 hours	1.45
Unincorporated Pima County	**Likely**	**Limited**	**<6 hours**	**<6 hours**	**2.65**
				County-wide average CPRI =	**1.72**

Jurisdictions in bold chose the hazard for mitigation in 2017 plan.

Unincorporated Pima County has ongoing vulnerabilities, particularly along the Santa Catalina Highway, due mainly to rockfalls and debris flows. Pima County Department of Transportation and the Arizona Geological Survey are planning surveys to document areas along the highway that experience repeated landslides to identify areas to potential mitigation efforts. Post-wildfire debris flows are also common in Arizona and Pima County. Some of the more recent post-fire debris flows have been documented[6] and debris flows that occur in the future will be added to the landslide database.

Loss Estimation

Losses are difficult to estimate given the a lack of accepted measurement standards, however, the County spends significant time and money removing and repairing landslide occurrences along this and several other roadways, especially following precipitation events. During rainfall events, residential properties in the Santa Catalina's and other regional ranges have suffered damage from land and mudslide events. The losses in the Santa Catalina Sabino Canyon flood and rockslide topped over 1 million dollars in 2006[7].

Development Trend Analysis

As development in unincorporated Pima County along the margins of the mountain ranges, building code enforcement is critical for any new development. Roadway improvements or development should follow current Federal Highway Administration design guidelines to avoid landslide hazards.

[6] Youberg, A., 2015, Geodatabase of Post-Wildfire Study Basins: Assessing the predictive strengths of post-wildfire debris-flow models in Arizona, and defining rainfall intensity-duration thresholds for initiation of post-fire debris flow. Arizona Geological Survey, geodatabase, excel workbook, report 10 p. http://repository.azgs.az.gov/uri_gin/azgs/dlio/1635

[7] Arizona State Geological Survey, http://www.azgs.az.gov/Hazards_ocr/slopefailure/Landslide-fact-sheet3.pdf, retrieved 2017

4.4.7 Severe Wind

Description

The hazard of severe wind encompasses all climatic events that produce damaging winds. For Pima County, severe winds usually result either from extreme pressure gradients that usually occur in the spring and early summer months, or from thunderstorms. Thunderstorms can occur year-round and are usually associated with cold fronts in the winter, monsoon activity in the summer, and tropical storms in the late summer or early fall. Three types of damaging wind related features typically accompany a thunderstorm, downbursts, straight-line winds, and infrequently, tornadoes.

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 60 mph or higher. Downburst winds have been measured as high as 140 mph. Downbursts are called macrobursts when the diameter is greater than 2.5 miles, and microbursts when the diameter is 2.5 miles or less. They can be either dry or wet downbursts, where the wet downburst contains precipitation that continues all the way down to the ground, while the precipitation in a dry downburst evaporates 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 downbursts 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.[1]

Straight-line winds are developed similar to downbursts, but are usually sustained for greater periods as a thunderstorm reaches the mature stage, traveling parallel to the ground surface at speeds of 75 mph or higher. These winds are frequently responsible for generating dust storms, sometimes called haboobs, reducing visibility and creating hazardous driving conditions.

A tornado is a rapidly rotating funnel (or vortex) of air that extends from the cloud to the ground. Most funnel clouds do not touch the ground, but when the lower tip of the funnel cloud touches the earth it becomes a tornado and can cause extensive damage. Tornadoes can also form when a dust devil is stretched upward to make contact with a thunderstorm cloud. For Pima County, tornadoes are the least common severe wind.

History

Pima County has had one state / federal declaration involving severe winds. The combined economic loss of those events is over $29.2 million to property and agriculture in the last 50 years, and there were at least 3 deaths and 103 injuries, with most being related to dust storm related accidents on Interstate 10. In reality, severe wind events occur on a significantly more frequent basis throughout the county, but do not always have reported damages associated with every event. For example, a search of the database revealed 120 events for the period of September 2011 through September 2016 when searching for “thunderstorm wind,” “tornado,” and “high wind”[2]. However, not all of those events had reports of damages, fatalities, or injuries associated with them. The following are examples of documented past events that have occurred in the last five years:

- In June 2009, severe thunderstorm downburst winds caused significant damage at Three Points. Several mobile homes and nearby sheds were either heavily damaged or destroyed. A more substantial brick veneer building was also damaged, with varying degrees of roof damage reported to several homes in Three Points. Several large trees were uprooted completely. Winds from this severe thunderstorm were estimated to be near 85 mph. Three Points Fire reported one injury was received by flying glass, after winds blew out a house window. Damages were estimated to exceed $150,000[2].
- In August 2010, local broadcast media reported up to 3 dozen trees damaged or uprooted in Rancho Vistoso neighborhood. A few ceramic roof tiles were also blown off homes. In addition, a NWS Employee reported several trees down in Dove Mountain with one tree leaning up against a home. There was only slight tile damage to the home. In addition, local broadcast media reported trees and power lines down in Marana at Interstate 10 and Marana/Trico Road as well as a roof ripped off a mobile home. The Marana Airport also sustained damage. Two small airplanes were ripped from their tie down chains and were flipped over while

[1] Arizona Division of Emergency Management, 2004, State of Arizona All Hazard Mitigation Plan.

[2] National Centers for Environmental Information (NCEI), 2016, https://www.ncdc.noaa.gov/stormevents/

another plane was blown into a field. A large hangar door was blown off its tracks and a few other hangars sustained light damage. In the same area, several power poles and lines were downed on Twin Peaks Road east of N. Sandario Road. Damages were estimated to exceed $100,000[2].

- Between 2011 and April 2016, there were 73 thunderstorm wind events in Pima County resulting in $4.766 million dollars in damage. On September 10, 2011, 66 mph winds hit south Tucson downing power poles, electric lines, street signs and trees. One trailer park had to be evacuated when a power pole hit a mobile home, and parts of roofs were blown off. Damage was estimated at $500K[3].
- On August 16, 2011, 69 mph winds downed trees and 18 power poles in Marana, closing Ina Road and isolating much of the community. Damage was estimated at $250K[3].
- On July 4, 2011, 58 mph winds brought trees and power poles across the Tucson area destroying buildings and tearing off roofs of a number of buildings. Over 20,000 residents were without power and damage was estimated at $750K[3].
- On July 15, 2012, 70 mph thunderstorm winds uprooted dozens of trees and snapped numerous power poles. About 15,000 customers were left without power. In addition, thunderstorm winds blew in a door at the Tucson Mall, knocking down an interior construction. Damages was estimated at $100K[3].
- On July 5, 2013, 74 mph thunderstorm winds downed two dozen power poles leaving 8,000 customers without electrical power. Thirty mobile homes were damaged by winds or downed trees. Two hangar doors were blown off at the Tucson International Airport. Damage was estimated at $150K[3].
- On July 13, 2014, 75 mph winds brought down telephone and power poles, trees, blew roofs off two east side homes, and flipped over a jet at the Davis-Monthan Air Force Base boneyard. Damage was estimated at $150,000, as the jets were not operational[3].
- On July 6, 2016, 75 mph thunderstorm winds uprooted dozens of large trees from Winterhaven to Himmel Park. Many of the trees fell on apartment buildings, houses and vehicles, and the roof of a church suffered severe wind damage. For some residents, power was not restored until noon on June 27. One person was electrocuted after coming in contact with a live downed wire but survived. Damage was estimated at $1 million[3].

Probability and Magnitude

Most severe wind events are associated with thunderstorms as previously mentioned. According to the NCEI database, from September 2011 to September 2016, Pima County averaged about 27 severe wind events a year totaling $3.5 million dollars in estimated damages. For that same five-year period, approximately $5.8 million in damages were estimated[3].

The NWS issues a severe thunderstorm watch when conditions are favorable for the development of severe thunderstorms. The local NWS office considers a thunderstorm severe if it produces hail at least 1 inch in diameter, wind of 58 mph or higher, or tornadoes. When a watch is issued for a region, residents are encouraged to continue normal activities but should remain alert for signs of approaching storms, and continue to listen for weather forecasts and statements from the local NWS office. When a severe thunderstorm has been detected by weather radar or one has been reported by trained storm spotters, the local NWS office will issue a severe thunderstorm warning. A severe thunderstorm warning is an urgent message to the affected counties that a severe thunderstorm is imminent. The warning time provided by a severe thunderstorm watch may only be hours, while a severe thunderstorm warning typically provides an hour or less warning time. As such, any future climate variability that increases these storms will increase the probability for damaging winds.

Based on the historic record, the probability of tornadoes occurring in Pima County is limited. Since 1950, 21 tornadoes have been observed. Tornado damage severity is measured by the Enhanced Fujita Tornado Scale, which assigns a numerical value of 0 to 5 based on wind speeds\ with the letters EF preceding the number (e.g., EFO, EF1, and EF2). All tornadoes in Pima County have been rated at EF2 or lower on the scale, but 3 fatalities and 53 injuries

[3] National Centers for Environmental Information (NCEI), 2016, https://www.ncdc.noaa.gov/stormevents/

have been attributed to tornadoes. Most tornadoes in southern Arizona last less than 15 minutes, have a path length of less than 1 mile and are less than 100 yards in width[4].

Vulnerability

Table 4-15: CPRI Results for Severe Wind for 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	Possible	Critical	6 to 12 hours	< 24 hours	2.45
Oro Valley	Likely	Limited	< 6 hours	< 6 hours	2.65
Pascua Yaqui Tribe	Likely	Limited	6 to 12 hours	< 6 hours	2.50
Sahuarita	Likely	Limited	< 6 hours	<1 week	2.85
Tucson	**Likely**	**Limited**	**<6 hours**	**<6 hours**	**2.65**
Unincorporated Pima County	**Highly Likely**	**Critical**	**12-24 hours**	**< 6 hours**	**3.10**
				County-wide average CPRI =	2.68

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

Severe wind in Tucson usually follows closely on the tails of the summer monsoon season. While heavy rainfall is predictable that time of year, and leads to short-term flash flooding, and the community is resilient to these weather events, severe wind is less predictable with these storms. While the average monsoon storm produces wind gusts between 45 and 65mph, some stronger storms produce straight line winds over 75mph.

Other storms, especially during the beginning of the monsoon in late July when there is still substantial daily ground heating, produce what are called microbursts (rapid pressure changes in the upper atmosphere that lead to large air masses dropping rapidly to the ground creating wind damage in a radius around the storm). Other storms have been reported near Tucson, with funnel clouds, and while most do not touch the ground, if a funnel cloud were to touch down and become a tornado, residents and businesses would find themselves vulnerable for wind damage to their homes and buildings and there would potentially be extreme damage to above ground infrastructure like power distribution systems.

Unincorporated Pima County's vulnerability is also because of mainly monsoon-type storms. The Pima County Department of Transportation is working to reduce the vulnerability of signs and signal poles to severe wind events such as microbursts. High winds and monsoonal outflows can also damage power lines leading to outages causing loss of cooling for thousands of residents.

Loss Estimations

The entire County is exposed to the damage risks associated with severe winds. Typically, incidents are fairly localized and damages associated with individual events are relatively small. Based on the historic record over the last five years, it is feasible to expect average annual losses of $0.5 to $1.0 million countywide. It is difficult to estimate losses for individual jurisdictions within the County due to the lack of discrete data.[1]

Development Trend Analysis

Future development will expand the exposure of life and property to the damaging effects of severe wind events. Enforcement and/or implementation of modern building codes to regulate new developments in conjunction with public education on how to respond to severe wind conditions are arguably the best way to mitigate against losses.

[4] National Centers for Environmental Information (NCEI), 2016, https://www.ncdc.noaa.gov/stormevents/

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4.4.8 Wildfire

Description

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke. Wildfires can be human-caused through acts such as arson, campfires, or the improper burning of debris, or can be caused by natural events such as lightning. Wildfires can be categorized into four types:

- ***Wildland fires*** occur mainly in areas under federal control, such as national forests and parks, and are fueled primarily by natural vegetation. Generally, development in these areas is nonexistent, except for roads, railroads, power lines, and similar features.
- ***Interface or intermix fires*** occur in areas where both vegetation and structures provide fuel. These are also referred to as wildland urban interface (WUI) fires. The WUI is commonly described as the zone where structures and other features of human development meet and intermingle with undeveloped wildland or vegetative fuels[1].
- ***Firestorms*** occur during extreme weather (e.g., high temperatures, low humidity, and high winds) with such intensity that fire suppression is virtually impossible. These events typically burn until the conditions change or the fuel is exhausted.
- ***Prescribed fires and prescribed natural fires*** are intentionally set or natural fires that are allowed to burn for beneficial purposes.

The following three factors contribute significantly to wildfire behavior and, as detailed more fully later, they can be used to identify wildfire hazard areas:

- ***Topography***: As slope increases, the rate of wildfire spread increases. South facing slopes are also subject to greater solar radiation, making them drier and thereby intensifying wildfire behavior. However, ridgetops may mark the end of wildfire spread, since fire spreads more slowly or may even be unable to spread downhill.
- ***Fuel:*** Wildfires spread based on the type and quantity of available flammable material, referred to as the fuel load. The basic characteristics of fuel include size and shape, arrangement and moisture content. Each fuel is assigned a burn index (the estimated amount of potential energy released during a fire), an estimate of the effort required to contain a wildfire, and an expected flame length.
- ***Weather:*** The most variable factor affecting wildfire behavior is weather. Important weather variables are temperature, humidity, wind, and lightning. Weather events ranging in scale from localized thunderstorms to large fronts can have major effects on wildfire occurrence and behavior. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildfire activity. By contrast, cooling and higher humidity often signals reduced wildfire occurrence and easier containment. Wind has probably the largest impact on a wildfire's behavior, and is the most unpredictable. Winds supply the fire with additional oxygen, further dry potential fuel, and push fire across the land at a quicker pace.

The frequency and severity of wildfires is also impacted by other hazards, such as lightning, drought, and infestations (e.g., Pine Bark Beetle). In Arizona, these hazards combine with the three other wildfire contributors noted above (topography, fuel, weather) to present an on-going and significant hazard across much of Arizona.

If not promptly controlled, wildfires may grow into an emergency or disaster. Even small fires can threaten lives, resources, and destroy improved properties. It is also important to note that in addition to affecting people, wildfires may severely affect livestock and pets. Such events may require the emergency feeding, shelter, evacuation, and increased event-caused deaths and burying of animals.

The indirect effects of wildfires can also 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

[1] Pima County Community Wildfire Protection Plan, 2013: http://webcms.pima.gov/cms/One.aspx?pageId=45265

streams thereby enhancing flood potential, harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased landslide hazards.

History

Wildfires have a prominent history in Pima County. Pima County has been included in 17 state and/or federal wildfire disaster declarations, none of which has occurred since the writing of the 2012 plan. There have been three wildfires that burned more than 10,000 acres in the last fifteen years in Pima County:

- In May of 2002, the Bullock Fire started in Bullock Canyon in the Catalina Mountains on the Coronado National Forest. The fire started on May 21 and continued through June 10. It was suspected to be human induced. The fire burned 30,563 acres along with two cabins and several outbuildings. The residents of Summerhaven were evacuated on May 25 and Catalina Highway closed on May 22. The fire also threatened Mt. Bigelow which had several telecommunication towers and 2 telescopes, however, fire fighters were able to contain the fire a half of a mile away. The entire firefight costs were estimated to be $14.3 million[2].
- In June of 2003, the Aspen Fire was started by human causes on June 17, 2003 and burned for about a month on Mount Lemmon, which is part of the Santa Catalina Mountains located in the Coronado National Forest north of Tucson. The fire burned 84,750 acres of land, and destroyed 333 homes and businesses in the community of Summerhaven. Electric lines, phone lines, water facilities, streets and sewers were also damaged. Total property damages were estimated to exceed $66 million. Firefight costs were estimated to exceed $17 million, and the Forest Service spent an estimated $2.7 million dollars to prevent soil loss. The losses in terms of timber for future lumber are estimated at $33 million. In 2002, the year before the fire started, Congress had been requested to allocate about $2,000,000 to cover the implementation of fire prevention measures in the Coronado National Forest. However, that allocation was reduced to about $150,000 in the Congressional budget process. A presidential disaster declaration (FEMA-1477-DR) was made on July 14, 2003.[3]
- In June of 2009, the Elk Horn Fire was started by human causes and an area 26 miles southwest of Three Points, Arizona. The fire started June 11, 2009 and was contained on June 22, 2009. The fire burned a total 23,440 acres with $1M plus in fire suppression costs and five reported injuries related to firefight efforts.

Probability and Magnitude

The probability and magnitude of wildfire incidents for Pima County are influenced by numerous factors including vegetation densities, previous burn history, hydrologic conditions, climatic conditions such as temperature, humidity, and wind, ignition source (human or natural), topographic aspect and slope, and remoteness of area. Wildfire risk for Pima County was mapped based on the data revised for the 2013 Pima County Community Wildfire Protection Plan (PCCWPP)[4]. Pima County and participating jurisdictions and organizations developed the PCCWPP to help local governments, fire departments and districts, and residents identify at-risk public and private lands to protect those lands from a severe wildfire threat.

The PCCWPP identified two models of wildland fuel hazards to represent a typical year of rainfall and an extraordinarily heavy rainfall year to present a range of wildland fuel hazards across the County. Each model divided the fuel hazard into three categories, high, medium and low, and accounted for previous burn areas and the major buffelgrass concerns.

Climate variability may have a positive or negative effect on wildfire risk in the future. Wildfire risk is intertwined with risk of drought in Pima County as well. Figure 4-14 shows the Wildfire hazard potential for Pima County.

[2] National Wildfire Coordination Group, 2016, Historical ICS 209 reports at: http://fam.nwcg.gov/fam-web/hist_209/report_list_209

[3] Arizona Division of Emergency Management, 2013, State of Arizona Multi-Hazard Mitigation Plan; National Wildfire Coordination Group, 2010, Historical ICS 209 reports at: http://fam.nwcg.gov/fam-web/hist_209/report_list_209 ;

[4] Pima County Community Wildfire Protection Plan 2013, http://webcms.pima.gov/cms/One.aspx?pageId=45265

Vulnerability

Table 4-16: CPRI Results for Wildfire for 2017

Participating Jurisdiction	Probability	Magnitude/ Severity	Warning Time	Duration	CPRI Score
Marana	**Possible**	**Critical**	**< 6 hours**	**< 1 week**	**2.70**
Oro Valley	**Likely**	**Critical**	**< 6 hours**	**> 1 week**	**3.25**
Pascua Yaqui Tribe	**Likely**	**Limited**	**< 6 hours**	**< 24 hours**	**2.75**
Sahuarita	Possible	Limited	< 6 hours	< 24 hours	2.30
Tucson	Likely	Negligible	< 6 hours	<6 hours	2.35
Unincorporated Pima County	**Highly Likely**	**Critical**	**< 6 hours**	**> 1 week**	**3.70**
				County-wide average CPRI =	**2.84**

*Jurisdictions in **bold** chose the hazard for mitigation in 2017 plan.*

There has not been a significant WUI event in Marana, but the possibility does exist. The areas of wildland-urban interface (WUI) fire risk in the Town of Marana have been identified. The threat areas primarily consist of the foothills areas of the Tucson and Tortolita Mountains, and the Santa Cruz wash. The threat of a WUI event is directly linked to light fuel vegetation growth, which in turn is tied to rainfall. Without a significant presence of these light fuels (annuals), it is difficult for a fire to carry over a significant distance. The immediate threat would be a WUI event that starts in the Santa Cruz wash due to vegetation overgrowth, causing flying brands or embers to be broadcast over a wide area. Additionally, in times of higher than average rainfall, the Tortolitas (Dove Mountain area) may see an increased WUI potential, but there are natural and fabricated breaks that would provide for a buffer between any residential or business property.

