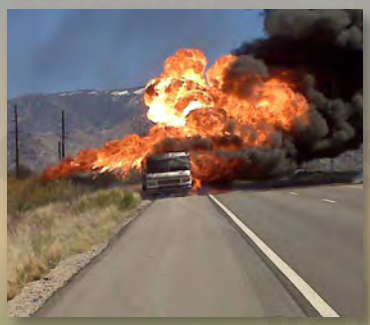
PIMA COUNTY
COMMUNITY WILDFIRE PROTECTION PLAN

July 2013








Pima County Board of Supervisors
City of Oro Valley
City of Sahuarita
Town of Marana
City of South Tucson
City of Tucson
Altar Valley Conservation Alliance
Southern Arizona Buffelgrass Coordination Center
Salt River Project
Tucson Electric Power
TRICO Electric Cooperative
Ajo-Gibson Volunteer Fire Department
Arivaca Fire District
Avra Valley Fire District
Cascabel Volunteer Fire Department
Corona de Tucson Fire Department
Drexel Heights Fire District
Elephant Head Volunteer Fire Department
Golder Ranch Fire District
Green Valley Fire District
Helmet Peak Volunteer Fire Department
Mescal-J6 Fire District
Mount Lemmon Fire District
Northwest Fire District
Pascua Yaqui Tribe Fire Department
Picture Rocks Fire District
Rincon Valley Fire District
Rural Metro Fire Department
Sonoita-Elgin Fire Department
South Tucson Fire Department
Three Points Fire District
Tucson Fire Department
Why Fire Department
Arizona State Forestry Division
Bureau of Land Management
Pascua Yaqui Tribe
Coronado National Forest
Saguaro National Park
Buenos Aires National Wildlife Refuge

DEDICATION

The citizens of Pima County dedicate this Pima County Community Wildfire Protection Plan to the 19 members of the Prescott Fire Department's interagency Granite Mountain Hotshots who died protecting the community of Yarnell from the Yarnell Hill Fire on June 30, 2013, and to all the firefighters who have perished before them responding to fires in the wildland-urban interface. May this plan help reduce the number of fires, lessen fire behavior, and protect lives and property so that such tragedies will never occur in our County.

Graphic donated by Palo Verde Signs Tucson, AZ

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ACRONYMS AND ABBREVIATIONS

ASLD	Arizona State Land Department
ASFD	Arizona State Forestry Division
BAER	burned area emergency response
BANWR	Buenos Aires National Wildlife Refuge (US Fish and Wildlife Service)
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CWPP	community wildfire protection plan
CNF	Coronado National Forest
drc	diameter at root collar
EMS	emergency medical service
FMU	fire management unit
FRCC	fire regime condition class
FS	Forest Service
GIS	geographic information system
GPS	Global Positioning System
HFRA	Healthy Forests Restoration Act of 2003
IGA	intergovernmental agreement
IMS	Internet Mapping Service (Federal Wildland Fire Occurrence)
ISO	Insurance Services Office
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PCOEM	Pima County Office of Emergency Management
NFPA	National Fire Protection Association
NPS	National Park Service
R_x	prescribed fire
SABCC	Southern Arizona Buffelgrass Co4dination Center
SR	state route
SRP	Salt River Project
SWReGAP	Southwest Regional Gap Analysis Project
TEP	Tucson Electric Power
USDA	US Department of Agriculture
USDI	US Department of the Interior
USFWS	US Fish and Wildlife Service
WFLC	Wildland Fire Leadership Council
WUI	wildland-urban interface

EXECUTIVE SUMMARY: PIMA COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

The Pima County Community Wildfire Protection Plan (CWPP) was developed in response to the Healthy Forests Restoration Act of 2003 (HFRA) for the at-risk communities and unincorporated areas in Pima County, Arizona, located in and around public lands administered by the US Department of the Interior Bureau of Land Management (USDI BLM) Gila District Office, Coronado National Forest (CNF), US Department of Interior Fish and Wildlife Service Buenos Aires National Wildlife Refuge (BANWR), the Tohono O'odham Nation, and the Pascua Yaqui Tribe. HFRA established unprecedented incentives for communities to develop comprehensive wildfire protection plans in a collaborative, inclusive process. Furthermore, this legislation gives direction to BLM and the US Forest Service to address local community priorities in fuel reduction treatments, even on nonfederal lands. For a community to take full advantage of the opportunities provided in HFRA, it must first prepare a CWPP. A CWPP developed in accordance with HFRA is the most effective way to acquire federal funding for fire preparedness and planning. Pima County, partner agencies, and participating communities wish to adopt a CWPP to better protect their communities from wildfire risk, to better prepare citizens, and to become eligible to apply for and receive federal and other grant monies to implement wildland fire mitigation projects and programs.

To ensure that all residents of Pima County were represented in this planning process, three core teams were formed to implement the agency and public collaboration necessary to develop a CWPP compliant with HFRA: the Northern Planning Zone Core Team consists of the communities of Oro Valley; Lukeville; Ajo; Why; Pima County lands adjacent to the Catalina Mountains; Rincon Mountains; Marana; Avra Valley; and Picture Rocks to the Gates Pass area, including Saguaro National Park West and Tucson Mountain Park. The Southern Planning Zone Core Team consists of the developed lands adjacent to the Pascua Yaqui Tribe, Robles Junction, Green Valley, Sahuarita, Arivaca-Sasabe CWPP lands, South Tucson, Vail, Corona de Tucson, Saguaro National Park East, and Pima County lands to the Cochise County boundary. The Central Core Team is composed of the Cities of Tucson and South Tucson.

Section I. Introduction

A primary objective of a CWPP is to help local governments, fire departments and districts, and residents identify at-risk public and private lands to better protect those lands from severe wildfire threat. Additional functions of a CWPP are to improve fire prevention and suppression activities, as well as to identify funding needs and opportunities to reduce the risk of wildland fire and enhance public and firefighter safety. Identifying at-risk areas and improving fire protection capabilities helps the communities to prioritize high-risk projects and to expedite overall project planning. Pima County's CWPP was created to meet these objectives at a local level while integrating with overall federal- and state-level fire planning.

The Core Teams identified needed agency and organization partners and interested parties to initiate the collaborative process and to establish the following overarching goals of the Pima County CWPP:

- Improve fire prevention and suppression, emphasizing firefighter and public safety
- Reduce hazardous fuels, emphasizing public and private property protection
- Restore forest, rangeland, and riparian health

- Promote community involvement and provide for community protection
- Recommend measures to reduce structural ignitability in the wildland-urban interface (WUI)
- Encourage economic development in the communities from vegetative treatments
- Promote development of wildfire emergency evacuation and communication plans
- Integrate use of the CWPP with surrounding community and agency fire management plans

The Core Teams developed and concurred with the process that was to be followed in developing the Pima County CWPP. This section establishes all necessary planning components and clearly articulates the intent of the Pima County CWPP, discloses the communities identified for analysis, and ensures that the Pima CWPP is compliant with HFRA.

Section II. Community Assessment

Section II covers the methods used in community wildfire risk assessments; the identification of the WUI; and the identification of communities with high, moderate, and low wildland fire risk within the WUI. The Pima County CWPP was developed through quantitative analyses of wildland fire risk across Pima County, designing mitigation measures and priority needs to implement mitigation measures, whether for wildland fire fuel manipulations, resource response, reduced structural ignitibility or public education and outreach.

Environmental elements used by the Core Teams to identify the WUI include wildland vegetative fuel hazards, comparison of normal and extreme rainfall years, consideration of aspect and local topography, historical fire occurrence, and wildfire ignition history. These environmental factors were coupled with community-based characteristics and values, such as local fire resource preparedness, infrastructure, evacuation routes, and population/structure density. An external element, the Fire Insurance Service Organization ratings, was also used in determining wildland fire risk to communities within the WUI. These elements were all identified and combined using spatial analysis within a geographic information system (GIS). As a result of the GIS analysis, a WUI and sub-WUI boundary map and a wildfire risk rating map were created. Sub-WUIs were divided into treatment management areas, according to high, moderate, and low fuel hazard. Several components, including slope, aspect, fire behavior models for each vegetation type, and presence of nonnative/invasive plants, were used to make fuel hazard determinations. The Pima County CWPP analysis consisted of 5,877,578 acres of federal, state, and private lands, of which 1,579,699 acres were classified as the WUI. Cumulative risk levels across the Pima County CWPP community WUIs include 121,511 acres (8%) of high wildland fire risk, 926,760 acres (59%) of moderate risk, and 531,189 acres (34%) of low risk.

Section III. Community Mitigation Plan

Section III prioritizes the areas in need of wildland fuel mitigation and recommends the types and methods of treatment and management necessary to mitigate the potential for catastrophic wildland fire in the WUI. Also presented in this section are the Pima County CWPP communities' recommendations for enhanced wildland fire protection capabilities; public education, information, and outreach; and support for businesses and industries centered on local wood products, woody biomass, and wildland vegetative fuel management.

As part of the community mitigation plan, the Core Teams identified the Pima County CWPP administrators—Pima County fire chiefs, Pima County Office of Emergency Management (PCOEM), CNF, Arizona State Forestry Division (ASFD), Tohono O'odham Nation, Pascua Yaqui Tribe and BLM—who will be mutually responsible for implementing and monitoring Pima County CWPP action recommendations in coordination with the future-established countywide community CWPP Working Group. Pima County CWPP administrators are responsible for ensuring implementation of the Pima County CWPP, for preparing reports and work plans, and for developing community bulletins and public service announcements that inform residents of wildfire dangers and preventive measures. Additional tasks include assisting federal and state agencies and private landowners to identify appropriate funding sources to implement action recommendations of the Pima County CWPP, as well as continued coordination with communities outside the analysis area. Pima County CWPP administrators are also responsible for the monitoring and reporting of implementation actions that will allow for enhanced coordination of management programs and that will reduce inconsistencies among local, state, and federal agencies.

To prioritize treatments, the Core Teams identified 95 wildland treatment management units within 23 sub-WUI designations of the WUI. These treatment units were analyzed and categorized according to potential risk for wildfire. The Core Teams ranked and described each unit, then provided a recommendation for each unit's preferred treatment type and method. Preferred treatments were recommended for treatment management units identified as high risk. These treatments are designed to meet the fuel reduction and modification objectives of the Pima County CWPP.

Section IV. Pima County CWPP Priorities: Action Recommendations and Implementation

To achieve the goals outlined in the CWPP, the Core Teams identified priority action recommendations, which are presented in Section IV. The first action recommendation was to identify priority treatment areas for fuel reduction projects. Treatment areas were identified within community WUIs to create survivable space through treatments within the home ignition zone, the use of strategically placed fuelbreaks, and the modification of hazardous wildland fuels. The objective of a fuels reduction project is to create an acceptable vegetation condition class for community and infrastructure protection and public and firefighter safety. Priority treatment management areas were designated in areas identified as high risk. Table 4.1 in Section IV lists the priority action recommendations for the reduction of hazardous fuels within the Pima County CWPP area. The second action recommendation identified by the Core Teams was to reduce structural ignitability. Reduction of structural ignitability is achieved through evaluation; maintenance; and, at times, upgrades to community response facilities, capabilities, and equipment. The third action recommendation identified was to promote community involvement through education, information, and outreach.

Section V. Monitoring Plan

The monitoring plan, outlined in Section V, describes how monitoring the implementation of the Pima County CWPP will occur. The Pima County CWPP administrators are responsible for implementation and monitoring. Implementation begins by securing grants and other funding necessary to execute the action items.

The Pima County CWPP administrators will report successful grant awards and projects implemented as a result of those awards to the CWPP signatories. The administrators will also update work plans based on projects completed in the previous years.

Acknowledgments

The following communities and agencies were involved in the collaborative process in preparation of and are assisting as appropriate in the implementation of the Pima County CWPP:

- Pima County Office of Emergency Management
- Arizona State Forestry Division
- Municipal fire departments and local fire districts and fire chiefs from the following communities:

Ajo-Gibson Volunteer Fire Department	Tucson Fire Department	Helmet Peak Volunteer Fire Department
Arivaca Fire District	Green Valley Fire District	Sonoita-Elgin Fire Department
Avra Valley Fire District	Cascabel Volunteer Fire Department	Picture Rocks Fire District
Three Points Fire District	South Tucson Fire Department	Mescal-J6 Fire District
Golder Ranch Fire District	Elephant Head Volunteer Fire Department	Pascua Yaqui Tribe Fire Department
Rural Metro Fire Department	Why Fire Department	Drexel Heights Fire District
Corona de Tucson Fire Department	Arivaca Fire District	Northwest Fire District
Mount Lemmon Fire District	Rincon Valley Fire District	

- US Department of the Interior, Bureau of Land Management
- US Forest Service, Coronado National Forest
- National Park Service, Saguaro National Park
- US Fish and Wildlife Service Buenos Aires National Wildlife Refuge
- Pascua Yaqui Tribe
- Southern Arizona Buffelgrass Coordination Center
- Altar Valley Conservation Alliance
- Salt River Project
- Tucson Electric Power
- TRICO Electric Cooperative

I. INTRODUCTION

The Pima County Community Wildfire Protection Plan (CWPP) was developed in response to the Healthy Forests Restoration Act of 2003 (HFRA) for the at-risk cities and unincorporated areas in Pima County, Arizona (Figure 1.1), located around public lands administered by the following agencies: the US Department of the Interior, Bureau of Land Management (USDI BLM), Gila District Field Office; the Coronado National Forest (CNF); the National Park Service (NPS), Saguaro National Park (SNP); Organ Pipe Cactus National Monument (OPCNM); the US Fish and Wildlife Service (USFWS), Buenos Aires National Wildlife Refuge (BANWR); the Arizona State Land Department (ASLD); and the Pascua Yaqui Tribe. HFRA established unprecedented incentives for communities to develop comprehensive wildfire protection plans in a collaborative, inclusive process. Furthermore, this legislation gives direction to BLM and the US Forest Service (FS) to address local community priorities in fuel reduction treatments, even on nonfederal lands.

Congress passed HFRA in November 2003, and the President signed it into law that December. When certain conditions are met, Title I of HFRA authorizes the Secretaries of Agriculture and the Interior to expedite the development and implementation of hazardous fuel reduction projects on federal, tribal, state, and private lands. HFRA requires federal agencies to collaborate with communities in developing hazardous fuel reduction projects and places priority on treatment areas identified by communities through the creation of a CWPP. Priority areas include the wildland-urban interface (WUI), municipal watersheds, areas affected by windthrow or by insect or disease epidemics, and critical wildlife habitat that would be negatively affected by a catastrophic wildfire.

In compliance with Title I of HFRA, the CWPP requires agreement among local governments, local fire departments and districts, and the state agency responsible for forest management. For the Pima County CWPP, this agency is the Arizona State Forestry Division (ASFD). The CWPP must also be developed in consultation with interested parties and the applicable federal agency managing the public lands surrounding the at-risk communities. The majority of lands surrounding the at-risk communities and unincorporated intermixed community zones within Pima County are located adjacent to “public lands,” as defined in Sections 3.1.A and B of HFRA; Indian tribal lands, as defined in Section 3.2 of HFRA; and Arizona State Trust lands.