The Town of Oro Valley is susceptible to wildfires due to the border with the Santa Catalina Mountains to the east. On the east side of SR77 in Oro Valley, the homes and businesses are at higher risk to fires due to the proximity to the Catalina's and without major fire breaks like a highway. A fire could potentially burn down the mountain causing concern for homes or businesses located close to those areas. Additionally, wildfires can be more localized due to vegetation overgrowth in washes, buffelgrass, and other available fuels for potential burns. Fire events cause concern to Oro Valley residents on a macro level due to air quality concerns, close proximity to the mountains, and the potential of high visibility fire resources and staging areas for fire crews. Because of the vulnerability to wildfires, regular mitigation projects are identified, prioritized, and completed. This includes the adoption of the PCCWPP, strategic location of wildland crews (GRFD Station #370) to be centralized to potential wildfire threats, and creation of firebreaks in critical areas including along the boundaries of state land surrounding Catalina State Park.

The Pascua Yaqui Tribe's vulnerability to wildland fire is mainly through the wildland fire urban interface. Tribal residences and businesses are situated within areas of natural desert vegetation. In general, brushfires are smaller than three acres. The Tribe is a signee on the PCCWPP and has mutual aid agreements with fire departments in the immediate area and have a cooperative agreement with the BIA in addition to having access to the Tribal Nations Response Team (TNRT).

Unincorporated Pima County is vulnerable for WUI fires in addition to fires on Federal or state land holdings due to high populations living in unincorporated areas in or near the Coronado National Forest, Saguaro National Parks East and West and other open spaces where fuels are moderate to high. The PCCWPP highlights the high population at-risk communities adjacent to public lands administered by the Bureau of Land Management, the National Park Service, and the Coronado National Forest as well as state and county properties. The PCCWPP also contains information on WUI areas in accordance with the Arizona State Forestry Department's guidance. Within 5,877,578 acres, there are 1,579,699 acres designated as WUI with 42% of the WUI being privately held.

Loss Estimations

The Pima County CWPP will be used as a resource to help coordinate long-term interagency mitigation of catastrophic wildfire events in at-risk communities within Pima County. The PCCWPP Core Teams established

specific goals for wildland fire prevention and loss mitigation, but did not address loss estimation, as it is specific to the area characteristics.

The analysis in the PCCWPP includes all risk factors required by the Arizona State Forestry Department. The areas of concern for wildland fuel hazards, risk of ignition and wildfire occurrence, local preparedness, and protection capabilities and loss of community values are evaluated to determine areas of highest wildland fire risk within Pima County. The analysis area included all of Pima County, including tribal lands. The initial analysis depicted all areas within the county at risk for unwanted wildland fire. Subsequent to the initial analysis, the Core Teams identified each Pima County community WUI in accordance with the Arizona State Forestry Division's guidance.[5]

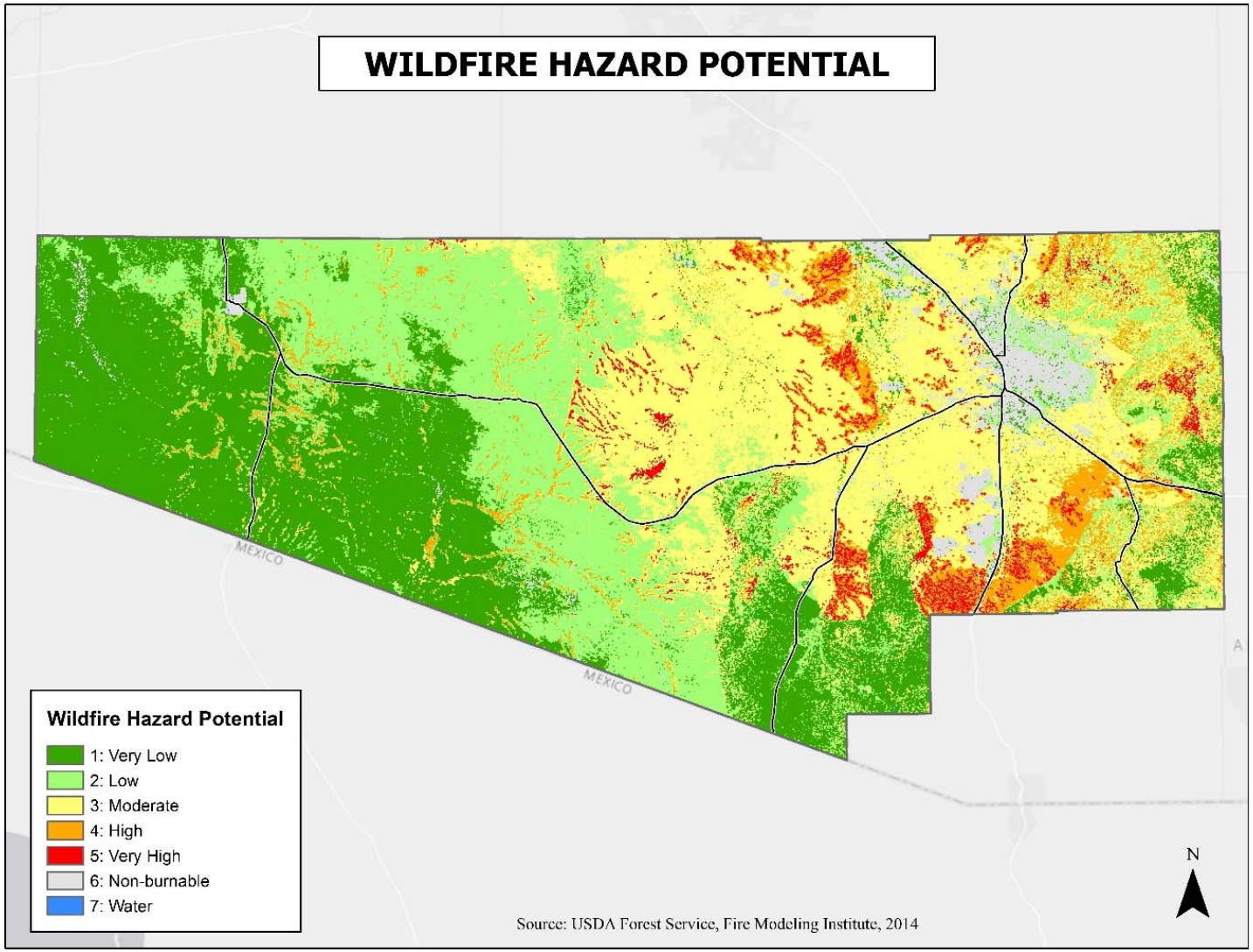
Risk-influencing factors of developed land and other infrastructures within the area of highest flammability were given the highest priority for protection. In areas where community values occur within or adjacent to areas of high risk due to the fuel hazards of vegetation associations, a cumulative risk from catastrophic wildland fire was created.

Development Trend Analysis

By its very definition, the Wildland Urban Interface (WUI) represents the fringe of urban development as it intersects with the natural environment. As previously discussed, wildfire risks are significant for a sizeable portion of the county. Any future development will only increase the WUI areas and expand the potential exposure of structures to wildfire hazards. In Pima County, developments tend to create a clear line of demarcation between the wildland fuels and the built environment. The 2013 PCCWPP analyzed community development throughout the county and found a mix of high-density, single-family, and multi-acre parcels. Development of isolated subdivisions or with more dispersed structure development, such as 1 to 3 acre parcels, are at the highest risk.[6]

[5] Pima County Community Wildfire Protection Plan 2013, http://webcms.pima.gov/cms/One.aspx?pageId=45265

[6] Pima County Community Wildfire Protection Plan 2013, http://webcms.pima.gov/cms/One.aspx?pageId=45265



Source: USDA Forest Service, Fire Modeling Institute, 2014

Figure 4-14: Wildfire Hazard Potential Pima County

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SECTION 5: MITIGATION STRATEGY

5.1 Section Changes

The mitigation strategy provides the "what, when, and how" of actions that will reduce or possibly remove the community's exposure to hazard risks. The three primary components of the mitigation strategy are:

I. **Goals and Objectives (See Section 5.2)**

II. **Capability Assessment (See Section 5.3)**

III. **Mitigation Actions/Projects and Implementation Strategy (See Section 5.4)**

The entire 2012 Plan mitigation strategy was reviewed and updated by the Planning Team. Specifics of the changes and updates are discussed in the subsections below.

5.2 Hazard Mitigation Goal and Objectives

A reassessment of the goals and objectives was made with the planning team at the suggestion of the Arizona State Mitigation Planner. The Team considered the following before revising the goals for 2017:

1. Do the goals and objectives identified in the 2012 Plan reflect the updated risk assessment?
2. Did the goals and objectives identified in the 2012 Plan lead to mitigation projects and/or changes to policy that helped the jurisdiction(s) to reduce vulnerability?
3. Do the goals and objectives identified in the 2012 Plan support any changes in mitigation priorities?
4. Are the goals and objectives identified in the 2012 Plan reflective of current State goals?

Upon consideration, the goal was simplified and objectives were refined to help focus jurisdictions on true mitigation actions.

Goal

- Reduce or eliminate the risk to people and property from natural hazards.

Objectives

- **Objective 1:** Reduce or eliminate risks that threaten life, critical facilities, and infrastructure.
- **Objective 2:** Promote hazard mitigation activities by increasing public awareness and education of hazards and risks.
- **Objective 3:** Integrate mitigation into planning efforts, capital improvement, grants and funding, multijurisdictional collaboration efforts, and training and exercising.

5.3 Capability Assessment

An important component of the Mitigation Strategy is a review of each participating jurisdiction's resources in order to identify, evaluate, and enhance the capacity of local resources to mitigate the effects of hazards. The capability assessment is comprised of several components:

- Legal and Regulatory Review – a review of the legal and regulatory capabilities, including ordinances, codes, plans, manuals, guidelines, and technical reports that address hazard mitigation activities.
- Technical Staff and Personnel – this assessment evaluated and describes the administrative and technical capacity of the jurisdiction's staff and personnel resources.
- Fiscal Capability – this element summarizes each jurisdiction's fiscal capability to provide the financial resources to implement the mitigation strategy.

The Planning Team reviewed the information provided in the 2012 Plan. The Planning Team chose to keep the format of the tables summarizing the administrative, technical, and fiscal capabilities. Each jurisdiction also has a table to summarize the legal and regulatory capabilities by summarizing and identifying the codes, ordinances, plans, and studies/reports used by the jurisdiction, as well as identify the appropriate agency/department with responsibility for

maintaining and updating those documents. Each jurisdiction was asked to update their tables and pare down any unnecessary information.

Jurisdictional Capabilities

Tables 5-1 through 5-19 summarize the legal and regulatory mitigation capability for each participating jurisdiction. Information provided includes a brief listing of current codes, mitigation relevant ordinances, plans, and studies/reports. There are three tables for each jurisdiction summarizing the legal and regulatory capabilities, staff and personnel resources, and the fiscal capability and budgetary tools available to each.

Table 5-1: Pima County Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
CODES	• 2006 International Building, Property Maintenance, Fuel Gas, Plumbing, Mechanical, Energy Conservation, Residential and Wildland-Urban Interface Code • 2005 National Electrical Code	• Development Services • Facilities Management • Department of Environmental Quality • Natural Resources, Parks & Recreation

ORDINANCES	• Pima County Code of Ordinances
	  • Title 7, Environmental Quality
	  • Title 8, Health & Safety
	  • Title 9, Public Peace, Morals & Welfare
	  • Title 15, Buildings & Construction
	  • Title 16, Floodplain and Erosion Hazard Management Ordinance (2010)
	  • Title 17, Air Quality Control
	  • Title 18, Zoning
		• Facilities Management
		• Wastewater Management
		• Department of Environmental Quality
		• Regional Flood Control District
		• Health Department

PLANS, MANUALS, and/or GUIDELINES	• Pima Co Hazard Mitigation Plan (2012) • Stormwater Detention/Retention Manual (1984) • Drainage and Channel Design Standards for Local Drainage Manual (1984) • Technical Policies (Interpretation of the Title 16 and Other Regulatory Documents) • Sonoran Conservation Plan • Pima County Sustainability Program • Pima County Comprehensive Plan • Pima County Drought Management Plan and Water Wasting	• Development Services • Regional Flood Control District
STUDIES	• 1999 Flood Insurance Study, Pima County Unincorporated Areas • FEMA DFIRM Maps (FEMA, Effective date of June 2011) • Special Floodplain Studies (see below) • 1983 Special Study 02 – Critical Watershed Management Plan Ruthrauff Road Area	• Regional Flood Control District

Table 5-2: Pima County Technical Staff and Personnel Capabilities		
Staff/Personnel Resources	☑	**Department/Agency - Position**
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Development Services, Department of Transportation (PCDOT), Regional Flood Control District (PCRFCD), Wastewater, Solid Waste, Natural Resources and Parks
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Development Services, PCDOT, Wastewater
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	☑	Development Services, PCDOT, PCRFCD, Wastewater, Natural Resources and Parks, Health Department
Floodplain Manager	☑	PCRFCD, Development Services
Surveyors	☑	PCDOT, PCRFCD, Natural Resources and Parks
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Development Services, PCDOT, Facilities Management, Health Department, Community Services, Sheriff's Department, Natural Resources and Parks, Risk Management, PCRFCD
Personnel skilled in GIS and/or HAZUS	☑	Development Services, PCDOT, PCRFCD, Wastewater, Facilities Management, Sheriff's Department, Natural Resources and Parks, Information Technology
Scientists familiar with the hazards of the community	☑	Health Department, Wastewater, Medical Examiner, Sheriff's Department
Emergency manager	☑	Office of Emergency Management (OEM)
Grant writer(s)	☑	OEM, Development Services, Health Department, Cultural Resources

Table 5-3: Pima County Fiscal Capabilities		
Financial Resources	**Accessible or Eligible to Use (Yes, No, Don't Know)**	**Comments**
Community Development Block Grants	Yes	
Capital Improvements Project funding	Yes	
Authority to levy taxes for specific purposes	Yes	
Fees for water, sewer, gas, or electric service	Yes	
Impact fees for homebuyers or new developments/homes	Yes	
Incur debt through general obligation bonds	Yes	
Incur debt through special tax bonds	Yes	

Table 5-4: Marana Legal and Regulatory Capabilities		
Regulatory Tools for Hazard Mitigation	**Description**	**Responsible Department/Agency**
CODES	• Marana Town Code • Land Development Code • 2012 International Building Code with amendments additional IBC Amendments • 2012 International Residential Code with amendments additional IRC Amendments • 2012 International Mechanical Code with amendments • 2012 International Plumbing Code with amendments • 2012 International Energy Conservation Code with amendments • 2012 International Property Maintenance Code with amendments • 2011 National Electrical Code with amendments • 2012 International Fire Code with amendments • 2012 International Fuel Gas Code • 2009 ICC A117-1 – Accessible & Useable Buildings and Facilities	• Building Safety • Planning • Engineering • Fire
ORDINANCES, RESOLUTIONS	• Res 2006- 174 – Approving & Authorizing Pima Co Multi-Jurisdictional Hazard Mitigation Plan • Res 2016-004, Sub grantee for funding for 2016 Arizona Department of Homeland Security Program Ordinance • Resolution 2012-077 Approval of MOU with Red Cross for preparing for and responding to disasters • Resolution No. 2012-074 Approval of Emergency Operations Plan • Resolution 2014-056 Approval of Pima County Community Wildlife Protection Plan • Resolution 2014-109 Approval of Arizona Mutual Aid Compact	• Legal • Council • Town Manager • Emergency Management Coordinator
PLANS, MANUALS, and/or GUIDELINES	• Town of Marana Emergency Operations Plan 2012	• Emergency Management Coordinator

Table 5-5: Marana Technical Staff and Personnel Capabilities		
Staff/Personnel Resources	☑	**Department/Agency - Position**
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Department of Public Works, Subdivision Engineering Department
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Department of Public Works, Manager Construction Mgmt. Div.
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	☑	Department of Public Works, Manager Environmental Engineering Div.
Floodplain Manager	☑	Department of Public Works, Subdivision Engineering Department
Surveyors	☑	GIS Department
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Police Department
Personnel skilled in GIS and/or HAZUS	☑	GIS Department/GIS Manager and Staff
Scientists familiar with the hazards of the community	☑	Town Engineer, Water Director, Public Works Director, Planning & Building Director, Fire Marshall
Emergency Management Coordinator	☑	Police Department
Grant writer(s)	☑	Community Development

Table 5-6: Marana Fiscal Capabilities		
Financial Resources	**Accessible or Eligible to Use (Yes, No, Don't Know)**	**Comments**
Community Development Block Grants	Yes	Community Development
Capital Improvements Project funding	Yes	Capital Improvement Program
Authority to levy taxes for specific purposes	Yes	Mayor & Council, Finance Department
Fees for water, sewer, gas, or electric service	Yes	Marana Water Department – Water & Sewer
Impact fees for homebuyers or new developments/homes	Yes	Mayor & Council, Finance Department
Incur debt through general obligation bonds	Yes	Mayor & Council, Finance Department
Incur debt through special tax bonds	Yes	Mayor & Council, Finance Department

Table 5-7: Oro Valley Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
CODES	• 2012 Int'l Building, Residential, Plumbing, Mechanical, Energy Conservation, Property Maintenance, Fire and Gas Code • National Electrical Code (2011) • Americans with Disabilities Act Accessible Guidelines (2010) • Oro Valley Zoning Code, Revised (2016) • Oro Valley Town Code, Chapters 6, 7, 15 & 17	• and Public Works (CDPW)
ORDINANCES	• Oro Valley Floodplain and Erosion Hazard Management Ordinance (2005) • Oro Valley Storm Water Management and Discharge Control Ordinance, Article 15-24 (2008) • Environmental Sensitive Lands Regulations, 27.10 • Zoning Code adopted by Ordinance includes: Hillside Development Zone, 24.2; and Airport Environs Zone, 24.8 (2011)	• Golder Ranch Fire District • CDPW
PLANS, MANUALS, and/or GUIDELINES	• US Army Corps of Engineers, Federal Highway Administration, "State Standard 7-98 Watercourse Bank Stabilization" • Pima County Multi-Jurisdictional Hazard Mitigation Plan (2012) • Pima County DOT Stormwater Detention/Retention Manual • Oro Valley General Plan (2016) • Capital Investment Plan (2010) • Oro Valley Subdivision Street Standards • Tucson Design Manual • Storm Water Ready Plan • Drainage Criteria Manual (2010) • Drought Management Plan • Community Wildfire Protection Plan • Pima County Navigable Waters and Flood Plains • Oro Valley emergency management plans	• Pima County Regional Flood Control District • Tucson • Golder Ranch • CDPW • Finance • Water Utility
STUDIES	• FEMA Flood Plain Maps • FEMA Flood Delineation Studies • Oro Valley Stormwater Utility Drainage and LOMR Studies (Various)	• FEMA • Pima County Regional Flood Control District • CDPW