The Pima County CWPP has been developed to assist local governments, fire departments and districts, and residents to identify lands—including federal lands—at risk from severe wildfire threat and to identify strategies for reducing hazardous vegetative fuels within the WUI while improving watershed and rangeland health, restoring ecosystem processes, creating resilient ecosystems, keeping people engaged, supporting local industry and local economies, and improving public and firefighter safety and response capabilities through innovative and scientific approaches. The Pima County CWPP is based on the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a); the *Arizona BLM Gila District Fire Management Plan* (USDI BLM 2013), the *Coronado National Forest Plan* (US Department of Agriculture [USDA] CNF 1988, as amended); the *Coronado Fire Management Plan* (USDA FS 2010); the Arizona FireScape Project (http://www.azfirescape.org); the *Saguaro National Park Fire Management Plan* (USDI NPS 2007); the *Tohono O’odham Fire Management Plan* (Tohono O’odham Nation 2004); the *Wildland Fire Management*

Plan Pascua Yaqui Tribe (Bureau of Indian Affairs [BIA] 2012a); and the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007). This CWPP has been developed in consultation with the BLM Gila District, the NPS Saguaro National Park, and CNF to help Pima County, local municipalities, and the State of Arizona implement the recommendations of the Pima County CWPP. Cooperating fire agencies include the Pascua Yaqui Tribe and the participating fire departments/districts of South Tucson, Tucson, Ajo, Arivaca, Avra Valley, Casabel, Corona de Tucson, Drexel Heights, Elephant Head, Golder Ranch, Green Valley, Helmet Peak, Hidden Valley, Picture Rocks, Mountain Vista, Mount Lemmon, Northwest, Rincon Valley, Sonoita-Elgin, Rural Metro, Sabino Vista, Tanque Verde Valley, Tucson Country Club Estates, and Three Points. The Pima County CWPP also encourages these entities to identify strategies for reducing vegetative fuels within the WUI while improving health of native habitats and undeveloped lands within Pima County, making recommendations for reducing structural ignitability, developing wildfire public education and outreach programs, and improving public and firefighter safety and response capabilities. The Pima County CWPP is based on guidance from the *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities* (Communities Committee et al. 2004), the *Community Guide to Preparing and Implementing a Community Wildfire Protection Plan* (Communities Committee 2008), and the *Southwest Community Wildfire Protection Plan Guide* (Southwest Strategy 2004).

To ensure that all residents of Pima County were represented in this planning process, three core teams were formed to implement the agency and public collaboration necessary to develop a CWPP compliant with HFRA: the Northern Planning Zone Core Team consists of the communities of Mount Lemmon; Oro Valley; northwest Tucson; Lukeville, Ajo; Why; Pima County lands adjacent to the Catalina Mountains; Rincon Mountains; Marana; Avra Valley; and Picture Rocks to the Gates Pass area, including Saguaro National Park West and Tucson Mountain Park. The Southern Planning Zone Core Team consists of the developed lands adjacent to the Pascua Yaqui Tribe, Robles Junction, Green Valley, Sahuarita, adjoining the Arivaca-Sasabe CWPP, South Tucson, Vail, Corona de Tucson, Saguaro National Park East, and Pima County lands to the Cochise County boundary. The Central Core Team is composed of the city of Tucson. The Core Teams agreed to and established an efficient process to be followed throughout the Pima County CWPP development. The Core Teams analyzed 5,877,578 acres for potential risk from catastrophic wildland fire within Pima County (Figure 1.1). This analysis resulted in describing 1,579,572 acres of community WUI to be managed for the protection of 33 communities determined to be "at risk" from wildland fire (Table 1.1).

In addition, the Core Teams were formed to ensure that local, state, and federal management recommendations for wildland fire protection, watershed, and riparian health were addressed in the Pima County CWPP. The Core Teams represent all identified at-risk communities and developed areas within Pima County. As additional guidance documents become available, changes or amendments will be incorporated into the Pima County CWPP as necessary.

The following sections detail the background and process used to develop the Pima County CWPP and define the associated WUI. In addition, the desired future condition of lands covered by the Pima County CWPP is described; current fire policies and programs are identified; and current projects and future needs are discussed. Finally, the goals of the Pima County CWPP are presented along with an outline of planning methods to achieve those goals.

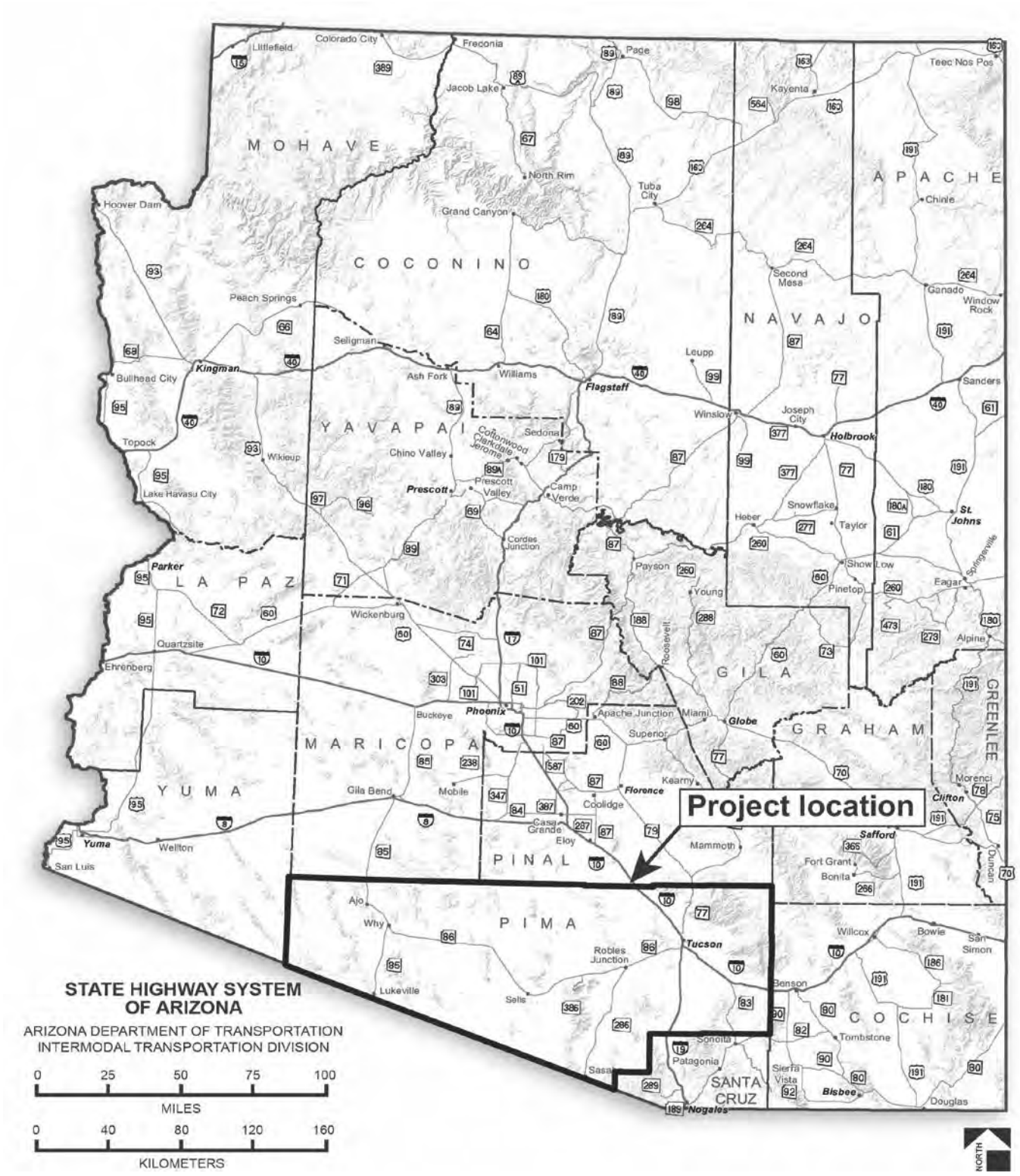

Figure 1.1 Pima County CWPP Analysis Area

Table 1.1. Pima County CWPP Recommended At-Risk Community WUIs and Communities

Community WUI[a]	Communities in Each WUI and Risk[b]	Fire Department/ District	Community WUI[a]	Communities in Each WUI and Risk[b]	Fire Department/ District
Ajo	Ajo	Ajo-Gibson Volunteer Fire Department	Cascabel	Redington	Cascabel Volunteer Fire Department
Arivaca	Arivaca	Arivaca Fire District	Tucson/ South Tucson	Tucson South Tucson	Tucson Fire Department South Tucson Fire Department
Avra Valley	Avra Valley	Avra Valley Fire District	Lukeville	Lukeville and Port of Entry	NA
Three Points	Robles Junction	Three Points Fire District	Picture Rocks	Picture Rocks	Picture Rocks Fire District
Golder Ranch	Catalina Saddle Brook 1 and 2 Florence Junction Mountain Vista Fire Department Oro Valley	Golder Ranch Fire District	Mescal-J6	Mescal-J6 Ranch and developments	Mescal-J6 Fire District
Catalina Foothills*	Tucson Country Club Estates Sabino Vista Hidden Valley Tanque Verde Valley	Rural Metro Fire Department	Pascua Yaqui	Pascua Yaqui Indian Communities	Pascua Yaqui Tribe Fire Department
Corona de Tucson	Corona de Tucson	Corona de Tucson Fire Department	Rincon Valley	Vail	Rincon Valley Fire District
Mount Lemmon	Summerhaven Loma-Sabino Pines, Willow Canyon, Soldier's Camp, Mt. Lemmon Ski Valley, Fern Ridge, Soldier Camp, Bear Wallow, Willow Canyon, Organization Ridge	Mount Lemmon Fire District	Sasabe	Sasabe and Port of Entry	Buenos Aires National Wildlife Refuge
Drexel Heights	Drexel Heights communities	Drexel Heights Fire District	Why	Why	Why Fire Department
Tohono O'odham	Tohono O'odham Indian Communities, including Sells and Kitt Peak San Xavier	Tohono O'odham Nation Fire Department	Green Valley	Green Valley Sahuarita Helmet Peak	Green Valley Fire District Elephant Head Volunteer Fire Department Helmet Peak Volunteer Fire Department
Northwest WUI	Marana Flowing Wells Tucson Mountains Dove Mountain	Northwest Fire District			

[a] Summerhaven listed as high; Arivaca, Kitt Peak, and Catalina listed as moderate; and Sasabe listed as low on the 2009 *Arizona Communities at Risk Matrix* (www.azsf.az.gov).

[b] Wildland fire risk: L = low, M = moderate, H = high.

* Through agreement with Rural Metro Fire Department.

A. Background

The process for developing this CWPP consisted of evaluating Pima County—including tribal trust lands—to identify communities, infrastructure, and remote private lands at risk from catastrophic wildland fire. During this analysis the County solicited federal, state, and local governments; fire chiefs; and interested individuals to participate in the Core Teams. The Core Teams were created to define and locate interface and intermix communities in which significant community values and infrastructure are at risk because of the potential of wildland fire.[1] The Pima County Office of Emergency Management (PCOEM) requested that local governments, fire departments and districts, BLM, NPS, CNF, ASFD, and interested individuals throughout Pima County participate in the Core Teams to develop the Pima County CWPP. Pima County is the local government authority for the unincorporated communities identified as at risk, while the city or town councils of the Cities of Marana, Oro Valley, Sahuarita, South Tucson, and Tucson are the appropriate municipal government authorities for cooperating fire departments in developing and agreeing to the Pima County CWPP. Pima County and the Core Teams recognize the value of conveying information developed from the Pima County CWPP process to local citizens. This process established by the Core Teams ensures an open public process, with the goal of all community interests being represented during the development of the Pima County CWPP. The Core Teams, in association with planned public involvement, meets all collaborative guidance criteria established by the Wildland Fire Leadership Council (WFLC 2002).

The Core Teams and collaborators developed this CWPP to increase preparedness, to reduce hazardous wildland fuels, to reduce impacts from catastrophic wildfire, and to prepare recommendations for reducing structural ignitability. In addition, the Core Teams developed this CWPP to increase communication with local, county, state, and federal emergency response personnel by determining areas of high risk from unwanted wildland fire; by developing mitigation measures to reduce hazardous wildland fuels; by improving emergency response to unplanned wildfire; by preventing wildfire ignitions from state and public lands from spreading into the WUI and into the communities; and by preventing wildfire ignitions within the WUI from spreading to adjacent state and public lands.

During initial analyses for the proposed wildland fuel mitigation recommendations, as well as the development of the Pima County CWPP, the Core Teams reviewed the following documents:

- "*Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire*," Federal Register Vol. 66, Nos. 3 and 160 (Federal Register 2001a, 2001b)
- *Field Guidance: Identifying and Prioritizing Communities at Risk* (National Association of State Foresters 2003)
- *Arizona Wildland Urban Interface Assessment* (Arizona State Forester 2004)
- *Arizona-Identified Communities at Risk* (Arizona State Forester 2009)
- *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007)

[1] *Interface communities* exist where structures directly abut wildland fuels; *intermix communities* exist where structures are scattered throughout a wildland area (USDA and USDI 2001a).

- *Forest Health Landscape-scale Restoration Recommendations.* (Western Governors' Association Forest Health Advisory Committee 2010)
- *Landscape Conservation and Restoration Strategic Action Plan* (USDA FS 2011)
- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan* (USDA FS and USDI BLM 2002)
- *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a)
- *Arizona BLM Gila District Fire Management Plan* (USDI BLM 2013)
- *Coronado National Forest Plan* (USDA CNF 1988, as amended)
- *Coronado National Forest Fire Management Plan* (USDA FS 2010)
- *Saguaro National Park Fire Management Plan* (USDI NPS 2007)
- *Organ Pipe Cactus NM Fire Management Plan* (USDI NPS 2004)
- *Tohono O'odham Nation Wildland Fire Management Plan* (Tohono O'odham Nation 2004)
- *Pascua Yaqui Tribe Wildland Fire Management Plan* (BIA 2012a)
- *Pascua Yaqui Tribe Fuels Management Plan* (BIA 2012b)
- Arizona FireScape Project (http://www.azfirescape.org/home)
- *Southern Arizona Buffelgrass Strategic Plan. A Regional Guide for Control, Mitigation and Restoration* (Buffelgrass Working Group 2008)
- *Mt Lemmon Wildland-Urban Interface Plan for Forest Health and Wildland Fire Management* (2004)
- *Catalina Community Wildfire Protection Plan* (Golder Ranch Fire Department 2007)
- *Sonoita Elgin Community Wildfire Protection Plan* (Sonoita Fire Department 2007)
- *Arivaca Sasabe Community Wildfire Protection Plan* (Arivaca Fire Department 2007)
- *Cascabel Community Wildfire Protection Plan* (Cascabel Fire Department 2006)
- *Altar Valley Fire Management Plan* (Natural Resources Conservation Service [NRCS] 2008)

The Core Teams also reviewed Section 101.16.B.iii of HFRA to determine an area adjacent to an evacuation route for hazardous fuel reduction measures to provide safer evacuation from an at-risk community. Since 1980, there have been 3,226 wildfire ignitions reported in federal and state databases within the Pima County analysis area. Large wildfires have become increasingly common in the desert vegetation zones due to the presence of invasive plant species, primarily nonnative annual and perennial grasses. In total, there have been nine large wildfires which burned approximately 137,000 acres of wildland habitat within and adjacent to the Pima County CWPP WUI in the 6-year period of 2002 through 2007. In 2003, a wildfire destroyed more than 314 buildings, including most of the businesses in