Table 5-8: Oro Valley Technical Staff and Personnel Capabilities

Staff/Personnel Resources	☑	Department/Agency - Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Community Development and Public Works
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Community Development and Public Works
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	☑	Community Development and Public Works, Oro Valley Police Department, Water Utility
Floodplain Manager	☑	Community Development and Public Works
Surveyors		
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Community Development and Public Works, Oro Valley Police Department, Water Utility
Personnel skilled in GIS and/or HAZUS	☑	Community Development and Public Works
Scientists familiar with the hazards of the community		
Emergency manager	☑	Oro Valley Police Department
Grant writer(s)	☑	Various departments
Others	☑	Town staff trained in NIMS and ICS

Table 5-9: Oro Valley Fiscal Capabilities

Financial Resources	Accessible or Eligible to Use (Yes, No, Don't Know)	Comments
Community Development Block Grants	Yes	
Capital Improvements Project funding	Yes	
Authority to levy taxes for specific purposes	Yes	
Fees for water, sewer, gas, electric service, and stormwater	Yes	
Impact fees for homebuyers or new developments/homes	Yes	
Incur debt through general obligation bonds	Yes	
Incur debt through special tax bonds	Yes	

Table 5-10: Pascua Yaqui Tribe Legal and Regulatory Capabilities		
Regulatory Tools for Hazard Mitigation	**Description**	**Responsible Department/Agency**
CODES	• International Building Code – 2012 and revisions and amendments per Tribal Resolution. The 2015 will be adopted as released. • International Fire Code – 2012 and subsequent amendments and revisions • NFPA Standards – current codes and standard and revisions and amendments per Tribal Resolution	• Fire Department • Facilities and Housing Department
ORDINANCES	• Zoning Ordinance (similar to Pima County) • Reference county and state ordinances	• Land Department/ Development Services
PLANS, MANUALS, and/or GUIDELINES	• Salt River Wildland Fire Management Plan – 2012 • Pima County Hazard Mitigation Plan – 2012	• Fire Department • Land Department/ Development Services
STUDIES	• Environmental and Floodplain Studies for new facilities • Endangered Species List study	• Land Department/ Development Services

Table 5-11: Pascua Yaqui Tribe Technical Staff and Personnel Capabilities		
Staff/Personnel Resources	☑	**Department/Agency - Position**
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Land Department/Development Services – Director Procurement Department – Construction Manager
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Facilities and Housing Department – Director, Inspectors Procurement Department – Construction Manager Outside consultants as needed
Planner(s) or engineer(s) with an understanding of natural and/or human-caused hazards	☑	Fire Department – Fire Chief
Surveyors		
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Health Department – Risk Manager
Personnel skilled in GIS and/or HAZUS	☑	Land Department/Development Services – GIS Analyst
Scientists familiar with the hazards of the community	☑	Outside consultants as needed
Emergency manager	☑	Police Department – Police Chief
Grant writer(s)	☑	Tribal Grants/Contracts
Other(s)	☑	Tribal Public Safety personnel trained in NIMS and ICS, outside consultants

Table 5-12: Pascua Yaqui Tribe Fiscal Capabilities		
Financial Resources	**Accessible or Eligible to Use (Yes, No, Don't Know)**	**Comments**
Community Development Block Grants	Yes	
Capital Improvements Project funding	Yes	Developed based on availability of funds. Rolling 5-year basis.
Authority to levy taxes for specific purposes	Yes	
Fees for water, sewer, gas, or electric service	No	PYT does not have the legal capability to impose fees. These fees are all imposed by non-Tribal utility providers. The Tribe would have the authority to tax these utility service fees, but currently does not.
Impact fees for homebuyers or new developments/homes	No	PYT has the legal capability to impose fees but currently does not.
Incur debt through general obligation bonds	Yes	
Incur debt through special tax bonds	Yes	The Tribe has this capability, but the taxes collected by the Tribe are probably not sufficient, and never will be sufficient, to support bonds based upon those possible tax streams.

Current and past financial sources available to the Tribe for hazard mitigation planning and projects include potential disaster and mitigation funds through FEMA (Public Assistance, HMGP, and PDM funds), programs established through the Indian Self Determination Act (Public Law 93-638), casino and tribal enterprise revenues, and various departmental operation budgets. Other potential sources of funds may include the U.S. Department of Interior (Bureau of Reclamation, Bureau of Indian Affairs, U.S. Geological Survey, Bureau of Land Management), U.S. Army Corps of Engineers, U.S. Housing and Urban Development, U.S. Department of Health and Human Services (Indian Health Service), and the U.S. Department of Agriculture (U.S. Forest Service, Natural Resources Conservation Service), State of Arizona (Governor's Office of Economic Development, Arizona Department of Transportation, Arizona Department of Housing, Arizona Department of Health Services), Pima Association of Governments, and other federal, state and local sources. All grants are tracked through the Grants Department at the Tribe and over 21 departments utilize grant funds of one type or another.

Tribal Pre- and Post-Disaster Hazard Management

In addition to Tables, the Pascua Yaqui Tribe is required to summarize and evaluate pre- and post-disaster hazard management to satisfy the §201.7 Tribal Planning capability assessment requirements. Accordingly, Table 5-3-14 summarizes hazard mitigation and pre- and post-disaster hazard management practices and roles that are currently accomplished through several Pascua Yaqui Tribe departments and programs.

Table 5-13: Mitigation Responsibilities for the Pascua Yaqui Tribe

Department or Agency	Hazard Mitigation and/or Disaster Management Activities
Office of the Chairman	• General emergency oversight • General development oversight
Tribal Council	• Final approval for all pre-disaster planning, projects and funding allocation for pre- and post-disaster hazard management activities.
Land Department	• Regulates land use and development including zoning and flood management. • Lead planning department for all tribal development including flood control, transportation, and other physical improvements on the reservation.
Fire Department	• Shared emergency management role with Police Department • Emergency response and mitigation responsibilities regarding fire and HazMat. • Hazmat awareness and operations, but not technical response for removal or clean-up. • Wildland fire awareness and operations • CERT Team collaboration • Part of the AZ Mutual Aid Compact (AZMAC) • Pima County Fire Chiefs Mutual Aid Agreement • Pima County Community Wildfire Protection Plan • Tribal Salt River Region Fuel Management Plan
Health Department	• Control of disease and outbreak incidents • Dispensing of medication and anti-viral vaccines through points of distribution and points of dispensing. • Public awareness and public service announcements in collaboration with the local radio station. • Conduct training for hazard related issues and incidents • CERT Team leadership
Police Department	• Shared emergency management role with Fire Department • Response and mitigation for many of the human-caused hazards related to the civil population and terrorism • Enforcement of tribal law • Participates in a regional SWAT team
Facilities Management	• Maintain and operate heavy equipment for response to disaster related needs • Maintain electricians on staff • Responsibility for emergency shut-off of water mains • Maintain a 24/7 on-call capability
Procurement Department	• Emergency and other purchases • Maintenance of emergency generators
Indian Health Services – Office of Engineering and Environmental Health	• Emergency response and post-disaster needs assessments for mitigation and recovery.
BIA	• Mutual aid cooperative agreement with PYT for fire response and financial assistance.

The Pascua Yaqui Tribe has several programs and policies in-place to provide for effective hazard mitigation, as is summarized in the applicable tables. For the 2017 Plan, the Tribe pulled together a Local Planning Team consisting of their Facilities, Housing, Enrollment, Health, Law Enforcement, Procurement, and Land Departments and included the Casino CEO. The Tribal Planning Team performed an evaluation/assessment of the information summarized, and noted the following regarding successes, gaps, opportunities and changes over the last plan cycle:

- Regarding pre- and post-disaster hazard management policies, programs, and capabilities, the tribal planning team:
    - Identified the ongoing need for the development and implementation of an emergency response plan.
    - Identified a need for continued resources to adequately respond to a human-caused incident at the AVA entertainment facility and casino.
    - Found that the current mutual aid agreements were proving effective in providing additional response capacity
    - The management of flood related hazards is by far the most prominent hazard mitigation need for the Tribe due to the reservation being wholly situated within a 100-year floodplain and subject to regular flooding. There is a serious need for flood control related funding and projects.
- There has been no significant change in the Tribe's policies related to development in hazard prone areas over the 2012 Plan cycle other than to regulate to the 100-year floodplain using the data and recommendations of the Master Drainage Study.
- Specific hazard management capabilities of the tribe that have changed since approval of the previous plan include:
    - New BIA, Pima Fire Chiefs, Pima County Wildfire Protection Plan, Arizona Mutual Aid Compact and SWAT cooperative/mutual aid agreements have been developed.
    - The Master Drainage Plan was completed and became available for flood management use. The plan is delivered in phases with completion of phase 2 concluding in October 2016.
    - CERT team collaboration.

Upon receipt of a presidential disaster declaration, the Tribe will work with FEMA to develop two post-disaster hazard management tools: 1) a Public Assistance Administration Plan, and; 2) a Hazard Mitigation Grant Program Administration Plan. Both plans will be used by the Tribe to identify the roles and responsibilities of the Tribe in administering the FEMA Public Assistance (PA) and Hazard Mitigation Grant Programs (HMGP), and to outline staffing requirements and the policies and procedures to be used. A result of developing these plans, as well as preparing this Plan, will be to further focus Tribal resources on the importance of hazard management and mitigation planning.

Table 5-14: Sahuarita Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
CODES	• Sahuarita Town Code, as amended • 2012 Series of International Codes (Chapter 15.05 of the Town Code), as amended • 2011 National Electric Code, as amended	• Planning & Building Safety • Police • Public Works • Green Valley Fire District • Rural/Metro Fire District

Table 5-14: Sahuarita Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
ORDINANCES	• Floodplain Management Ordinance, as amended • Aquifer Protection permit #103602	• Public Works • Water Reclamation

PLANS, MANUALS, and/or GUIDELINES	• Pima County Hazard Mitigation Plan (2012)
	• Lee Moore Wash Basin Management, as amended
	• Town of Sahuarita General Plan (2015)
	• Specific Plans
	  • Madera Highlands
	  • La Joya Verde
	  • Quail Creek
	  • Sahuarita Farms
	  • Rancho Sahuarita
	• Strategic Plan for Economic Development (2009)
	• Strategic Plan, as amended
	• Capital Improvement Plan (5-Year Rolling Plan Updated Annually)
	• Strategic Plan for Emergency Preparedness 2011
		• Planning & Building Safety
		• Public Works
		• Police Department

STUDIES	• None	• None

Table 5-15: Sahuarita Technical Staff and Personnel Capabilities

Staff/Personnel Resources	☑	Department/Agency - Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Public Works Director, Planning Director, Building Official
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Public Works Director, Building Official
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	☑	Public Works Director, Planning Director, Building Official
Floodplain Manager	☑	Public Works Director
Surveyors	☑	Contract firm
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Public Works Director, Planning & Building Director, Police Chief
Personnel skilled in GIS and/or HAZUS	☑	Contract Firm for Planning and Public Works Department
Scientists familiar with the hazards of the community	☑	Public Works Director, Planning & Building Director, Fire Marshall
Emergency manager	☑	Police Department
Grant writer(s)	☑	Police Department, Public Works, Parks and Recreation Department, Office of the Town Manager

Table 5-16: Sahuarita Fiscal Capabilities

Financial Resources	Accessible or Eligible to Use (Yes, No, Don't Know)	Comments
Community Development Block Grants	Yes	
Capital Improvements Project funding	Yes	Multi-year CIP Program
Authority to levy taxes for specific purposes	Yes	None
Fees for water, sewer, gas, or electric service	Yes	Sewer connection/hook-up fees, no other for Town
Impact fees for homebuyers or new developments/homes	Yes	None, see "other" below
Incur debt through general obligation bonds	Yes	Only when necessary
Incur debt through special tax bonds	Yes	None
Other/Construction Sales Tax	Yes	Levied for each new home built in community

Table 5-17: Tucson Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
CODES	• 2012 International Building Code amendments (w/la) • 2011 National Electrical Code (w/la) • Amendments to the 2012 International Energy Conservation Code (w/la) • Amendments to the 2012 International Existing Building Code (w/la) • Amendments to the 2012 International Fuel Gas Code (w/la) • Amendments to the 2012 International Mechanical Code (w/la) • Amendments to the 2012 International Plumbing Code (w/la) • Amendments to the 2012 International Residential Code (w/la) • Amendments to the 2012 International Fire Code (w/la) • City of Tucson/Pima County Outdoor Lighting Code • Tucson Unified Development Code (UDC)	• Planning and Development Services
ORDINANCES	• Tucson Code of Ordinance	• City Manager

Table 5-17: Tucson Legal and Regulatory Capabilities

Regulatory Tools for Hazard Mitigation	Description	Responsible Department/Agency
PLANS, MANUALS, and/or GUIDELINES	• Pima County Multi-Jurisdictional Hazard Mitigation Plan (2012) • "Plan Tucson", the City of Tucson General & Sustainability Plan (2013) • Tucson Emergency Operations Plan (2014) • Design Standards Manual for Water (2005) • National Flood Insurance Program (NFIP) Regulations • Pima Association of Governments (PAG) Standard Specifications and Details for Public Improvements (2014) • Third-party Plan Review Policies and Standards • Tucson Climate Mitigation Report (2011)	• City Manager • COT Office of Emergency Mgt. & Homeland Security • Pima County OEM • Tucson Water • Tucson Fire • Pima Association of Gov'ts • Office of Integrated Planning • Various Departments
STUDIES	• FEMA DFIRM Maps • Dam Safety Studies and Emergency Action Plans • Flood Insurance Studies (FIS) • Tucson Climate Impact Study (2012)	• Planning and Development Services • Parks & Recreation • Office of Integrated Planning

Table 5-18: Tucson Technical Staff and Personnel Capabilities

Staff/Personnel Resources	☑	Department/Agency - Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	☑	Planning Department – Principal Planner, Planner II, Planner III Water Services – Superintendents, Project Engineers, Civil Engineers, Project Coordinators, Principal Engineering Technicians, Principal Planners
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	☑	Street Transportation Department - Civil Engineers Water Services – Superintendents, Civil Engineers, Project Coordinators, Principal Engineering Technicians
Planner(s) or engineer(s) with and understanding of natural and/or human-caused hazards	☑	Planning Department – Principal Planner, Planner II, Planner III Water Services – Superintendents, Civil Engineers, Principal Engineering Technician, Hydrologist
Floodplain Manager	☑	Street Transportation Department - Civil Engineer III
Surveyors	☑	Street Transportation Department – Survey Teams
Staff with education or expertise to assess the community's vulnerability to hazards	☑	Water Services – Environmental Programs Coordinator, Civil Engineers, Water Quality Inspectors

Table 5-18: Tucson Technical Staff and Personnel Capabilities

Staff/Personnel Resources	☑	Department/Agency - Position
Personnel skilled in GIS and/or HAZUS	☑	Information Technology Services – Info Tech Analyst/Programmers and Info Tech Specialists Fire Department – Fire Protection Engineer Police Department – Senior User Technology Specialist Street Transportation Department - Info Tech Analyst/ Programmer II and Senior GIS Technician Water Services Department – GIS and Senior GIS Technicians
Scientists familiar with the hazards of the community	☑	Office of Environmental Programs – Environmental Quality Specialists Water Services – Chemists, Environmental Quality Specialist, Laboratory Technician, Environmental Programs Coordinator
Emergency manager	☑	Tucson Office of Emergency Management
Grant writer(s)	☑	Fire Department – Fire Captains and Grant Manager Planning Department – Principal Planner, Planner II, Planner III Police Department – Police Research Analysts Public Transit, Division of Transportation

Table 5-19: Tucson Fiscal Capabilities

Financial Resources	Accessible or Eligible to Use (Yes, No, Don't Know)	Comments
Community Development Block Grants	Yes	Housing, Community Services, and Water Services projects
Capital Improvements Project funding	Yes	
Authority to levy taxes for specific purposes	Yes	
Fees for water, sewer, gas, or electric service	Yes	Water and Solid Waste Fees
Impact fees for homebuyers or new developments/homes	Yes	For new developments inside impact fee areas-zones only. The Impact Fees are charged to new developments.
Incur debt through general obligation bonds	Yes	This excludes the Water Department
Incur debt through special tax bonds	Yes	Excise (sales) taxes

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5.4 Mitigation Actions/Projects

Mitigation actions/projects (APs) are those activities identified by a jurisdiction, that when implemented, will have the effect of reducing the community's exposure and risk to the particular hazard or hazards being mitigated. The implementation strategy addresses the "*how, when, and by whom*?" questions related to implementing an identified AP. APs should be measurable and mitigation-based. Response or recovery activities were removed from the 2017 plan as they are better addressed in county and local jurisdictional operational plans.

The process for defining the list of mitigation APs for the Plan was accomplished in three steps. First, an assessment of the actions and projects specified in the 2012 plan was performed. Second, a new list of APs for the Plan was developed by combining the carry forward results from the assessment with new APs. Third, an implementation strategy for the combined list of APs was formulated.

Previous Mitigation Actions/Projects Assessment

The Planning Team and Local Planning Team for each jurisdiction reviewed and assessed the actions and projects listed in the Mitigation Strategy section of the 2012 Plan. The assessment included evaluating and classifying each of the previously identified APs based on the following criteria:

Status		Disposition	
Classification	Explanation Requirement:	Classification	Explanation Requirement:
"**No Action**"	Reason for no progress	**"Keep"**	None required
"**In Progress**"	What progress has been made	**"Revise"**	Revised components
"**Complete**"	Date of completion and final cost of project (if applicable)	**"Delete"**	Reason(s) for exclusion.

Any AP with a disposition classification of "Keep" or "Revise" was carried forward to become part of the AP list for the 2017 Plan. All APs identified as "Delete" were removed and are not carried forward in this Plan. The results of the assessment for each of the 2012 Plan APs is summarized by jurisdiction in Appendix C.

New Mitigation Actions

Upon completion of the assessment, each jurisdiction's Local Planning Team developed new APs using the 2017 goals and objectives, results of the vulnerability analysis and capability assessment, and the planning team's institutional knowledge of hazard mitigation needs in the community.

The APs can be generally classified as either structural or non-structural. Structural APs typify a traditional "brick and mortar" approach where physical improvements are provided to effect the mitigation goals. Examples may include forest thinning, channels, culverts, bridges, detention basins, dams, emergency structures, and structural augmentations of existing facilities. Non-structural APs deal more with policy, ordinance, regulation and administrative actions or changes, buy-out programs, and legislative actions.

For each AP, the following elements were identified:

- **Description** – a brief description of the AP including a supporting statement that tells the "what" and "why" reason for the AP.
- **Hazard(s) Mitigated** – a list of the hazard or hazards mitigated by the AP.
- **Community Assets Mitigated** – Existing, new or both.
- **Estimated Cost** – concept level cost estimates that may be a dollar amount or estimated as staff time.
- **Anticipated Completion Date** – a realistic and general timeframe for completing the AP. Examples may include a specific target date, a timeframe contingent upon other processes, or recurring timeframes.
- **Lead Agency** – the agency, department, office, or other entity and corresponding job title that will have responsibility for the AP and its implementation.
- **Funding Source** – the source or sources of anticipated funding for the AP.