Summerhaven and the Mt Lemmon WUI. The fire departments and districts within the county have responded to and suppressed numerous wildland fires within the WUI during the past several years. The areas with the greatest potential for fire ignition, either from natural or human (though unplanned) causes, are found within the communities of Sells, Summerhaven, and along the eastern edge of Pima County (http://wildfire.cr.usgs.gov/firehistory/). Many of these wildland fire ignitions have occurred within areas infested with nonnative grasses such as buffelgrass (*Pennisetum ciliare*), red brome (*Bromus rubens*), and Mediterranean grass (*Schismus barbatus*); xeroriparian corridors; and higher-elevation chaparral and woodland vegetation associations that threaten the at-risk communities of Pima County with the potential for catastrophic wildland fire. Continued extreme weather conditions, dry fuels, increased nonnative invasive vegetation, and increased fuel loading on federal and nonfederal lands contribute to the potential for catastrophic wildland fires within Pima County (Photo 1.1). As a result, the fire departments and districts and governmental agencies have initiated fire preparedness and land-treatment planning efforts to deal with the types and densities of wildland fuels that significantly threaten communities with potential catastrophic wildfire.

Photo 1.1. Saltcedar-Infested Riparian Corridor in Pima County (courtesy of Northwest Fire Department)

Wildland fire behavior as it relates to weather can be basically divided into four periods equating to the four seasons. Wildfires occurring during the late spring and early summer often exhibit erratic behavior due to dry light and heavy fuels from high average daily temperatures and seasonal droughts. In recent years, the southwest United States has experienced widespread and intense drought, which has been stressing forests (Karl et al. 2009). Record wildfires are also being driven by rising temperatures and related reductions in spring snowpack and soil moisture (Westerling et al. 2006). Associations between wildfire and hydroclimate in western forests indicate that increased wildfire activity over recent decades may be tied to reduced winter precipitation and an early spring snowmelt, particularly in mid-elevation forests (Westerling et al. 2006). If the Southwest becomes warmer and drier, as projected by many climate models, wildland fire seasons are anticipated to increase in length and severity driven by rising spring and summer

temperatures and related reductions in spring snowpack and soil moisture (Karl et al. 2009; Westerling et al. 2006; USDA 2012). If periods of extended drought and warmer temperatures become more common in Pima County, increases in wildland fire occurrences, particularly in higher-elevation vegetation associations, and fire severity can be anticipated.

In 2003, Governor Janet Napolitano created the Forest Health Advisory Council and the Forest Health Oversight Council in response to the increasing number, frequency, and intensity of unwanted wildfires threatening Arizona communities and forests (Executive Order 2003-16). The councils were directed to develop scientific information and policy recommendations to advise the Governor's administration on matters of forest health, unnaturally severe forest fires, and community protection. In 2005, the councils established a subcommittee to begin work on a 20-year strategy to restore forest health, protect communities from fire, and encourage forest-based economic activity. Governor Napolitano approved and signed the *Statewide Strategy for Restoring Arizona's Forests* in June 2007. Governor Janice Brewer issued Executive Order 2007-17, re-establishing the Forest Health Council on July 9, 2009. The Core Teams have reviewed the strategy—specifically, the Sky Islands landscapes—to ensure that the recommendations adopted by the Core Teams and presented within the Pima County CWPP comply with, and complement, the *Statewide Strategy for Restoring Arizona's Forests*. The Core Teams have also reviewed the goals and objectives of the Arizona FireScape Project to ensure that the Pima County CWPP is compatible with and complementary to the FireScape Project. Using the information gathered from these supporting documents, the Core Teams and collaborators agreed that the Pima County communities listed in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009), as well as other developed areas identified as at risk within the Pima County CWPP WUI, constitute interface or intermix communities (see USDA and USDI 2001a; Arizona State Forester 2007) at risk from wildland fire.

B. WUI and Delineation Process

In 2009, five Pima County communities (Kitt Peak, Summerhaven, Arivaca, Sasabe, and Catalina) were included in *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) and were given a WUI risk rating for catastrophic wildland fire. The Core Teams and collaborators concur with this 2009 listing of at-risk communities maintained by the Arizona State Forester. The Core Teams and collaborators recommend maintaining the listing of those five communities, based on the results of the Pima County CWPP wildland fire analysis, and further recommend including 28 other Pima County communities, along with their associated WUI risk ratings, in the 2009 *Arizona-Identified Communities at Risk* (see Table 1.1).

The Pima County CWPP analyzes risk and makes recommendations to reduce the potential for unwanted wildland fire to the 23 at-risk community WUIs composed of 33 individual communities in Pima County, including tribal trust lands. The Pima County CWPP analysis further refines components of wildland fire risk and prioritizes community recommendations for reducing wildland fire potential through vegetative fuel management and public outreach/education for reducing structural ignitability. Figure 1.2 summarizes the process that the Core Teams followed to produce the Pima County CWPP. At the far right of each tier is the "product" resulting from the activities in that tier. These tiers correspond to the sections in the Pima County CWPP and serve as a guide for the rest of this document.

According to HFRA, an "(1) At-risk community . . . means an area – (A) that is comprised of – (i) an interface community . . . or (ii) a group of homes and other structures with basic infrastructure and services . . . within or adjacent to Federal land; (B) in which conditions are conducive to a large-scale wildland fire disturbance event; and (C) for which a significant threat to human life or property exists as a result of a wildland fire disturbance event" (Secs. 101.1.A.i–ii, 101.1.B, and 101.1.C).

The at-risk communities within Pima County are adjacent to federal lands, including public lands administered by BLM, NPS, and CNF, and are consistent with the Arizona State Forester's definition of an *intermix* or *interface community* (ASF 2007:1):

> The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. The developed density in the intermix community, ranges from structures very close together to one structure per forty acres. Local fire departments and/or districts normally provide life and property fire protection and may also have wildland fire protection responsibilities.
>
> The Interface Community exists where structures directly abut wildland fuels. There is a clear line of demarcation between wildland fuels and residential, business, and public structures. Wildland fuels do not generally continue into the developed area. The development density for an interface community is usually three or more structures per acre, with shared municipal services. Fire protection is generally provided by a local fire department with the responsibility to protect the structure from both an interior fire and an advancing wildland fire.

In addition to a community's listing status, the current condition of the wildland fuels within and adjacent to at-risk communities significantly contributes to the possibility of a catastrophic wildfire capable of damaging or destroying community values, such as houses, infrastructure, recreational sites, businesses, wildlife, and unique plant communities, especially desert areas with saguaro cactus, which are important economically for maintaining property values and tourism. Establishing a CWPP to enhance the protection of community values and to minimize the potential loss of property while ensuring public and firefighter safety during a catastrophic wildfire remains the overriding priority recommendation of the Pima County CWPP.

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. Communities in the WUI face substantial risk to life, property, and infrastructure. Wildland fire in the WUI is one of the most dangerous and complicated situations firefighters face. The *National Cohesive Wildland Fire Management Strategy Phase II National Report* (WFLC 2012) emphasizes working collaboratively with communities in the WUI to reduce their risk from large-scale wildfire. HFRA builds on existing efforts to restore healthy wildland conditions in the WUI and empowers local communities to determine the extent of the WUI; determine appropriate wildland fuel mitigation measures; enhance public education for the prevention of wildland fire; and to authorize expedited environmental assessments, administrative appeals, and legal review for qualifying projects on federal land.