- **Priority Ranking** – each AP was assigned a priority ranking of either "High", "Medium", or "Low". The assignments were subjectively made using a simple process that assessed how well the AP satisfied the following considerations:
  - A favorable benefit versus cost evaluation, wherein the perceived direct and indirect benefits outweighed the project cost.
  - A direct beneficial impact on the ability to protect life and/or property from natural hazards.
  - A mitigation solution with long-term effectiveness

Tables 5-20 through 5-25 summarize the current mitigation AP and implementation strategy for each participating Plan jurisdiction. Projects listed in *italics font* are recognized as being more response and recovery oriented, but are considered to be a significant part of the overall hazard management goals of the community.

Table 5-20: 2017 Mitigation Measures for Unincorporated Pima County

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Enforce Flood & Erosion Hazard Ordinance in accordance with the NFIP.	Flood	Both	$1.2 million	High	Regulatory	Ongoing	PCRFCD / Floodplain Management Division	Flood Control Tax Levy
Implement NFIP tasks such as LOMR submittals, maintaining a countywide map repository, performing master drainage studies, and coordinating to ensure the digital map is correct.	Flood	Both	$600,000	High	Regulatory	Ongoing	PCRFCD / Planning & Development Division	Flood Control Tax Levy
Provide flood risk mitigation through Capital Improvement Projects (CIP).	Flood	Both	$4.0 million	High	Capital Improvement	Ongoing	PCRDFD / Planning & Development Division	Flood Control Tax Levy & USACOE
Participate in Community Rating System to reduce insurance premiums.	Flood	Both	$50,000	Medium	N/A	Ongoing	PCRFCD / Planning & Development Division	Flood Control Tax Levy
Buffelgrass Mitigation – identify public outreach opportunities, locate county areas for mitigation of buffelgrass and administer grant funding for ongoing activities related to wildfire reduction through removal and reduction in Buffelgrass.	Wildfire	Both	$3,000,000	Medium	Community Wildfire Protection Plan	Ongoing	PCOEM, Natural Resources, Parks & Recreation	Mitigation Grants

Table 5-20: 2017 Mitigation Measures for Unincorporated Pima County

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Treat soil surfaces with appropriate stabilization materials and vegetation control to reduce blowing dust.	Severe Wind	Both	$2,000,000	Medium	Road Design Manual	Ongoing	PCDOT	Highway User Revenue Funds, Local Regional Transportation Authority Funds
Continue to identify vulnerable populations for heat related illness, provide education targeted toward recreational activities, visitors/travelers, hospitality industry, homeless populations, and build cooling center capacity.	Extreme Heat	Both	$100,000	High	Heat Adaptation and Mitigation Plan	Ongoing	PCHD, PCOEM, Parks & Recreation	Mitigation Grants, Public Health Emergency Preparedness
Implement the Drought Management Plan. If drought conditions worsen, the Board of Supervisors may consider increasing the drought stage that will trigger drought conservation measures.	Drought	Both	None	Medium	Drought Management Plan and Water Wasting Ordinance	Ongoing	OSC/Water Resources Unit	General fund and RWRD enterprise fund
Pima County DOT in conjunction with the Arizona Geological Survey and the US Forest Service will work to identify vulnerable slide areas and begin developing mitigation approaches and monitoring protocols.	Landslide	Existing	Staff Time	Medium	Road Clearing and Slope Stabilization and Dressing Procedures	Ongoing	PCDOT	Highway User Revenue Funds, Mitigation Funds, Bond Fund, Aid to Federal Highways

Table 5-21: 2017 Mitigation Measures for Marana

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Provide training to the applicable Marana departments on the adopted hazard mitigation plan and its requirements.	All	Both	$500	High	Town wide Emergency Management Program	2021	Emergency Management Coordinator	General Fund
Conduct a public education campaign to increase awareness of natural hazards by distributing ADEM and Pima County mitigation flyers at community events and public gathering opportunities, as appropriate. This will be accomplished semi-annually by Community Services. This will be accomplished at events such as the Town of Marana Founders Day (Mar), the 4th of July Celebration (Jul), the Cotton Festival (Oct) and the Holiday Tree Lighting (Dec) and at community meetings by the Community Services Department.	All	Both	$500	High	Town wide Emergency Management Program	2021	Community Development Director	General Fund
Encourage bridge or culvert construction where roads are susceptible to flooding. This will be accomplished as part of the Planning Process when Developers apply to build in Marana.	Flood	Both	Staff Time	High	Regulatory	2016	Development Services/ General Manager	General Fund
Marana will continue to participate in the National Flood Insurance Program by reviewing applications for buildings, ensuring they are properly designed.	Flood	Both	Staff Time	High	Town wide Emergency Management Program	2016	Development Services/ General Manager	General Fund

Table 5-21: 2017 Mitigation Measures for Marana

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
On Rattlesnake Pass, from Saguaro Bloom to Twin Peaks Road, the Public Works Department and Planning Departments are installing infrastructure, making roadway drainage improvements and grading the storm water conveyance systems to mitigate flooding hazards in the area.	Flood	Both	$29.8 Million	High	Town wide Emergency Management Program	2018	Public Works / Planning Department	Transportation Fund, General Fund
Barnett Linear Park and Flood Control – Construct a 3-mile channel along Barnett Road to mitigate the drainage and flood hazard from the Santa Cruz River	Flood	Both	$16.5 Million	High	Regulatory	2016	Public Works / Director	General Fund, Future MMPC Bonds
Ina Road Bridge – Remove and replace the Ina Road bridge that crosses the Santa Cruz River	Flood	New	$17.5 Million	High	Departmental Plan	2016	Development Services / Director	Transportation Fund, HURF Bonds, General Fund
Ina Road Improvements from Silverbell Road to I-10 – widening of Ina Road to 4-lane section with raised median, sidewalks, and drainage improvements	Flood	Both	$16.5 Million	High	CIP	2016	Public Works/Director	Transportation Fund, Federal Grants
Tangerine Road Corridor - provide a minimum of 4 lanes with raised medians, drainage improvements, sidewalks, ADA facilities, multi-use path and lanes, Traffic Signals, Right-of-Way acquisitions, Utility relocations, Marana Water line extensions, and sewer modifications and additions.	Flood	Both	$95.5 Million	High	CIP	2019	Public Works / Director	RTA, Future Bond Money

Table 5-21: 2017 Mitigation Measures for Marana

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Ina Road TI – lower I-10 and construct a new overpass that will span both I-10 and the UPRR tracks. Project will mitigate flood issues and also improve access that will reduce accidents and HazMat incidents	Flood	New	$65.0 Million	High	CIP	2018	Public Works / Director in coordination with ADOT	ADOT, RTA
Marana will continue to participate in the Flood Prone Land Acquisition Program and acquire properties located in flood hazard areas.	Flood	Both	Staff	High	CIP	2016	Development Services/ General Manager	Grants, Partnership w/ Pima County

Table 5-22: 2017 Mitigation Measures for Oro Valley

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Conduct Floodplain Mapping to mitigate flood risk by delineating floodplains boundaries within existing subdivisions that were not required at the time of subdivision or commercial property platting. This includes subdivisions and commercial properties constructed prior to 1984 and falls within some recently annexed areas of the Town. This includes three projects: Carmack Wash/Shadow Mountain Estates subdivision, Peglar Wash/Suffolk Hills Subdivision/Rancho Catalina Subdivision, Highlands Wash/Highlands subdivision.	Flood	Existing Homes / Subdivisions/ Commercial Properties	$200K	High	Stormwater Utility CIP	July 2018	Town of Oro Valley Stormwater Utility	PCRFCD CIP
Mitigate and stabilize areas damaged by storm related activity by: Designing and constructing of wash stabilization components to protect damaged areas from scour and deposition of sediment that is causing damage to existing properties. This includes three projects: 3 known projects: Carmack Wash/Shadow Mountain Estates subdivision, Peglar Wash/Suffolk Hills Subdivision/Rancho Catalina Subdivision, Highlands Wash/Highlands subdivision.	Flood	Existing Homes / Subdivisions/ Commercial properties	$1M-2M/	High	Stormwater Utility CIP	July 2019	Town of Oro Valley Stormwater Utility	PCRFCD CIP

Table 5-22: 2017 Mitigation Measures for Oro Valley

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Lambert Lane (Rancho Sonora to La Canada). All weather crossing, lowering hill profile and adding soil nail walls. Upgrading signal at Lambert Lane. Adding secondary access point to fire station from Lambert, currently only accessible from La Canada Dr.	Flood	Existing road improvement	$5.5 Million (Road) $730,000 (Utility)	High	20 Year RTA Plan	September 2017	Town of Oro Valley Stormwater Utility	RTA, Water Utility, Town of Oro Valley
Tangerine Rd. (Oro Valley portion of project is Shannon to La Canada). All weather crossings, multi-use path, raised medians, curb and gutters, traffic signal improvement at La Cholla and Tangerine.	Flood	Existing road improvement	$95.5 Million (Total Tangerine Project)	High	20 Year RTA Plan	May 2018	Town of Marana	RTA, Town of Marana, Pima County, and Town of Oro Valley
La Cholla (Oro Valley portion of project is Lucero Rd. to Tangerine). 4 lane divided with a raised median, separated multi-use path, all weather crossings. Traffic signal improvement at Lambert, Naranja, and Glover.	Flood	Existing road improvement	$20 Million	High	20 Year RTA Plan	2020	Town of Oro Valley	RTA, Pima County, and Town of Oro Valley
Purchase 2,000 acre-ft. of groundwater extinguishment credits in the Tucson Active Management Area (TAMA) to bolster the Town's groundwater allowance account for future use.	Drought	New	$400,000	Medium	Water Utility CIP	June 31, 2017	Water Utility	Water Utility Fees

Table 5-22: 2017 Mitigation Measures for Oro Valley

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Remove regulatory barriers and develop programs that support sustainable designs, landscapes, green infrastructure, and development practices. Update and develop new building codes and design standards that help reduce urban heat island effect.	Extreme Heat	Both	Staff Time $3,750 per year	Low	General Plan2016	2021	CDPW	Town of Oro Valley
Installation of hydrants in urban interface area targeting areas where there is a higher risk for brush fire.	Wildfire	New	$21,000 per year	Medium	Mountain Vista Fire District CIP	2021	Mountain Vista Fire District	MVFD general fund
Annual maintenance on established and identified as critical fire break locations in the urban/wildland interface (Catalina State Park, Sun City Oro Valley, etc.).	Wildfire	Both	$10,000 per year	Medium	Golder Ranch Fire District	October 2021	Golder Ranch Fire District	Golder Ranch Fire District
Provide annual, public awareness and public outreach on local hazards, mitigation, preventative, and other activities through presentations to homeowners and HOAs, newsletters, and website.	All	Both	$500 per year	Medium	Town-wide emergency management program	2021	Town of Oro Valley	Town of Oro Valley
Mitigate and stabilize areas damaged by storm related activity in the Catalina Ridge Drainage Channel by reconstructing 3,400 linear feet of channel bottom, improve wash degradation, and mitigate side slope to protect public and private property, public infrastructure and utilities from additional damage.	Flood	Existing	$1.9 Million.	High	Stormwater Utility CIP	2021	Town of Oro Valley Stormwater Utility	PCRFCD CIP, TOV, FEMA

Table 5-22: 2017 Mitigation Measures for Oro Valley

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Establish a community risk reduction program to include all hazards, education, outreach, and plans.	All	Both	$2,500 per year	Medium	FireWise Community	Establish a community risk reduction program to include all hazards, education, outreach, and plans.	All	Both

Table 5-23: 2017 Mitigation Measures for Pascua Yaqui Tribe

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
The Pascua Yaqui Tribes Master Drainage Report overseen by Facilities Management Division will be implemented within phases • Oversee floodplain modeling • Review floodplain map revision • Assessments of flooding runoff in public gathering areas	Flood	Existing	Staff time	Medium	Continued Implementation of Regional Flood Control Project	Ongoing and Continuous	Tribal Council, Facilities Department, Land Department	General Fund
Complete and implement Phase 2 finalization of Master Drainage Report; anticipated target date of November 2017.	Flood	Existing	Staff time	Medium	Continued Implementation of Regional Flood Control Project	Ongoing and Continuous	Tribal Council, Land Department	General Fund
Update and resume the existing intergovernmental agreement between the Tribe and the State Forestry Department. Conduct Annual maintenance on established and identified critical fire break locations in the urban/wildland interface around all housing, neighborhoods projects and commercial buildings on the Pascua Yaqui Reservation.	Wildfire	Existing	Staff time	High	Continue Wildland Urban Inference	Continuing	Fire Department, Attorney General's, Office, Tribal Council	General Fund
Modify and continue to evaluate existing building codes to help mitigate hazards. • Evaluate material and installation of equipment to buildings and residence • Educate community on hazard via website, department brochures	Extreme Heat	Existing	Staff Time	High	Continued code enforcement by Housing Division for new and remolded construction projects	Ongoing and Continuous	Tribal Council, Fire Department, Land Department, Housing/Facilities Department	General Fund

Table 5-24: 2017 Mitigation Measures for Sahuarita

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Complete Multi-Sector General Permit (Wastewater facility) inspections and perform maintenance and repairs of control measures as identified during inspections.	Flood	Existing	Staff Time	High	Maintenance and Inspection	Quarterly	Public Works - Wastewater	Enterprise
Organize and host annual Southern Arizona Beat Back Buffelgrass community removal event.	Wildfire	Both	Staff Time	Medium	Community Wildfire Protection Program	Annual (typically January)	Public Works, Planning and Zoning	None
Review, update and modify NFIP requirement and make appropriate modifications to Floodplain Ordinance.	Flood	Both	Staff Time	High	Regulatory	Spring 2017	Public Works	General Fund
Educate the public to increase awareness of hazards, and potential opportunities for mitigation actions. Make Pima County's public information material sheets, websites, mitigation brochures, and media outlets available.	Extreme Heat, Flood	Both	Staff Time	Low	Public Information Program	Dec 2018	Town Clerk	None
Conduct pre-storm season inspections and debris removal for Town-owned roads and drainage crossings.	Flood	Existing	Staff Time	High	Maintenance	Ongoing, pre-Monsoon	Public Works	HURF
Complete construction of Sahuarita Road: Interstate-19 to Eastern Town Limits including drainage improvements and a new 2-lane bridge over the Santa Cruz River.	Flood	Both	$47.7M	High	General Plan	December 2016	Public Works	RTA, HURF, private
Complete construction of the Pima Mine Road Bridge Replacement at the Santa Cruz River, which corrects structural deficiencies of the existing bridge, provides additional roadway capacity at the bridge, and provides additional capacity for delivery of CAP water to Sahuarita.	Flood, Drought	Both	$7.2M	High	General Plan	December 2016	Public Works	RTA, HURF, private

Table 5-24: 2017 Mitigation Measures for Sahuarita

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Finalize License Agreements allowing installation of CAP pipelines in Town rights-of-way to facilitate the delivery of CAP water to Sahuarita.	Drought, Extreme Heat, Flood	Both	Staff Time	High	General Plan	December 2016	Public Works	None

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	**Hazard(s) Mitigated**	**Community Assets Mitigated (Ex/New)**	**Estimated Cost**	**Priority Ranking**	**Planning Mechanism(s) for Implementation**	**Anticipated Completion Date**	**Primary Agency / Job Title Responsible for Implementation**	**Funding Source(s)**
Identify funding source and construct two bridges and 50 box culverts with 380 back-up power units for signalized intersections at high flood hazard crossings in Tucson limits in accord with the Department of Transportation 5-yr plan. If a box culvert cannot be constructed an automated warning device, consisting of a barricade, signs and flashing lights would be installed.	Flood, Severe Wind	New	$100 million, Staff Time	High	Tucson Floodplain Management Plan and Floodplain Ordinances	Ongoing effort with long-term horizon. Schedule dependent upon funding	Transportation Department Streets Administrator and Streets Chief Engineer	Grant Funds
Promote disaster-resistant water delivery system by constructing redundant water transmission lines (e.g., The Utility and the community will be less susceptible to loss of water delivery due to natural or human-caused disasters).	All	Both	$7.9 million	High	Tucson Water 2020 strategic plan.	On-going with full completion by 2020	Water Department / Water Administrator Maintenance & Operations	Operations Budget

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Re-direct drainage canal at Barrio Viejo to prevent continued repetitive losses.	Flood	Existing	$425,000	High	Tucson Floodplain Management Plan and Floodplain Ordinances	2013	Transportation Department Project Administrator	Grant Funds, General Fund, PCRFCD
In compliance with the NFIP, Tucson will continue to require the preparation and submittal of a CLOMR or CLOMR-F for all proposed development within FEMA delineated Special Flood Hazard Areas	Flood	Existing	Staff Time	High	Regulatory	Annual - Ongoing	Planning and Development Services	Department Budget and Fees for Developers
Maintain compliance with NFIP regulations by enforcement of the current floodplain management ordinance through review of new development located in the floodplain and issuance of floodplain use permits.	Flood	Existing	Staff Time	High	Regulatory	Annual - Ongoing	Planning and Development Services	Department Budget

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	**Hazard(s) Mitigated**	**Community Assets Mitigated (Ex/New)**	**Estimated Cost**	**Priority Ranking**	**Planning Mechanism(s) for Implementation**	**Anticipated Completion Date**	**Primary Agency / Job Title Responsible for Implementation**	**Funding Source(s)**
Improve floodplain administration under the NFIP program by sending inspectors into the field when we receive a flood warning from the NWS , to assess bridges, washes and other critical infrastructures within Tucson.	Flood	Existing	Staff Time	Medium	Tucson Department of Transportation "Operation Splash" and regulatory	Annual-Ongoing	Transportation Department	Department Budget

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Continue to fund and promote the following rebate and incentive programs: residential and small commercial rainwater harvesting rebate program; residential high-efficiency clothes washer replacement rebate program; Single-family residential gray-water rebate program; Single-family residential high-efficiency toilet replacement; rainwater harvesting grant/loan program for low-to-moderate income customers; free toilet replacement program for low-to-moderate income homeowners; commercial or multi-family high-efficiency toilet replacement program; commercial and industrial high-efficiency urinal replacement program.	Drought	Existing	$1.4M	Medium	Tucson Water Department Drought Preparedness and Response Plan	Annual-ongoing	Tucson Water	Conservation Utility Fee

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Continue to fund and promote the Tucson Water Zanjero (water manager) residential water audit program.	Drought	Existing	$271K	Medium	Tucson Water Department Drought Preparedness and Response Plan	Annual-ongoing	Tucson Water	Department Budget
Continue to participate in, promote and sponsor the Pima County SmartScape program in partnership with the University of Arizona Cooperative Extension.	Drought	Existing	$239K	Medium	Tucson Water Department Drought Preparedness and Response Plan	Annual-ongoing	Tucson Water	Conservation Utility Fee
Review and update the City of Tucson Water Department Drought Preparedness and Response Plan.	Drought	Both	Staff Time	Medium	N/A	Every 5 years - ongoing	Tucson Water	Department Budget
Assess, inventory, and map the vulnerability within Tucson to seismic hazards.	Earthquake	Both	Staff time	High	N/A	January, 2019	Planning and Development Services	Department Budget
Perform feasibility study of a downtown District Energy model that would create greater energy and water resiliency in downtown Tucson.	Drought, Extreme Heat, Winter Storm	Both	$75K	High	Tucson Emerging 2030 District plan	July 2017	Environmental and General Services	City operating funds with matching County contribution

Table 5-25: 2017 Mitigation Measures for Tucson

Mitigation Action/Project				Implementation Strategy				
Description	Hazard(s) Mitigated	Community Assets Mitigated (Ex/New)	Estimated Cost	Priority Ranking	Planning Mechanism(s) for Implementation	Anticipated Completion Date	Primary Agency / Job Title Responsible for Implementation	Funding Source(s)
Assess the vulnerability of critical facilities to flooding from runoff and encourage reducing runoff and means for mitigating critical facilities when runoff cannot be reduced.	Flooding	Both	Staff time	Medium	N/A	Annual-ongoing	Planning and Development Services	Department Budget
Implement a severe wind risk awareness program with information about shelter locations; education for homeowners about retrofits ; and education for professionals about wind mitigation.	Severe Wind	New	Staff time	Medium	N/A	June, 2016	Office of Emergency Management and Homeland Security	Department Budget
Implement a winter weather risk awareness program to educate the public on the risks of severe cold during winter storms.	Extreme Cold	New	Staff time	Medium	N/A	November, 2017	Office of Emergency Management and Homeland Security	Department Budget
Assess and identify specific at-risk populations vulnerable to long-term power outages and organize outreach efforts include establishing and promoting heating and cooling centers in the community.	Extreme Heat, Extreme Cold	Both	Staff time	High	N/A	January, 2018	Office of Emergency Management and Homeland Security	Department Budget

SECTION 6: PLAN MAINTENANCE PROCEDURES

Elements of this plan maintenance section include:

Monitoring, Evaluating, and Updating

Monitoring of Mitigation Activities

Incorporation into Other Planning Mechanisms

The participating jurisdictions in this Plan recognize that it is intended to be a "living" document with regularly scheduled monitoring, evaluation, and updating. The 2012 Plan outlined specific steps in the Plan Maintenance; however, the Planning Team indicated that few formal reviews occurred over the past five years. Reasons for the lack of formal review were discussed by the Planning Team, and included:

- Lack of funding or adequate staffing,
- Perceived lack of practicality and or usefulness beyond keeping eligibility for grants,
- Staffing changes and turnover wherein the maintenance requirements and even existence of the Plan was not communicated, and
- Lack of Plan awareness by departments outside of the emergency management community.