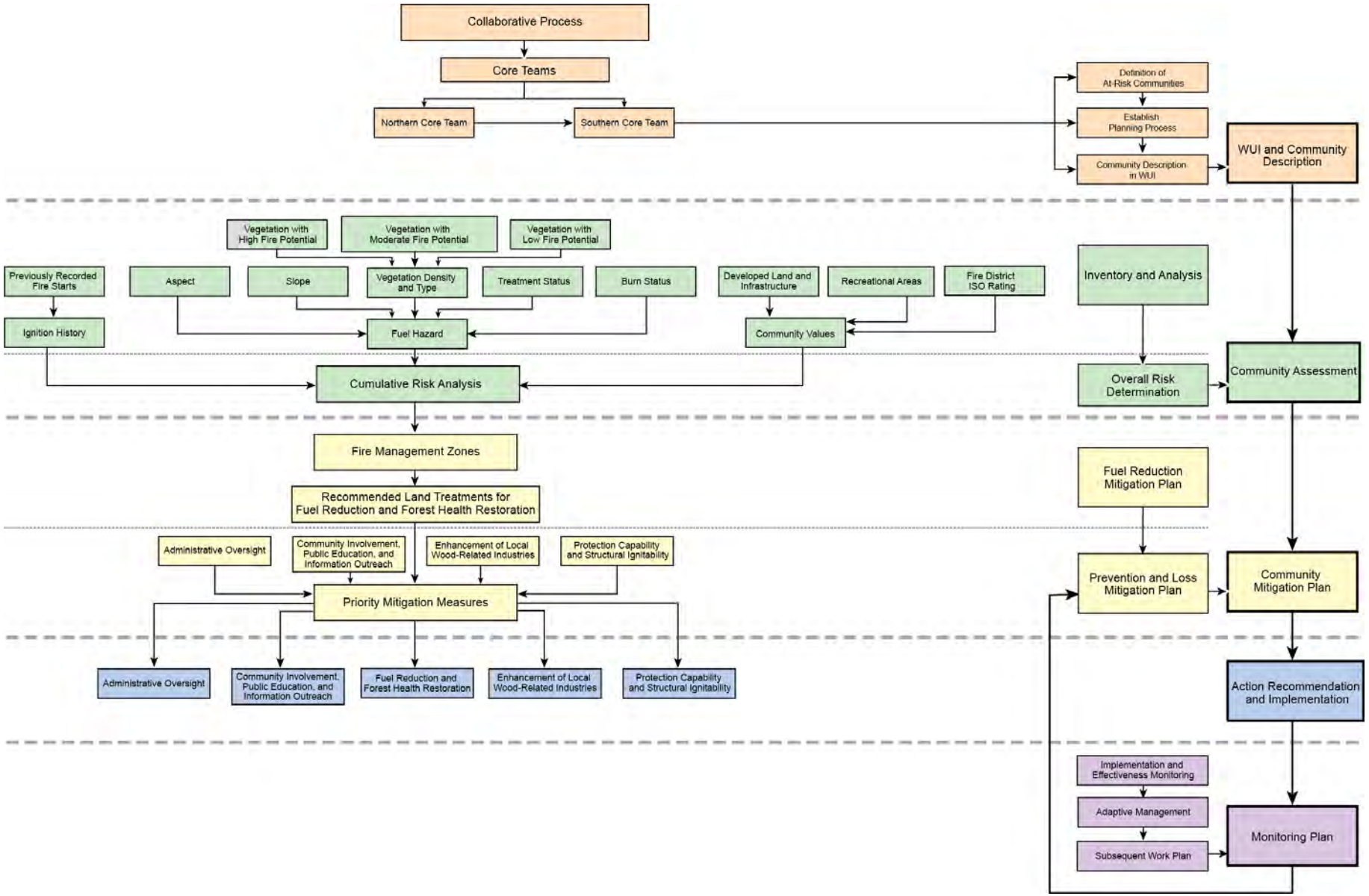

Figure 1.2. Pima County CWPP Process

The Pima County CWPP process of delineating WUI boundaries for at-risk communities involved collaboration among local, state, and federal government representatives, as well as interested individuals within the communities (Photo 1.2).

Photo 1.2. Pima County CWPP Core Planning Team Meeting

The Pima County CWPP WUI is the minimum area needed to provide protection to each community and its surrounding community values. The identified WUI includes a total of 1,579,572 acres composed of a mix of private, county, state, tribal trust, and federal lands. The WUI lands that surround the communities are in a condition conducive to a large-scale wildland fire, and such a wildfire could threaten human life and properties (Photo 1.3.).

Photo 1.3. Wildland Fire in Pima County
(courtesy of Northwest Fire Department)

General elements used in creating the WUI for Pima County at-risk communities include the following:

- Fuel hazards, local topography, vegetative fuels, and natural firebreaks
- Historical fire occurrence
- Community development characteristics
- Firefighting preparedness and response capabilities
- Infrastructure and evacuation routes
- Recreation, scenic, and wildlife values

C. Desired Future Condition and Wildfire Mitigation in the WUI

The desired future condition of Pima County CWPP lands includes the maintenance of, or return to, wildland fire resiliency status and the maintenance of, or return to, the vegetation component of the historical plant potential community and appropriate management of nonnative vegetation across Pima County. The historical plant potential community is composed of desert scrublands, shrublands (mesquite uplands), riparian corridors, and semidesert grasslands, oak woodland, pine-oak woodland, and pine and mixed conifer forests, all of these plant communities have an associated understory of grasses and shrubs. Some historic plant communities have become invaded and colonized by invasive grasses or woody species and may have undergone a permanent type conversion (NatureServe 2004; Gori and Enquist 2003). The Core Teams intend the Pima County CWPP to complement BLM, NPS, and CNF wildland fire management objectives; the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007); the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a); the *Coronado National Forest Plan* (USDA CNF, 1988 as amended), *Coronado National Forest Fire Management Plan* (USDA FS 2010) and the *Saguaro National Park Fire Management Plan* (USDI NPS 2007), *Organ Pipe Cactus NM Fire Management Plan* (USDI NPS 2004), *Arizona BLM Gila District Fire Management Plan* (USDI BLM 2010*),* and the Arizona FireScape Project (http://www.azfirescape.org/home).

The desired future condition of public lands is consistent with those described by the Core Teams—community wildfire protection, watershed and rangeland restoration, and protection of community values, as well as the restoration of native vegetation to historical wildfire return intervals. However, in the face of changing climate conditions historical vegetation communities may not be achievable. The Core Teams encourage land-management agencies to develop landscape-scale restoration of vegetation communities that restore critical wildlife habitat, ensure healthy functioning watersheds, and safeguard our communities. Vegetative types maintained in this condition allow natural processes such as fire to be incorporated into long-term management practices to both sustain habitat health and meet Pima County CWPP management goals while providing for community protection from unwanted wildland fire. Public education and land treatment projects in the Pima County CWPP area—coupled with current efforts of local governments, fire departments and districts, CNF, NPS, Pascua Yaqui Tribe, and BLM—will create a better-informed constituency capable of protecting at-risk communities through restoration and vegetative fuels mitigation efforts within the WUI. Federal wildfire reduction policy on public lands is planned and administered primarily by BLM, NPS, USFWS, Pascua Yaqui Tribe, and CNF, which are the federal

governing agencies for the public lands associated with the Pima County CWPP planning area. These agencies and tribes manage wildland fire to help reduce unnaturally high wildland fuel loads that contribute to catastrophic wildland fire, to help encourage the return of fire to a more natural role in fire-adapted ecosystems, to achieve ecosystem goals, to keep fire out of fire-sensitive desert and riparian plant communities, reduce economic impacts, and to enhance public and firefighter safety.

The desired future condition of federal lands includes improving public and firefighter safety from wildland fire, using wildland fire as a management tool to achieve resource objectives where appropriate, managing hazardous wildland fuels within and adjacent to the WUI, providing adaptive wildland fire response and suppression, and returning public lands to Condition Class I status. Federal lands in this condition class can carry wildfire without significant impacts on habitat components. Current federal fire policy allows wildland fires to be concurrently managed for one or more objectives, and, objectives can change as the fire spreads across the landscape (USDA and USDI 2009). The BLM, NPS, Pascua Yaqui Tribe, and CNF adhere to federal policy when managing all unplanned wildfire ignitions on public lands within the WUI. Federal policy for reducing wildfires on public lands (that is, BLM, NPS, Pascua Yaqui Tribe, and FS lands) is planned and administered locally through the BLM's field offices, Saguaro National Park, Pascua Yaqui Tribe, and the CNF. In Saguaro National Park, all fires are suppressed in desert areas where plants are not adapted to fire. In fire-adapted plant communities at higher elevations, fire may be managed to achieve resource objectives depending on the current and predicted situation. At Organ Pipe Cactus National Monument, desert areas are protected from fire. The Tohono O'odham Nation and Pascua Yaqui Tribe manage tribal wildland fire programs.

Under the proposed action described in the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a), BLM-administered public lands are assigned one of two land use allocations for fire management: Allocation 1 includes areas suitable for wildland fire use for resource-management benefit, and Allocation 2 includes areas not suitable for wildland fire use for resource benefit. The *CNF Fire Management Plan* (USDA FS 2010) has identified two fire management units (FMUs). These FMUs maintain consistency with the management objectives as outlined in the CNF Plan (1988, as amended). FMU 1 includes a full range of responses, from aggressive initial attack to managing natural ignitions to achieve desired CNF Plan objectives when risk is within acceptable limits. FMU 2 is generally located at elevations less than 4,500 feet on the Santa Catalina, Santa Rita, Galiuro, and Tumacacori Ecosystem Management Areas. In this FMU, resource protection is the only objective, as it contains non-fire-adapted vegetation, which within the CNF is the southwestern desert scrub vegetation associations.

The basic objectives of the management policies at Saguaro National Park are the protection and perpetuation of naturally operating ecosystems to the fullest extent consistent with safeguarding public safety, cultural resources and private property. As described in the *Saguaro National Park Fire Management Plan (*USDI NPS 2007*)*, fire is a natural process in the Park's ecosystems, and consequently, fire must be managed so that it can assume its natural role, either as wildland fire use or through prescribed burning. Management-ignited prescribed fire will be used to re-establish the natural influence of fire and restore natural fuel loadings through the reduction of hazardous fuel accumulation. All projects that include prescribed burning will include specific burning prescriptions that will ensure that the fire can be

controlled within established boundaries and that the burning will meet the desired fire management objectives for the resource.

The desired future condition of private lands in the WUI is for landowners to comply with the National Firewise Communities program (www.Firewise.org) or to meet home-ignition-zone landscaping (www.fireadapted.org) or fire-safe landscaping recommended by the Pima County CWPP fire departments and districts in compliance with local ordinances. The Fire Adapted Communities Web site offers information and specific actions homeowners can take to reduce risk of wildfire. Firewise is a national program that helps communities reduce wildfire risks and provides them with information about protecting themselves against catastrophic wildfires and mitigating losses from such fires. Within Arizona, the State Forester administers the Firewise certification program. Fire departments and districts and local governments in Pima County would like to make this information available to their citizens and to encourage its application. Residential and other structures that comply with Firewise standards significantly reduce fire-ignition risks in a community, as well as the potential for fires to spread to surrounding habitats. Additionally, structures that comply with Firewise recommendations are more likely to survive wildland fires that do spread into a community (Cohen 2008).

The Core Teams are aware that wildland fuel accumulations primarily associated with the invasion of woody species and nonnative grasses, together with community growth in the WUI, have produced areas at high risk from catastrophic wildfire. The Core Teams aspire to achieve restored, self-sustaining, biologically diverse habitats of mixed open space and developed areas that contribute to a quality of life demanded by Pima County citizens. The Core Teams recognize that protection from catastrophic wildland fire requires collaboration and implementation through all levels of government and through an informed and motivated public. The Core Teams considered restoring the health of forest, rangeland, desert and riparian areas, community protection, and public and firefighter safety while developing this CWPP.

Financial commitments required to reduce the risk of catastrophic wildfire can be extensive for municipal, county, state, and federal governments; for fire districts; and for the small rural communities surrounded by public lands. Pima County, CNF, NPS, Pascua Yaqui Tribe, and BLM have implemented wildland fuel mitigation projects within or near the Pima County CWPP WUI. Fire departments and districts have improved wildland fire suppression response and continue public education and outreach programs concerning wildland fire threat and home-ignition-zone recommendations. However, the availability of federal, state, and local funding for mitigation of wildland fire risk, enhanced response and public education will drive the ability of the Cooperators to meet the goals of the Pima County CWPP (i.e., treatments depend on fund availability). The CWPP Core Team recognizes the importance or partnering with organizations such as the Southern Arizona Buffelgrass Coordination Center (SABCC) and others to assist in meeting CWPP goals and objectives. Pima County fire departments and districts have standing automatic-aid agreements allowing for closest resources to provide initial attack response. The fire departments and districts of Pima County maintain wildland fire response teams supported by various engines and support equipment including ambulances, brush trucks, fire engines, ladder trucks, and heavy-rescue vehicles, and various other specialized response vehicles to help suppress wildland fires (Photo 1.4.).

Photo 1.4. Type 6 Wildland Fire Truck
(courtesy of Northwest Fire Department)

Additionally, the fire departments and districts have taken proactive measures to encourage willing property owners to reduce fire risk on private property (HFRA, Sec.103.d.2.B). Wildland fire response teams are composed of personnel with various levels of wildland firefighting training, including red-carded firefighters. The response teams have coordinated radio frequencies to improve communications between initial-attack and responding firefighting agencies and departments. Specially trained wildland fire response teams not only provide suppression response to brush fires but also provide community awareness programs and structural-fire risk assessments. The Core Teams, BLM, NPS, Pascua Yaqui Tribe, and CNF collaborators are proposing additional wildland fuel treatments and wildland fire suppression enhancements and have been proactive in pursuing funding for wildland fire public outreach programs and fire-suppression training and equipment.

D. Goals for the Pima County CWPP

To reduce the risks to life and property from catastrophic wildland fire, and as a collaboration of communities and agencies, the Core Teams have agreed on the following primary goals of the Pima County CWPP:

- Improve fire prevention and suppression, emphasizing firefighter and public safety
- Reduce hazardous fuels, emphasizing public and private property protection
- Maintain and appropriately restore forest, rangeland, and riparian health
- Promote community involvement and provide for community protection
- Recommend measures to reduce structural ignitability in the WUI
- Encourage economic development in the communities from vegetative treatments

- Promote development of wildfire emergency evacuation and communication plans
- Use the CWPP in conjunction with surrounding community and agency fire management plans

E. Planning Process

During initial analysis, and to aid the overall development of this plan, the Core Teams reviewed the following documents and studies:

- "Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire," *Federal Register* Vol. 66, Nos. 3 and 160 (USDA and USDI 2001a, 2001b)
- *Healthy Forests: An Initiative for Wildfire Prevention and Stronger Communities (Presidential Policy 2002)*
- *HFRA*
- *The Healthy Forests Initiative and Healthy Forests Restoration Act: Interim Field Guide* (USDA FS and USDI BLM 2004)
- *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities* (Communities Committee et al. 2004)
- *Field Guidance: Identifying and Prioritizing Communities at Risk* (National Association of State Foresters 2003)
- *Arizona Wildland Urban Interface Assessment* (Arizona State Forester 2004)
- *Arizona-Identified Communities at Risk* (Arizona State Forester 2009)
- *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers* (Arizona State Forester 2007)
- *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007)
- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan* (USDA FS and USDI BLM 2002)
- *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a)
- *Arizona BLM Gila District Fire Management Plan* (USDI BLM 2013)
- *Coronado National Forest Plan* (USDA CNF 1986, as amended)
- *Coronado National Forest Fire Management Plan* (USDA FS 2010)
- *Saguaro National Park Fire Management Plan* (USDI NPS 2007)
- *Organ Pipe Cactus National Monument Fire Management Plan* (USDI NPS 2004)
- *Southern Arizona Buffelgrass Strategic Plan* (Rogstad 2008)
- *Wildland Fire Use Implementation Procedures Reference Guide* (USDI and USDA 2005)