Recognizing the need for improvement, the Planning Team discussed ways to make sure that the Plan review and maintenance process will occur over the next five years. The results of those discussions are outlined in the following sections.

6.1 Monitoring, Evaluating and Updating

The Planning Team has established the following monitoring and evaluation procedures revised for this Plan:

- **Schedule** – The Plan shall be reviewed on at least an annual basis or following a major disaster. The Pima County Office of Emergency Management (PCOEM) will take the lead to reconvene the Planning Team on or around the anniversary of the official FEMA approval date.
- **Review Content** – One month prior to the Planning Team review meeting, a reminder questionnaire will be distributed to each jurisdictions' point of contact by the PCOEM Planner and will be returned by each jurisdiction within a minimum of three weeks. The questionnaire will be comprised of the following questions:
    - **Hazard Identification:** Have the risks and/or hazards changed? Is there new information to include regarding the risks/hazards?
    - **Goals and objectives:** Are the goals and objectives still able to address current and expected conditions?
    - **Mitigation Projects and Actions:** What is the status of the mitigation measures in the current Plan?

During the annual meeting, each jurisdiction will have the opportunity to provide a report to the group summarizing its review of the Plan. The report will include their responses to the above questions and any other items specific to their community. Documentation of the annual meeting may include notes on the results of the meeting as well as more specific information on the reasoning for proposed changes to the Plan for the next update cycle. Copies of the annual review report will be kept with the Plan for review and consideration in future reviews and the five-year update.

The Plan requires updating and approval from FEMA every five years. The Plan updates will adhere to that set schedule using the following procedure:

- One year prior to the plan expiration date, the Planning Team will re-convene to review and assess the materials accumulated from annual reviews and other documents related to hazards, disasters and mitigation actions taken;

- The Planning Team will update and/or revise the appropriate or affected portions of the plan and produce a revised Plan;
- The revised plan will be submitted to ADEM and FEMA for review, comment and approval; and
- The revised Plan will be presented before the respective councils and boards for an official concurrence/adoption of the changes.

The APs and their implementation details are identified in the Plan's mitigation strategy. For each annual review and 5-year plan update, PCOEM will coordinate with the jurisdictional point of contact to assess the implementation status of the identified AP and generate a summary of each project using the following criteria:

- Current Status of Action/Project - Assign a 'No Action', 'In-Progress' or 'Completed' status as appropriate;
- Project Disposition – Assign a 'Keep' or 'Drop' to identify future disposition of action/project; and
- Explanation - Provide a description of the current project status, may include date of implementation, challenges faced, percentage completed, funding sources used, etc.

For FEMA supported projects, progress reports will be submitted to FEMA on a quarterly basis, or as required throughout the project duration. The degree of quarterly reporting will be dependent upon the type of AP, its funding source, and the associated requirements. The quarterly report may include:

- Project Completion Status,
- Project Challenges or Issues (if any),
- Budgetary Considerations (Cost Overruns or Underruns), and
- Detailed Documentation of Expenditures.

Upon completion of projects, the project location will be visited and final results viewed and documented. Closed projects will then be monitored for effectiveness of the intended mitigation action. FEMA supported project closeouts will include an audit of the AP financials as well as other guidelines and requirements set forth under the funding or grant rules, and any attendant administrative plans developed by the Pascua Yaqui Tribe.

6.3 Incorporation into Other Planning Mechanisms

Incorporation of the Plan into other planning mechanisms, either by content or reference, enhances a community's ability to perform hazard mitigation by expanding the scope of the Plan's influence. The participating jurisdictions acknowledge that incorporation of the Plan into other planning mechanisms has improved over the prior plan. Additional ways in which the 2012 Plan has been incorporated or referenced into other planning mechanisms for each jurisdiction are summarized below.

Past Activities

Pima County

- The 2012 Plan is cited in the Annual Recertification and 5-yr Cycle Verification of the Community Rating System for the NFIP.
- The Plan is referenced in amendment of the Comprehensive Plan, Rezoning, and Basin or River Management Planning efforts.
- The plan is used as reference material for the update of the Pima County Emergency Operations Plan on an annual basis. In 2015, the Plan was used to develop an El Niño Flood Annex to the EOP which was then converted to a Flood Annex for the EOP which also contains NFIP Community Rating System requirements.
- The drought hazard identification and risk information was used in the development of the County's Drought Response Plan and Water Wasting Ordinance.
- The wildfire hazard identification and risk information was used in the development of the Community Wildfire Protection Plan, 2013.

Marana

- Used by the Town of Marana during the update of the Emergency Operation Plan beginning in March 2010 and again in 2016.
- Used as a reference for the identification of natural and human-caused hazards in the Town's General Plan for 2010.
- Used as a reference for the identification of initiatives related to natural and human-caused hazards in the Town's Strategic Plan for 2015.
- Used by the Town of Marana as reference for development of Administrative Directives (ADs), Safety Directives (SDs), Standard Operating Procedures (SOPs) and Town policies; beginning in 2010.
- Used as a reference for updating and eventual adoption of the Community Wildfire Protection Plan, 2013.

Oro Valley

- The plan is used as reference material for reviews and updates of the Town of Oro Valley Emergency Operations Plan and development of hazard specific plans.
- Mitigation actions and projects identified in the Plan correlate to Capital Improvement Projects or other planned projects.
- Supports the Town General Plan, adopted in November 2016.
- Used by the Stormwater Water Utility when looking at flood hazards, planning mitigation projects, and looking at mitigation funding.
- The wildfire hazard identification and risk information was used in the development of the Community Wildfire Protection Plan, 2013.

Pascua Yaqui Tribe

- Pascua Yaqui Tribe's Master Land Use Plan serves as a guide for decision makers to minimize incompatible land use. It provides a balance of land uses that preserves and enhances the neighborhood, support in-fill strategies, promote economic development, and protect environmentally and culturally significant resources. Mitigation strategies were addressed in the development of this plan.
- The master drainage study is a critical component to the Tribe's economic well-being, as well health, safety and general welfare of the community. It was adopted in 2004 to minimize the flooding and drainage problems. It requires no development zones set aside for conveyances of floodwaters and the construction of regional storm water retention facilities

Sahuarita

- The plan was used when developing the General Plan mainly in reference to the hazards and risks.

Tucson

- Used as reference material for the update of the 2014 Emergency Operations Plan.
- Used as reference material for the 2013 through 2015 Threat and Hazard Identification and Risk Assessment processes.
- Used as reference in the development of Continuity of Operations Plans for City departments.
- Used as a reference in the development of the new 2016 Tucson Floodplain Management Plan.

Future Activities

Typical ways to use and incorporate the Plan over the next five-year planning cycle, include:

- Use of, or reference to, Plan elements in general and comprehensive planning update documents,
- Addition of defined mitigation APs to capital improvement programming,

- Inclusion of Plan elements into development planning and practices, and
- Resource for developing and/or updating emergency operations plans.

The Plan will continue to function as a standalone document subject to its own review and revision schedule. The Plan will serve as a reference for other mitigation and land planning needs of the participating jurisdictions. Whenever possible, the participating jurisdiction will endeavor to incorporate portions of the Plan into existing and future planning mechanisms as appropriate.

Specific incorporation of the Plan risk assessment elements into the natural resources and safety elements of each jurisdictions' general plans (county comprehensive plan) and development review processes, adding or revising building codes, adding or changing zoning and subdivision ordinances, and incorporating mitigation goals and strategies into general and/or comprehensive plans, may help to ensure hazard mitigated future development. Table 6-1 contains jurisdictional activities for continuing stakeholder involvement.

Pima County

- An annual review of the plan will be scheduled by the Office of Emergency Management including all 2017 plan participants. This will be held in April or May of each year and include a review of the hazards and risks and evaluation of mitigation Aps.
- The plan revision planning process will begin in May, 2021 for the 2022 plan. The Office of Emergency Management will again coordinate planning activities.
- The plan will be referenced annually when updating the Pima County Emergency Operations Plan.

Marana

- The plan will be used as a resource during the update of the 2017 Town of Marana Emergency Operations Plan.
- The plan will be used for reference to identify hazards and mitigation strategies for the Town's General Plan 2020.
- The plan will define mitigation APs for Town of Marana capital improvement projects and programming, for the next five-year cycle.

Oro Valley

- Participate in annual review of plan, as coordinated by the Pima County Office of Emergency Management.
- Use as a resource during next update of the Town Emergency Operations Plan.
- Inclusion of mitigation APs in capital improvement planning.
- Inclusion of Plan in implementation of the Town's newly adopted General Plan.

Pascua Yaqui Tribe

- A review of the plan will be conducted with the other jurisdictions annually.
- The plan will be referenced when working with other tribal departments on grants and plans development.
- The hazards and risks will be used in development of exercises for the tribe.
- As a part of National Flood Insurance Program requirements, the plan will be used as a reference.

Sahuarita

- The Town will participate in the annual plan reviews with other jurisdictions.
- The plan will be used as a resource when the Emergency Operations Plan is revised.

Tucson

- The 2017 plan will be used as reference in the ongoing revision of the City of Tucson Emergency Operations Plan and its ESF, Incident Specific and Support annexes with planned adoption in calendar year 2017.
- The plan will be used as reference in the development and revision of City of Tucson departmental continuity of operations plans.
- The plan will be referenced in review and revision to the "Plan Tucson" general and sustainability plan adopted and ratified in 2013.

Table 6-1: Continued Public and Stakeholder Involvement	
Jurisdiction	**Activity or Opportunity**
Pima County	• Continue working with the Regional Flood Control District on the Community Rating System (CRS) Program for Public Information, Notification and Exercise requirements. • Schedule annual mitigation review meetings with jurisdictional partners. • Enhance public outreach on mitigation issues through Everbridge mass notification tool. • Maintain the Mitigation Plan on the website. • Assist jurisdictions and county departments with mitigation grant funding opportunities.
City of Tucson	• Continue to pursue past activities listed above, in table 3-3, as appropriate. • Maintain a mitigation-focused page, with the updated mitigation plan, on the City of Tucson website. • Expand the use of social media to provide timely and accurate information on hazards and mitigation actions that can be taken against them. • Launch a localized Ready campaign for the City. • Build relationships with neighborhood organizations, HOA's, and other local leadership groups to help distribute hazard mitigation information to their communities.
Town of Oro Valley	• Continue to pursue past activities identified in Table 3-3. • Expand use of social media, PSAs, and websites to provide applicable and timely information on hazards. • Implement public involvement components identified in the 2016 General Plan.
Town of Marana	• Continue to pursue the past activities listed above, as appropriate. • Have a municipal representative attend state and locally funded symposiums such as The Continuing Challenge: HazMat Symposium, and the Southwest Gas Pipeline Safety Symposium for increased awareness of hazardous materials incident preparedness measures. • Provide floodplain related hazard and mitigation information to targeted properties in high-risk areas. • Provide flood hazard outreach annually to residents of the Town of Marana located within the flood plain. • Create updated brochures for building within the flood plain. • Conduct public outreach through open-house meetings for new "L" Series FEMA Flood Insurance Rate Maps (DFIRMs).
Pascua Yaqui	• Continue emphasizing mitigation activities in correlation to the Pascua Yaqui Tribe Improvement Projects program. • Continue PSAs on the Plan on the Intranet/Intranet and on Yaqui Radio Station. • Continue to use the plan for reference for profiling of cultural sites for economic development. • The Pascua Yaqui Department of Public Safety will continue to support the plan by referencing the plan with other tribal departments for grants and infrastructure improvement opportunities. • Participate in Tribal Recognition Days and other public outreach opportunities to promote mitigation opportunities and hazard reduction throughout the community.
Town of Sahuarita	• Solicit comments for Multi-Jurisdictional Hazard Mitigation Plan/announce Plan availability through social media outlets, town website and town newsletter. • The Emergency Operations Plan will be revised within the next year and reposted on town website. • Maintain link to Multi-Jurisdictional Hazard Mitigation Plan on town website. • Maintain "Be Prepared" information developed by FEMA on town website. • Launch social media campaign to promote emergency preparedness.

APPENDIX A: ACRONYMS

ADEMA .....Arizona Division of Emergency Management and Military Affairs
ADFFM .....Arizona Department of Forestry and Fire Management
ADEQ .....Arizona Department of Environmental Quality
ADTF .....Arizona Drought Task Force
ADWR .....Arizona Department of Water Resources
AGFD .....Arizona Game and Fish Department
AP .....Actions/Projects
ARS .....Arizona Revised Statutes
ASCE .....American Society of Civil Engineers
ASERC .....Arizona State Emergency Response Commission
ASLD .....Arizona State Land Department
ASU .....Arizona State University
AZGS .....Arizona Geological Survey
BLM .....Bureau of Land Management
CAP .....Central Arizona Project
CAP .....Community Assistance Program
CFR .....Code of Federal Regulations
CNF .....Coronado National Forest
CPRI .....Calculated Priority Risk Index
CRS .....Community Rating System
CWPP .....Community Wildfire Protection Plan
DEMA .....Arizona Department of Emergency and Military Affairs
DFIRM .....Digital Flood Insurance Rate
DMA 2000/2K ...Disaster Mitigation Act of 2000
DOT .....Department of Transportation
EHS .....Extremely Hazardous Substance
EMAP.....Emergency Management Accreditation Program
EOP .....Emergency Operations Plan
EPA .....Environmental Protection Agency
EPCRA .....Emergency Planning and Community Right to Know Act
ESF .....Emergency Support Function
FEMA .....Federal Emergency Management Agency
FIRM .....Flood Insurance Rate Maps
FMA .....Flood Mitigation Assistance Grant Program
GIS .....Geographic Information System
GRFD .....Golder Ranch Fire District
HAZMAT .....Hazardous Material
HAZUS-MH .....Hazards United States Multi-Hazard
HI.....Heat Index
HMGP .....Hazard Mitigation Grant Program
HUD .....Housing and Urban Development
IFCI .....International Fire Code Institute
LEPC .....Local Emergency Planning Committee
LDIG .....Local Drought Impact Group
LPT .....Local Planning Team
MMI .....Modified Mercalli Intensity
MJHMP .....Multi-Jurisdictional Hazard Mitigation Plan
NASB .....Northern Arizona Seismic Belt
NCDC .....National Climate Data Center
NDMC .....National Drought Mitigation Center

NESDIS .....National Environmental Satellite, Data and Information Service
NFIP .....National Flood Insurance Program
NFPA .....National Fire Protection Association
NHC .....National Hurricane Center
NIBS .....National Institute of Building Services
NID .....National Inventory of Dams
NIDIS .....National Integrated Drought Information Systems
NIST .....National Institute of Standards and Technology
NPS .....National Park Service
NSF .....National Science Foundation
NOAA .....National Oceanic and Atmospheric Administration
NRC .....National Response Center
NWCG.....National Wildfire Coordination Group
NWS .....National Weather Service
PAG .....Pima Association of Governments
PCOEM .....Pima County Office of Emergency Management
PCRFCD.....Pima County Regional Flood Control District
PCCWPP .....Pima County Community Wildfire Protection Plan
PGA.....Peak Ground Acceleration
PYT .....Pascua Yaqui Tribe
PDM-C .....Pre-Disaster Mitigation Competitive
PSDI .....Palmer Drought Severity Index
RL .....Repetitive Loss
SARA .....Superfund Amendments and Reauthorization Act
SOP.....Standard Operating Procedures
SPI .....Standardized Precipitation Index
SRLP .....Severe Repetitive Loss Properties
SRL .....Severe Repetitive Loss
SRP .....Salt River Project
TNRT.....Tribal Nations Response Team
UBC .....Uniform Building Code
USACE .....United States Army Corps of Engineers
USDA .....United States Department of Agriculture
USDM .....United States Drought Monitor
USFS .....United States Forest Service
USGS .....United States Geological Survey
USSDO .....United States Seasonal Drought Outlook
VA .....Vulnerability Analysis
WUI .....Wildland Urban Interface

APPENDIX B: RESOLUTIONS OF ADOPTION

APPENDIX C: PLANNING PROCESS DOCUMENTATION

APPENDIX D: ASSESSMENT OF PREVIOUS ACTION ITEMS

Table D-1: 2012 Mitigation Measures for Pima County

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Primary Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Enforce Flood & Erosion Hazard Ordinance in accordance with the NFIP.	Flood	$1.2 million	Ongoing	RFCD / Floodplain Management Division	Flood Control tax Levy	In Progress	Keep	District staff including hydrologists, engineers and inspectors provides enforcement.
Implement NFIP tasks such as LOMR submittals, maintaining a countywide map repository, performing master drainage studies, and coordinating to insure the digital map is correct.	Flood	$600,000	Ongoing	RFCD / Planning & Development Division	Flood Control Tax Levy	In Progress	Keep	District staff including GIS programmers, hydrologists, engineers and project managers provides map information services.
Arroyo Chico Multi-Use Project – Phase 2B (Basins 1, 2 & 3)	Flood	$13.3 million	September, 2013	RFCD / Engineering Division	Flood Control Tax Levy & USACOE	Complete	Delete	Construction completed in 2015.
Inspection and preventative maintenance on levees as needed.	Levee Failure	$50,000	Ongoing	RFCD / Infrastructure Management Division	Flood Control Tax Levy	In Progress	Keep	District inspectors monitor conditions at least annually and after floods.
Develop and implement multi-agency exercises and drills related to outbreaks of communicable illnesses and vector control.	Disease (Response)	Staff Time	12 months	Health Department Director	Grant Funds	In Progress	Remove	This is covered by Health Department Plans and Planning, not Mitigation.

Table D-1: 2012 Mitigation Measures for Pima County

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Primary Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Develop a Shelter in Place Plan (appendix to Pima County Emergency Operations Plan).	All (Response)	Staff Time	24 months	Pima County Office of Emergency Management and Homeland Security, Director	Grant Funds (as available)	Completed	Remove	This has been updated in the County EOP and integrated into the Response plan for hazardous materials.
Participate in Community Rating System to reduce insurance premiums.	Flood	$50,000	Ongoing	RFCD / Planning & Development Division	Flood Control Tax Levy	In Progress	Keep	Pima County maintains a high rating and inclusion of flood hazards in this plan is a critical component of the score.
Buffelgrass Mitigation – identify public outreach opportunities, locate county areas for mitigation of buffelgrass and administer grant funding for ongoing activities related to wildfire reduction through removal and reduction in Buffelgrass.	Wildfire		Ongoing	Tucson Clean and Beautiful, Pima County Parks and Recreation	Mitigation Grants	In Progress	Keep	Working on completing a HMG and acquiring another grant.

Table D-2: 2012 Mitigation Measures for Marana

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Provide training to the applicable Marana departments on the adopted hazard mitigation plan and its requirements.	All	$500	2021	Emergency Management Coordinator	General Fund	In Progress	Keep	This will be a continuing process as staff changes
Conduct a public education campaign to increase awareness of natural hazards by distributing ADEM and Pima Co mitigation flyers at community events and public gathering opportunities, as appropriate. This will be accomplished semi-annually by Community Services.	All	$500	2021	Community Development Director	General Fund	In Progress	Keep	This will be a continuing process and the Town grows
Encourage bridge or culvert construction where roads are susceptible to flooding. This will be accomplished as part of the Planning Process when Developers apply to build in Marana.	Flood	Staff Time	2016	Development Services/ General Manager	General Fund	In progress	keep	We look at this with each development and road project.
Marana will continue to participate in the National Flood Insurance Program by reviewing applications for buildings, ensuring they are properly designed.	Flood	Staff Time	2016	Development Services/ General Manager	General Fund	In progress	keep	This is an ongoing effort.

Table D-2: 2012 Mitigation Measures for Marana

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Rattlesnake Pass from Saguaro Bloom to Twin Peaks Road.	Flood	$29.8 Million	2018	Public Works / Director	Transportation Fund, General Fund	No progress	keep	This will be constructed by developer but the trigger has not been met
Barnett Linear Park and Flood Control – Construct a 3-mile channel along Barnett Road to mitigate the drainage and flood hazard from the Santa Cruz River	Flood	$16.5 Million	2016	Public Works / Director	General Fund, Future MMPC Bonds	In progress	keep	Incrementally completed with each development along Barnett
Ina Road Bridge – Remove and replace the Ina Road bridge that crosses the Santa Cruz River	Flood	$17.5 Million	2016	Development Services / Director	Transportation Fund, HURF Bonds, General Fund	In progress	revise	Completion date will be 2019
Ina Road Improvements from Silverbell Road to I-10 – widening of Ina Road to 4-lane section with raised median, sidewalks, and drainage improvements	Flood	$16.5 Million	2016	Public Works/Director	Transportation Fund, Federal Grants	In progress	revise	Completion date will be 2019
Tangerine Road Corridor - provide a minimum of 4 lanes with raised medians, drainage improvements, sidewalks, ADA facilities, multi-use path and lanes, Traffic Signals, Right-of-Way acquisitions, Utility relocations, Marana Water	Flood	$95.5 Million	2019	Public Works / Director	RTA, Future Bond Money	In progress	keep	Clarify that Phase I completion in 2018 and Phase II (DM Blvd. to I-10) to start construction in 2020

Table D-2: 2012 Mitigation Measures for Marana

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
line extensions, and sewer modifications and additions.								
Ina Road TI – lower I-10 and construct a new overpass that will span both I-10 and the UPRR tracks. Project will mitigate flood issues and also improve access that will reduce accidents and HazMat incidents	Flood, HazMat, Traffic Accidents	$65.0 Million	2018	Public Works / Director in coordination with ADOT	ADOT, RTA	In progress	keep	Starting construction, TI to close in January 17' for two years
Marana will continue to participate in the Flood Prone Land Acquisition Program so we acquire properties located in flood hazard areas.	Flood	Staff	2016	Development Services/ General Manager	Grants, Partnership w/ Pima Co	In progress	keep	There is no completion date so perhaps this could be changed to an "ongoing status."

Table D-3: 2012 Mitigation Measures for Oro Valley

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Develop, implement, and update a mass evacuation strategy for Oro Valley (including training and exercising).	All (Response)	Staff Time	Annually, ongoing	Emergency Management and DIS	General Fund and grant	Complete	Delete	Preparedness. Oro Valley included in other regional evacuation plans such as the Pima County and statewide evacuation plans.
Develop, implement, and regularly update a Shelter in Place educational program (including training and exercising).	All (Response)	Staff Time	Annually, ongoing	Emergency Management	General Fund and grant	Complete	Delete	Preparedness. Shelter in place is included as part of regular town emergency management activities.
West Nile Virus Program Continued testing of mosquitoes for West Nile Virus. If a positive result, the area is sprayed.	Disease	$5,000	Annually, ongoing	Stormwater Utility	Pima Co Health Dept.; Stormwater Utility, and AZ Dept. of Health Zoonotic Diseases	Complete	Delete	This is an annual and ongoing program managed by the Pima County Health Department and no longer by the Town.

Table D-3: 2012 Mitigation Measures for Oro Valley

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Buffelgrass Program actively educates and removes buffelgrass in public areas across the Town.	Wildfire	Staff and Volunteer Time	Annual, ongoing	DIS	General Fund, grant, and volunteer time	In progress	Keep	This is an annual and ongoing program.
Regularly update wildland-urban interface plans and educate communities about fire hazards.	Wildfire	Staff Time	Annual, ongoing	Golder Ranch Fire District	Golder Ranch	In progress	Delete	GRFD is developing and implementing a community risk reduction program that includes all hazards, planning, and education. That is included in a new mitigation action project in the plan update.
Widening of Lambert Lane between Pusch View Lane Bridge and La Canada Dr. will include drainage improvements to eliminate roadway flooding and debris.	Flood	$8M	Sept. 2013	DIS	Pima Association Governments	Complete	Delete	Road project was completed in June 2013.
Public education and outreach about protecting pipes and irrigation systems from freezes.	Extreme Cold	Staff Time	Annual, ongoing	Oro Valley Water Utility	Water Utility Fees	Complete	Delete	Preparedness. This is an annual and ongoing program.
Applicable Hazmat training and exercising for first responders; as well as participation in multi-agency regional hazmat and decontamination teams.	HazMat	Staff Time and Training Costs	Annual, ongoing	Oro Valley Police Department and Golder Ranch	General Fund and Grant Funds	Complete	Delete	Preparedness. GRFD participates in agency specific and regional hazmat training and exercises.

Table D-3: 2012 Mitigation Measures for Oro Valley

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Town Cistern Project includes the addition of cisterns across the Town campus, water collected will be used for Town landscaping. Landscaping will be planned around the xeriscaping concept.	Drought	$12,000	Annual, ongoing	DIS, Water, and Parks	General Fund and Private Funds	Complete	Delete	Project completed in August 2011.
Continue to develop, expand, and implement a Drought Response Plan to address potential or long-term drought conditions.	Drought	Staff Time	Annual, ongoing	Water Utility	General Fund	Complete	Delete	This is an annual and ongoing program.
Town of Oro Valley Stormwater Utility will continue to Manage Public Information Activities. • Monitor and maintain elevation certificates • Provide FEMA map information service • Conduct outreach projects to increase public awareness of flooding hazard promote flood insurance in general • Provide Flood protection information	Flood	Staff Time and SW Utility Fees	Annually ongoing	Storm Water Utility, EM, Permitting Div., TOV Library	Storm Water Utility Fees	In progress	Keep	This is part of the annual and ongoing stormwater program.

Table D-3: 2012 Mitigation Measures for Oro Valley

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Conduct Floodplain Mapping and Regulatory Activities. • Manage/prepare LOMCs* for FEMA designated floodplains • Generate and collect additional (local) floodplain maps and information • Promote and enforce open space preservation • Enforce and augment regulatory floodplain standards • Manage town wide floodplain data • Oversee stormwater management program	Flood	Staff Time and SW Utility Fees	Annually ongoing	Storm Water Utility	Storm Water Utility Fees	In progress	Keep	This is part of the annual and ongoing stormwater program.
Conduct Flood Damage Reduction Activities • Organize floodplain management planning doc. • Investigate acquisition and relocation of flood prone properties • Conduct and manage drainage system maintenance	Flood	Staff Time and SW Utility Fees	Annually ongoing	Storm Water Utility	Storm Water Utility Fees	In progress	Keep	This is part of the annual and ongoing stormwater program.

Table D-3: 2012 Mitigation Measures for Oro Valley

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Conduct Flood Preparedness Activities • Coordinate flood warning program w/PCRFCD • Monitor levee safety for OV's certified levee	Flood	Staff Time	Annually ongoing	Storm Water Utility	Storm Water Utility Fees	In progress	Keep	This is part of the annual and ongoing stormwater program.
Oro Valley Emergency Management will provide training to applicable Town staff on the adopted hazard mitigation plan and its requirements.	All	Staff Time	Annually, ongoing	All Town Departments and Emergency Management	General Fund and grant	Complete	Delete	Town staff education is part of the regular emergency management activities and will be provided again upon adoption of the plan.
Review existing Oro Valley General Plan and zoning code to determine how these documents help limit development in hazardous areas. Modify with additional guidelines, regulations, and land use techniques as necessary within the limits of state statues, while also respecting private property rights.	All	Staff Time	Annually, ongoing	DIS	General Fund	Complete	Delete	This is an annual and ongoing component of the departmental roles and responsibilities. The General Plan 2016 is slated for vote in November 2016.

Table D-3: 2012 Mitigation Measures for Pascua Yaqui Tribe

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Regional Flood Control Facilities Design was implemented with the 2004 Master Drainage Report. New tasks were completed such as topography, food plain modeling and letter map revision.	Flood	Staff time	Ongoing and Continuous	Tribal Council Land Department	General Fund	In Progress	Keep	Drainage and culvert annual maintenance and repairs (small and large) to road projects.
Regional Flood Control Design, Phase 2 finalization.	Flood	Staff time	Ongoing and Continuous	Tribal Council Land Department	General Fund	In Progress	Keep	Cultural Survey, Design Plans, Cost Plans and Utility Relocation Plans were implemented in Phase 2. City of Tucson has approved Phase 1 but Phase 2 is still under review.
Continue the existing intergovernmental agreement between the Tribe and the State Forestry Department for assistance in the provision of emergency services within each other's jurisdictions.	Wildfire	Staff time	Continuing	*Fire Department *Attorney General's Office *Tribal Council	General Fund	In Progress	Keep	Completion of the Pima County Community Wildfire Protection Plan (CWPP) of 2013; completion of BIA Wild Fire Management Plan (WFMP) and, BIA Fuels Management Plan (FMP) of 2012

Table D-3: 2012 Mitigation Measures for Pascua Yaqui Tribe

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Review existing building codes to determine adequate protection for new development in hazard areas. Where feasible and necessary, modify codes to help mitigate hazards imposed on such development within the limits of the Reservation, while also respecting private property rights adjacent to the Reservation.	Extreme Temperature	Staff Time	Ongoing and Continuous	Tribal Council, Fire Department, Land Department, Housing Department	General Fund	In Progress	Keep	Install roofing materials with high reflectivity and high emittance ratings Install high performance windows that meet or exceed Energy Star criteria for "U" value and SHGC Improve "U" value of roof and wall systems by installing insulation which exceed current IECC requirements Install high efficiency HVAC with minimum SEER ratings including Adhering to the building codes of 2012, International Building Codes

Table D-3: 2012 Mitigation Measures for Pascua Yaqui Tribe

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Review existing building codes to determine adequate protection for new development in hazard areas. Where feasible and necessary, modify codes to help mitigate hazards imposed on such development within the limits of the Reservation, while also respecting private property rights adjacent to the Reservation.	Drought Earthquake Severe Wind	Staff	Ongoing and Continuous	*Land Development *Tribal Council	General Fund	In Progress	Delete	Drought no longer necessary. Tribal Land Department with BIA resources determined we did not have sustainable water. Earthquake no longer necessary. Overseen by AZGS. Serve wind, no longer necessary. Overseen by Tribal Building Inspections, addressed through adhering to the building codes.
Continued coordination between the Tribe, Pima County Departments, municipalities, Pima Association of Governments, and other agencies in the development and maintenance of accurate geographic information system information for those hazard areas identified in the adopted hazard mitigation plan.	All	Staff	Ongoing and Continuous	*Land Development *Tribal Council	General Fund	In Progress	Delete	

Table D-3: 2012 Mitigation Measures for Pascua Yaqui Tribe

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Develop a Mass Evacuation strategy and formalize in a published document	All	Staff time	Continuing	*Fire & Police Departments *Land and Procurement Departments	General Fund	In Progress	Delete	

Table D-3: 2012 Mitigation Measures for Pascua Yaqui Tribe

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Conduct and enhance environmental and epidemiological surveillance activities in those areas identified as being of high public health importance and related to environmental factors such as; food safety, protection, and vector control activities. Surveillance activities must include the identification of vulnerabilities and environmental factors that may contribute to the transmission of the communicable diseases associated with the operation and presence of these facilities in the Tribe, as well as the implementation of preventative action that may be applied to reduce or eliminate the potential for transmission of communicable illnesses. Develop and improve the system of coordination and communication of these findings, trends and observations with other federal, state and local agencies that have similar or related interest.	Disease	N/A	Ongoing	*Epidemiology Center Director	General Fund	In Progress	Delete	No longer necessary; overseen by our Tribal PHEP/Injury Prevention Coordinator

Table D-4: 2012 Mitigation Measures for Sahuarita

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Promote Child Drowning Prevention programs throughout the Town.	Drowning	$3,000 and staff time	May 2012	Police Communications	Open		Delete	Not mitigation
Continued adherence to AAC R18-9 for reductions in pollutant discharge at Town Aquifer.	HazMat	$15,000	March 2012	Public Works	Waste Water Fund		Delete	Covered under separate plan
Update Waste Water Department contingency and emergency plans	HazMat	Staff time	March 2012	Public Works	None		Delete	Covered under separate plan
Continue annual updating of Town Storm water/Flooding Pollution Prevention Plan	Flood	Staff Time	January 2013	Public Works	None	In Progress	Keep, revise	Ongoing program; AZPDES requirement
Continue use of permit process from Corp of Engineers to streamline maintenance and bank stabilization efforts when needed	Flood	Staff Time	Ongoing	Public Works	HURF Funds	In Progress	Delete	Ongoing task, not task specific

Table D-4: 2012 Mitigation Measures for Sahuarita

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Organize and host annual Southern Arizona Beat Back Buffelgrass community removal event	Wildfire	Staff Time		Public Works	T.O. Nation Grant	In Progress	Keep, revise	Ongoing work through volunteer and staff efforts to remove/spray Buffelgrass; removal of noxious/invasive species through Sahuarita Town Code for Riparian Habitat Protection and Mitigation Requirements
Implement Vector Borne Illness prevention program through mosquito abatement	Disease (Pandemic)	$10,000	September 2012	Public Works Parks and Rec	General Fund		Delete	Ongoing program, not task specific
Updating of riparian ordinance to protect various species that reduces erosion to mitigate flooding potentials and also reduces development in flood prone areas	Flood	$300 and staff time	December 2011	Planning and Zoning	General Fund	Complete	Delete	Resolution 2013-0344 and Ordinance 2013-077 amending the Riparian Habitat Protection and Mitigation Requirements of Town Code were adopted on January 16, 2013

Table D-4: 2012 Mitigation Measures for Sahuarita

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Continued Controlled Burns on Town Property	Wildfire	$2,000 and staff time	January 2012	Fire Department Public Works	General Fund		Delete	Ongoing program based on Fire Department programming
Review, Update and Modify NFIP requirement and make appropriate modifications to Flood Plain Ordinance	Flood	Staff Time	January 2013	Public Works	None	In Progress	Keep, revise	Coordination with Arizona Department of Water Resources for ordinance update
Educate the public to increase awareness of hazards, and potential opportunities for mitigation actions. Make Pima County's public information material sheets, websites, mitigation brochures, and media outlets available.	All	Staff Time	July 2012	Emergency Management	None	Complete and Ongoing	Keep, revise	Resolution 2012-0303 adopting the Pima County Multi-Jurisdictional Hazard Mitigation Plan was approved on June 11, 2012. Posting of educational materials and links to Pima County's information on the Town Website is being explored.
Landscape code amendment requiring vegetation adjustment in developed areas to	Extreme Temperatures	$300 and staff time	December 2011	Planning and Zoning	General Fund	Complete	Delete	Resolution 2011-0280 and Ordinance 2011-060 amending the Landscaping, Buffering and

Table D-4: 2012 Mitigation Measures for Sahuarita

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
reduce the heat island effect								Screening Standards of Town Code were adopted on October 24, 2011.
Develop and Implement internal emergency response procedure	All (Response)	Staff Time	May 2012	Public Works	None	Complete	Delete	Resolution 2012-0297 adopting the Town of Sahuarita Emergency Operations Plan was approved on May 29, 2012.
Improve upon existing capabilities to warn the public of emergencies by initiating a system to test the ability of local emergency managers to activate the AENS systems.	All (Response)	$5,000	January 2013	Emergency Management	General Fund		Delete	Not mitigation
Develop and Implement an interoperable communications between all emergency-related departments	All (Response)	Staff Time	January 2013	Emergency Management, Local Fire District	None		Delete	Not mitigation
Implement Development Criteria for the Lee Moore	Flood	Staff Time	Ongoing	Public Works,	None		Delete	Resolution 2010-237 adopting the Lee Moore Wash Basin

Table D-4: 2012 Mitigation Measures for Sahuarita

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Wash Basin Management Plan				Planning and Zoning				Management Study was adopted on December 13, 2010. Ongoing work includes implementation of the development criteria.

Table D-5: 2012 Mitigation Measures for Tucson

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Identify funding source and construct two bridges and 50 box culverts with 380 back-up power units for signalized intersections at high flood hazard crossings in Tucson limits in accord with the COT Department of Transportation 5-yr plan. If a box culvert cannot be constructed an automated warning device, consisting of a barricade, signs and flashing lights would be installed.	Flood, Severe Wind	$100 million, Staff Time	Ongoing effort with long-term horizon. Schedule dependent upon funding	Department of Transportation Streets Administrator and Streets Chief Engineer	Grant Funds	No Progress	Keep	No funding
Tucson Water, a division of the Utility Services Department will secure its assets and facilities by implementing actions, in phases, as identified in the Federally mandated Water System Vulnerability Assessment completed in Oct 2002.	Terrorism, Vandalism	$20 million	On-going with full completion by 2020	Water Department / Water Engineer & Operations	Operations Budget	N/A	Delete	Not a natural hazard

Table D-5: 2012 Mitigation Measures for Tucson

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Promote disaster-resistant water delivery system by constructing redundant water transmission lines (e.g., The Utility and the community will be less susceptible to loss of water delivery due to natural or human-caused disasters).	All	$7.9 million	On-going with full completion by 2020	Water Department / Water Administrator Maintenance & Operations	Operations Budget	In progress	Keep, revise	Work has been ongoing in constructing redundancy in to the system. Project will be revised to include new project goals and increase estimated cost.
Work with the AZGS and USGS on projects that mitigate geo-hazards (e.g. continue the feasibility study with the AZGS and USGS Water Plan 2000-2050.	Drought, Earthquake, Subsidence, other geo-hazards.	$51.2 million	Ongoing effort with long-term horizon. Schedule dependent upon funding	Water Department / Staff	Operations Budget	Complete	Delete	Work on mitigating subsidence was done with the USGS. Subsidence issues were monitored in concert with USGS.
Construct second recharge facility to be known as the Southern Avra Valley Recharge and Recovery Project (SAVSARP). The utility could then use its entire allotment of Central AZ Project water and provide capacity for recharging additional water supplies. Construction will take 5 years).	Drought, Earthquake, Subsidence, other geo-hazards.	$51.2 million	2016	Water Department/Staff	Operations Budget	Complete	Delete	Completed ahead of schedule, total investment of $45 million.

Table D-5: 2012 Mitigation Measures for Tucson

Description	Hazard(s) Mitigated	Estimated Cost	Anticipated Completion Date	Lead Agency	Potential Funding Source(s)	Status • No Progress • In Progress • Complete	Disposition • Keep • Delete • Keep, revise	Explanation or brief description of work so far or reason for 'no progress'
Re-direct drainage canal at Barrio Viego to prevent continued repetitive losses.	Flood	$425,000	2013	Transportation Department / Project Administrator	Grant Funds, General Fund, PCRFCD	No progress	Keep	No funding
In compliance with the NFIP, Tucson will continue to require the preparation and submittal of a CLOMR or CLOMR-F for all proposed development within FEMA delineated Special Flood Hazard Areas	Flood	Staff Time	Annual - Ongoing	Development and Planning Services Department / Director	Department Budget and Fees for Developers	In Progress	Keep	Ongoing annually
Tucson will maintain compliance with NFIP regulations by enforcement of the current floodplain management ordinance through review of new development located in the floodplain and issuance of floodplain use permits.	Flood	Staff Time	Annual - Ongoing	Development and Planning Services Department / Director	Department Budget	In Progress	Keep	Ongoing annually
Improve floodplain administration under the NFIP program by sending inspectors into the field when we receive a flood warning from the NWS , to assess bridges, washes and other critical infrastructures within Tucson.	Flood	Staff Time	Annual-Ongoing	Development and Planning Services Department / Director	Department Budget and Information	In Progress	Keep	Ongoing annually

APPENDIX E: PUBLIC INVOLVEMENT

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OEM, DEQ, other agencies work to protect residents from disasters

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The Pima County Department of Environmental Quality is actively participating in the collaborative working group, headed up by the Pima County Office of Emergency Management (PCOEM), that is updating the 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan. This plan is used to identify risks and vulnerabilities associated with potential disasters and to develop long-term strategies for mitigating these risks in order to protect the residents of Pima County.

The hazards addressed in this plan include disease, drought, extreme temperatures, floods, wildfires, and more.

We encourage the public to comment on the current plan and the final draft when the plan is updated. The 2012 plan is currently available for viewing and comment on the Pima County website at PCOEM Mitigation.

Comments may be submitted through the electronic form also located on the PCOEM website. The 2012 plan is available for comment and revisions before FEMA approval by the end of the 2016 calendar year.

Once plan revisions are complete, the final draft will be made available for review and comment, so please check back with PCOEM regularly. Additional information regarding hazard mitigation and the Pima County Multi-Jurisdictional Hazard Mitigation Plan can be found on the PCOEM webpage.

If you have questions, please contact: Courtney Bear, Program Manager, PCOEM, (520) 724-9300.


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Environmental Quality
Pima County Department of Environmental Quality (PDEQ), formed in 1989, serves Pima County by protecting public health and the environment. PDEQ operates programs to monitor air and water quality, hazardous waste, solid waste, and assist in waste minimization and pollution prevention. PDEQ also provides public outreach, education, and citizens' assistance; processes environmental permits; and responds to public complaints and inquiries with investigations and enforcement.
Our Mission
Preserve and protect the environment of Pima County for the long-term benefit of residents' health, welfare, safety, and quality of life. Identify and respond to environmental issues by providing public services including monitoring, enforcement, information, education, and solid waste management.
Featured News
August 04, 2016 - OEM, DEQ, other agencies work to protect residents from disasters
July 29, 2016 - Pima DEQ issues air-quality advisory
July 28, 2016 - Pima DEQ offers these back-to-school tips
July 22, 2016 - Pima DEQ issues air quality advisory
July 21, 2016 - County stormwater manual wins national honor
View more news articles
Special Notice: Starting June 20, 2016, PDEQ will begin a new procedure for invoicing plans received by the department for review. The updated plan review procedure affects submittals for sewer projects, water projects, and the approval of sanitary facilities for subdivision projects.
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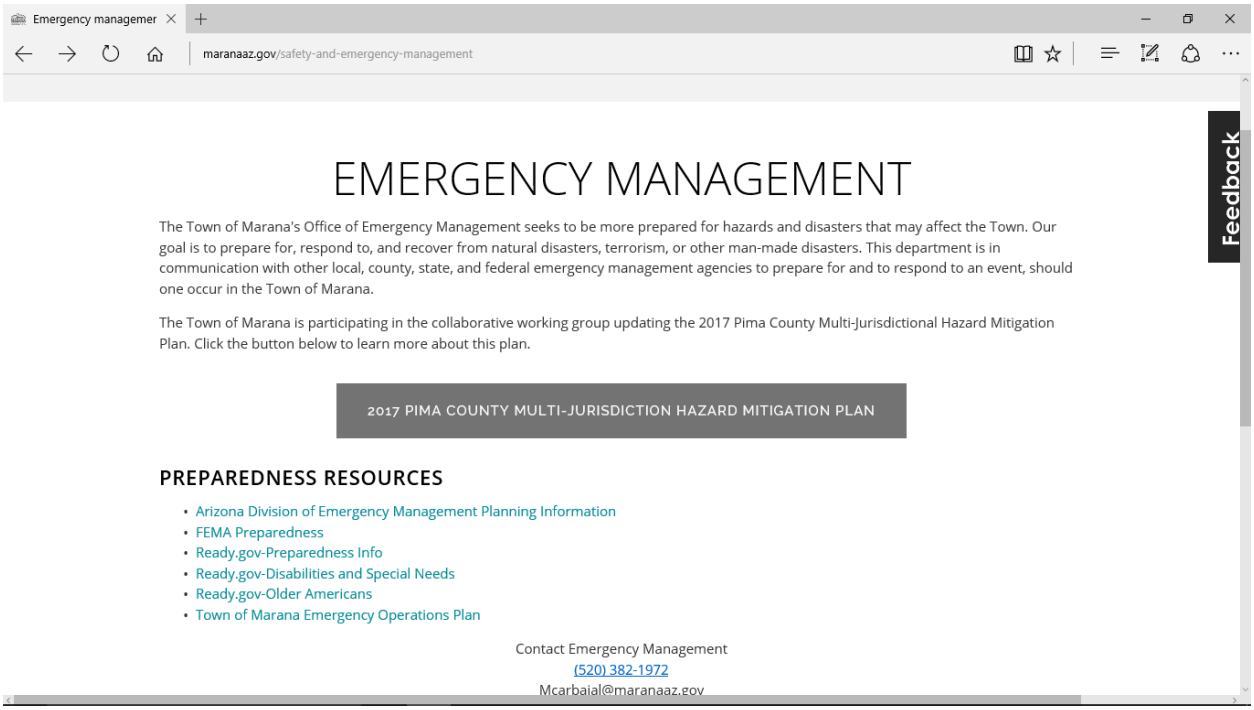

http://www.maranaaz.gov/safety-and-emergency-management

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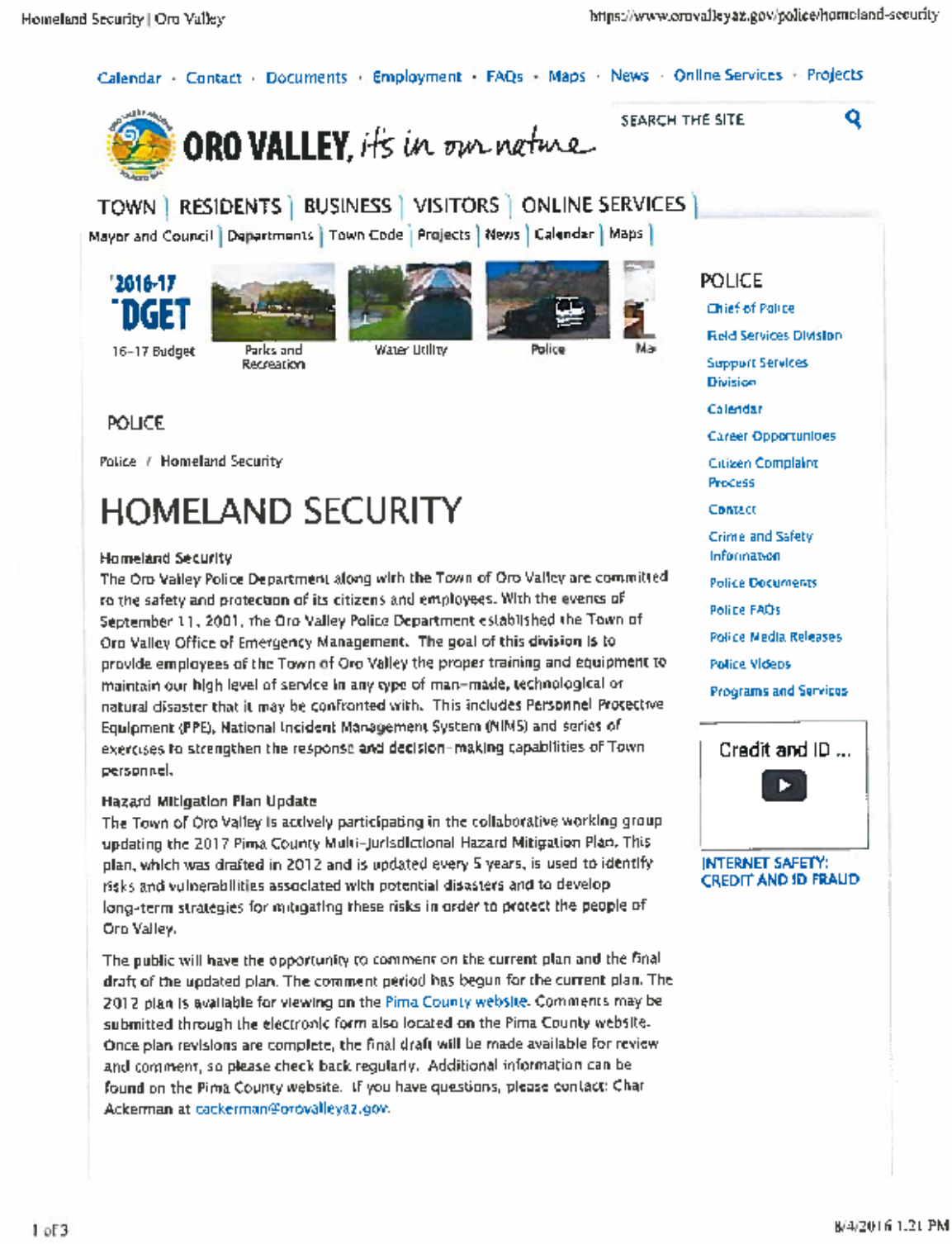

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Homeland Security

The Oro Valley Police Department along with the Town of Oro Valley are committed to the safety and protection of its citizens and employees. With the events of September 11, 2001, the Oro Valley Police Department established the Town of Oro Valley Office of Emergency Management. The goal of this division is to provide employees of the Town of Oro Valley the proper training and equipment to maintain our high level of service in any type of man-made, technological or natural disaster that it may be confronted with. This includes Personnel Protective Equipment (PPE), National Incident Management System (NIMS) and series of exercises to strengthen the response and decision-making capabilities of Town personnel.

Hazard Mitigation Plan Update

The Town of Oro Valley is actively participating in the collaborative working group updating the 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan. This plan, which was drafted in 2012 and is updated every 5 years, is used to identify risks and vulnerabilities associated with potential disasters and to develop long-term strategies for mitigating these risks in order to protect the people of Oro Valley.

The public will have the opportunity to comment on the current plan and the final draft of the updated plan. The comment period has begun for the current plan. The 2012 plan is available for viewing on the Pima County website. Comments may be submitted through the electronic form also located on the Pima County website. Once plan revisions are complete, the final draft will be made available for review and comment, so please check back regularly. Additional information can be found on the Pima County website. If you have questions, please contact: Char Ackerman at cackerman@orovalleyaz.gov.

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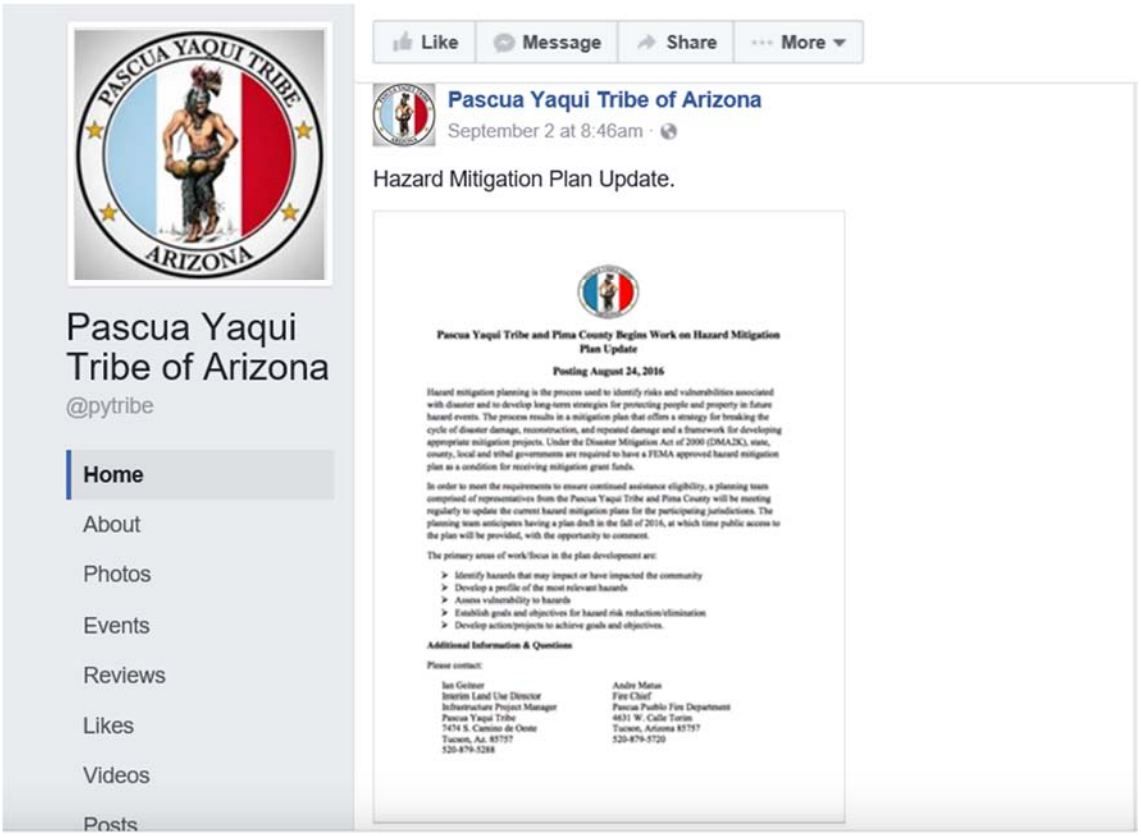

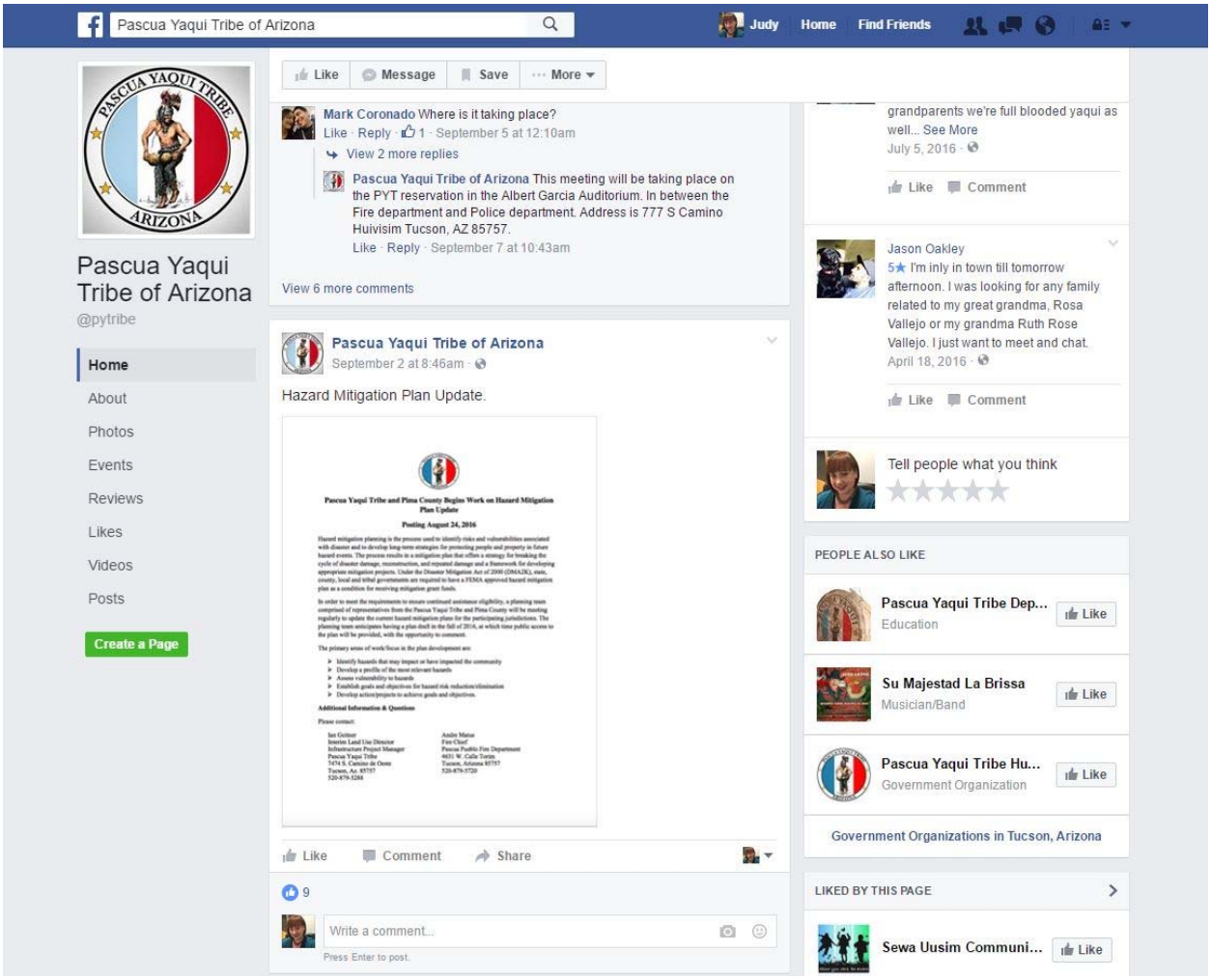
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Pascua Yaqui Tribe of Arizona This meeting will be taking place on the PYT reservation in the Albert Garcia Auditorium. In between the Fire department and Police department. Address is 777 S Camino Huivisim Tucson, AZ 85757.
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Pascua Yaqui Tribe and Pima County Begin Work on Hazard Mitigation Plan Update
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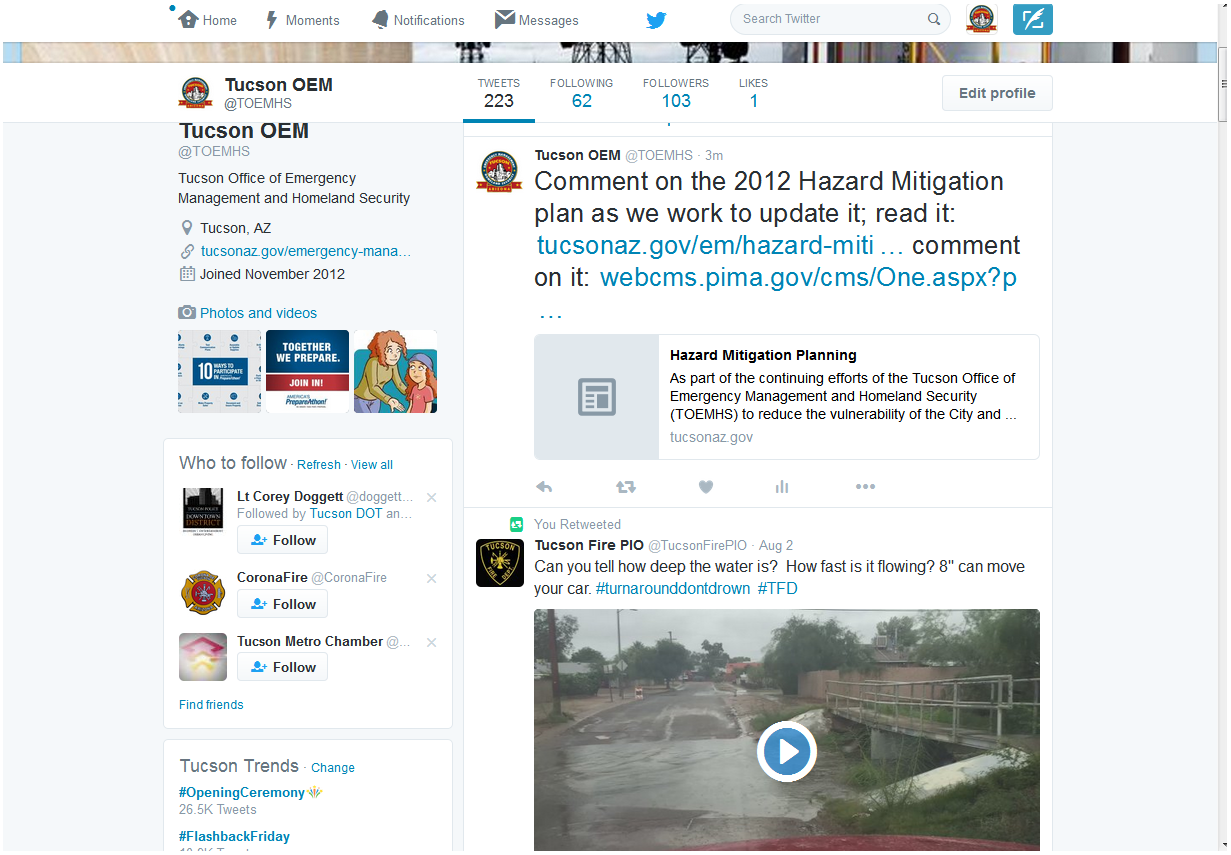

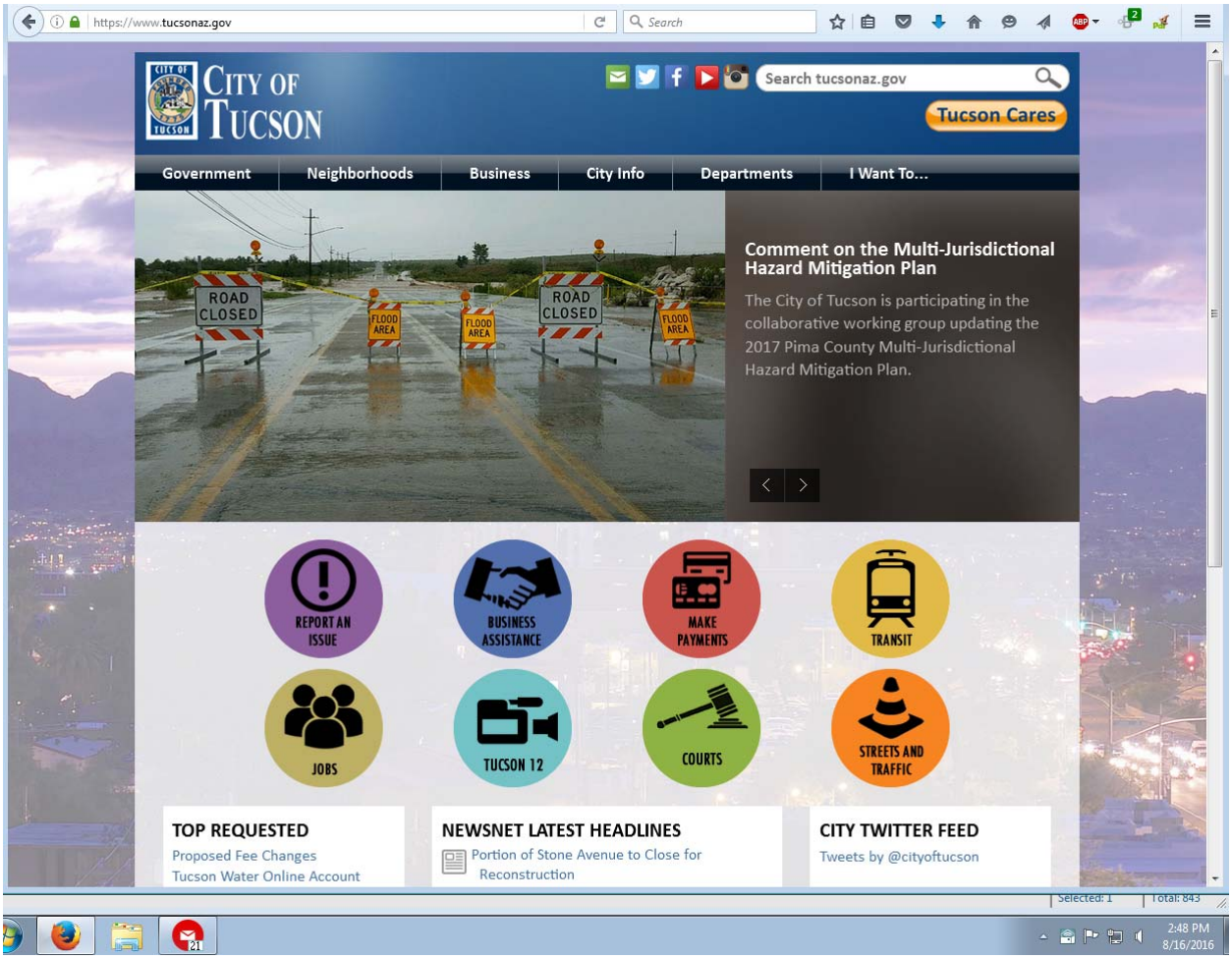
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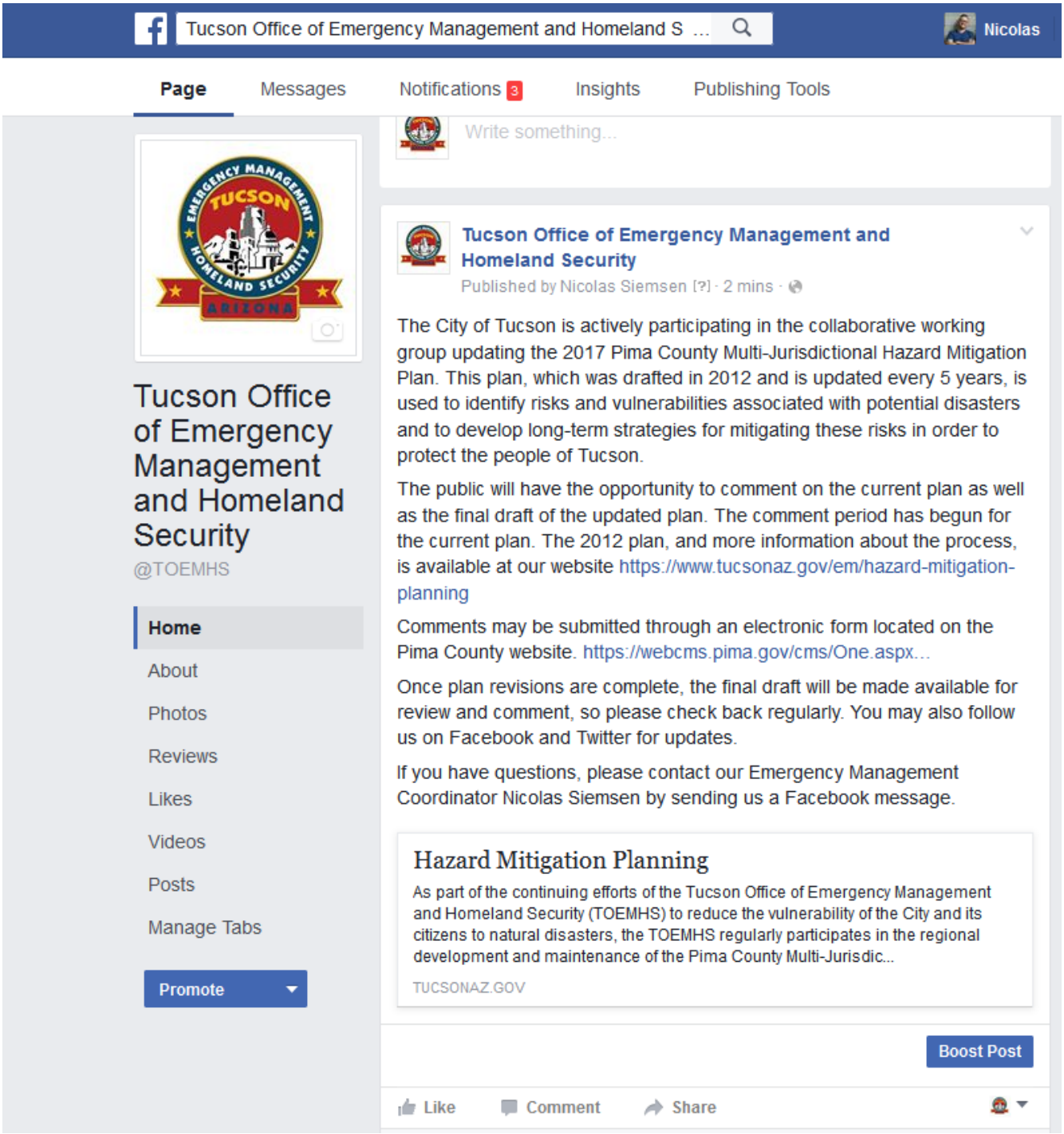
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Published by Nicolas Siemsen [?] · 2 mins ·
The City of Tucson is actively participating in the collaborative working group updating the 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan. This plan, which was drafted in 2012 and is updated every 5 years, is used to identify risks and vulnerabilities associated with potential disasters and to develop long-term strategies for mitigating these risks in order to protect the people of Tucson.
The public will have the opportunity to comment on the current plan as well as the final draft of the updated plan. The comment period has begun for the current plan. The 2012 plan, and more information about the process, is available at our website https://www.tucsonaz.gov/em/hazard-mitigation-planning
Comments may be submitted through an electronic form located on the Pima County website. https://webcms.pima.gov/cms/One.aspx...
Once plan revisions are complete, the final draft will be made available for review and comment, so please check back regularly. You may also follow us on Facebook and Twitter for updates.
If you have questions, please contact our Emergency Management Coordinator Nicolas Siemsen by sending us a Facebook message.
Hazard Mitigation Planning
As part of the continuing efforts of the Tucson Office of Emergency Management and Homeland Security (TOEMHS) to reduce the vulnerability of the City and its citizens to natural disasters, the TOEMHS regularly participates in the regional development and maintenance of the Pima County Multi-Jurisdic...
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Comment period is open for the current 2012 Multi-Jurisdictional Hazard Mitigation Plan

The City of Tucson is actively participating in the collaborative working group updating the 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan. This plan, which was drafted in 2012 and is updated every 5 years, is used to identify risks and vulnerabilities associated with potential disasters and to develop long-term strategies for mitigating these risks in order to protect the people of Tucson.

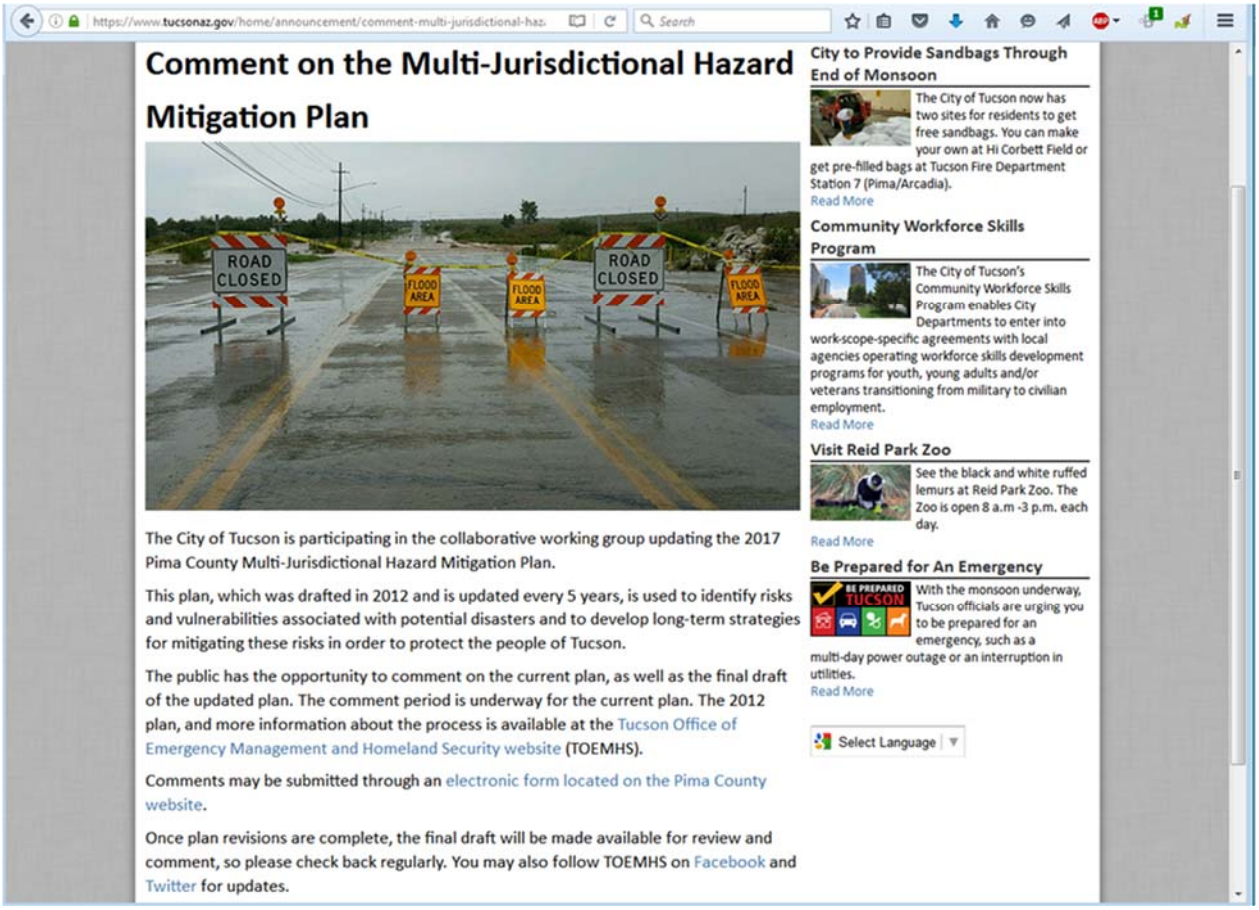
The public will have the opportunity to comment on the current plan as well as the final draft of the updated plan. The comment period has begun for the current plan. The 2012 plan, and more information about the process, is available at our website.

Comments may be submitted through an electronic form located on the Pima County website.

Once plan revisions are complete, the final draft will be made available for review and comment, so please check back regularly. You may also follow us on Facebook and Twitter for updates.

If you have questions, please contact our Emergency Management Coordinator Nicolas Siemsen.

Founded in 2007, the Tucson Office of Emergency Management and



Comment on the Multi-Jurisdictional Hazard Mitigation Plan

The City of Tucson is participating in the collaborative working group updating the 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan.

This plan, which was drafted in 2012 and is updated every 5 years, is used to identify risks and vulnerabilities associated with potential disasters and to develop long-term strategies for mitigating these risks in order to protect the people of Tucson.

The public has the opportunity to comment on the current plan, as well as the final draft of the updated plan. The comment period is underway for the current plan. The 2012 plan, and more information about the process is available at the Tucson Office of Emergency Management and Homeland Security website (TOEMHS).

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Once plan revisions are complete, the final draft will be made available for review and comment, so please check back regularly. You may also follow TOEMHS on Facebook and Twitter for updates.

City to Provide Sandbags Through End of Monsoon

The City of Tucson now has two sites for residents to get free sandbags. You can make your own at Hi Corbett Field or get pre-filled bags at Tucson Fire Department Station 7 (Pima/Arcadia).
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Community Workforce Skills Program

The City of Tucson's Community Workforce Skills Program enables City Departments to enter into work-scope-specific agreements with local agencies operating workforce skills development programs for youth, young adults and/or veterans transitioning from military to civilian employment.
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Visit Reid Park Zoo

See the black and white ruffed lemurs at Reid Park Zoo. The Zoo is open 8 a.m -3 p.m. each day.
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With the monsoon underway, Tucson officials are urging you to be prepared for an emergency, such as a multi-day power outage or an interruption in utilities.
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