- *Wildland Fire Suppression (Including Wildland Fire Use) and Rehabilitation in Riparian and Aquatic Habitats (RA)* (USDI BLM 2004b)
- *Guidance for Implementation of Federal Wildland Fire Management Policy* (USDA and USDI 2009)
- *Pima County Multi-Jurisdictional Hazard Mitigation Plan* (PCOEM 2012)
- *Pascua Yaqui Wildfire Management Plan* (BIA 2012a)
- *Pascua Yaqui Fuels Management Plan* (BIA 2012b)
- *Tohono O'odham Wildfire Management Plan* (Tohono O'odham Nation 2004)
- *Pima County Ordinance No 2012-34. Adopting the 2012 International Wildland-Urban Interface Code applicable to areas designated Rural Forest Village under the Pima County Comprehensive Plan*
- Arizona FireScape Project (http://www.azfirescape.org/home)

Action recommendations for at-risk areas within the Pima County CWPP WUI boundaries have been developed as part of this planning process. Treatments for wildland vegetative fuels and additional wildland fire mitigation measures are recommended to be implemented in specific time frames and with associated monitoring to determine and document measurable outcomes. Successful implementation of the Pima County CWPP will require collaboration by fire departments and districts, governments, resource-management agencies, and private landowners. The cooperating agencies must develop processes and systems that ensure recommended actions of the Pima County CWPP comply with applicable local, state, and federal environmental regulations. The dedication of the Core Teams and collaborators in implementing the Pima County CWPP ensures that all agencies, groups, and individuals involved will develop any additional formal agreements necessary for the timely implementation, monitoring, and reporting of the Pima County CWPP. The Core Teams were formed not only to meet collaborative requirements of HFRA but also to represent all of the different interests and diversity within Pima County communities, with all parties being involved and committed to the development and implementation of the Pima County CWPP.

II. PIMA COUNTY CWPP COMMUNITY ASSESSMENT AND ANALYSIS

The community risk assessment is an analysis of the potential for catastrophic wildland fire to Pima County communities. This risk analysis incorporates the current fire regime-condition class, wildfire fuel hazards, risk of ignition, local preparedness and protection capabilities, and at-risk community values. In addition, the Arizona State Forester's *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers* (2007), *Arizona Forest Resource Assessment* (ASFD 2010a), *Arizona Forest Resource Strategy* (ASFD 2010b) and the *National Cohesive Wildland Fire Management Strategy* (USDA and USDI 2011) were reviewed and incorporated as appropriate to ensure that the Pima County CWPP is compatible with and complementary to national and statewide CWPP planning efforts. This analysis includes all risk factors required by the Arizona State Forester for a compliant CWPP. 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 initial analysis area included all of Pima County, including tribal trust 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 Forester's guidance. The initial analysis area comprises 5,877,578 acres of land, of which 1,579,699 acres are designated as community WUI (Table 2.1; Figures 2.1a–2.1c).

Table 2.1. Land Management within the Pima County Community WUIs

Ownership Type	WUI Acres	% of WUI Acres
Barry M. Goldwater Air Force Range	538	0
Buenos Aires National Wildlife Refuge (BANWR)	20,131	1
Bureau of Land Management (BLM)	94,969	6
Bureau of Reclamation (BOR)	2,992	0
Coronado National Forest (CNF)	75,129	5
Davis Monthan Air Force Base	10,728	1
Arizona Game and Fish Department	1,556	0
Military Reservation	40	0
Organ Pipe Cactus National Monument	1,389	0
Other/Unclassified	22	0
Parks and Recreation	11,192	1
Pascua Yaqui Tribe	557	0
San Xavier Indian Reservation	71,227	5
Tohono O'odham Nation	24,256	2
Private Land	727,999	46
Saguaro National Park	33,302	2
State Trust Lands	503,672	32
Total	1,579,699	100

*Actual total may not add to 100 because of rounding.

The Pima County CWPP planning area primarily includes private lands (46%), state trust lands (32%), BLM (6%), and CNF (5%) lands, and SNP (2%). Tribal trust lands consisting of Pascua Yaqui, San Xavier, and Tohono O'odham lands collectively compose over 7 percent of the Pima County CWPP WUI.

Outside tribal trust lands, primary landownership in the Pima County CWPP planning area is a mosaic of privately owned lands and lands administered by the ASLD, BLM, and CNF (Figures 2.1a–2.1c). Private lands within the Pima County CWPP planning area include urban areas with associated adjacent urban development in proximity to undeveloped public and state lands (such as Oro Valley), rural communities with minimal development (such as Arivaca), and undeveloped land parcels.

Of the publicly owned lands within the analysis area, Arizona State Trust lands (state lands) compose the largest acreage—503,672 acres, or 32 percent—of land within the analysis area. State lands were established in 1912 under the terms of the Arizona Enabling Act. With statehood, Arizona was granted ownership of four sections per township. The ASLD manages state lands to produce revenue for the Arizona State Trust beneficiaries, including the state's school system. Within the Pima County CWPP area, State lands are managed primarily for recreation, natural resource protection, and livestock grazing.

There are several large county, state, and national parks within the analysis area. These include Tucson Mountain Park, Catalina State Park, and Saguaro National Park. There are a large number of popular hiking trails within these designated parks as well as within the CNF, such as the Sabino Canyon Recreation Area. Designated parks and recreation areas adjacent to the major communities of the Tucson Basin can increase potential wildfire fire risk due to human-caused ignitions.

Of the remaining publicly owned lands within the analysis area, CNF lands compose 75,129 acres, or approximately 5 percent, of the analysis area. CNF lands within the WUI recreational residences such as Greater Soldier Camp and Willow Canyon, organizational recreational areas such as the Camp Lawton Boy Scout Camp and the Whispering Pines Girl Scout Camp, as well as the First Southern Baptist Church, Sycamore Canyon Academy-Rite of Passage, Camp Zion, Amphi Camp, St. Marks Presbyterian Church, Pima County Sheriff's Department, as well as communications sites, observatories, and University of Arizona research sites. These federal lands provide extensive popular hiking, hunting, and recreational areas within or adjacent to the analysis area.

Private land within the analysis area composes the largest ownership within the CWPP at 727,999 acres, or roughly 46 percent, of the analysis area. Private lands are mostly clustered near the communities, with some scattered private in-holdings located throughout the analysis area. The municipalities/unincorporated communities of Ajo, Catalina, Green Valley, Marana, Oro Valley, Sahuarita, Sells/Tohono O'odham, Summerhaven, South Tucson, Tucson, and Vail contain the majority of private land acreage within the analysis area. Commercial structures are clustered along state and federal highways and community centers, and they are assumed to remain as the principal commercial corridors within the Pima County at-risk communities.

Pima County has experienced considerable growth in population and housing during past decades. The 1900 decennial census recorded 14,689 residents in Pima County. In 2010, the population center moved southwest, closer to the intersection of South Park Avenue and East Aviation Parkway. The earlier north-south pattern of expansion appears to be recurring, and future development in Pima County is expected to be oriented around I-10 and I-19 corridors. The majority of the population lives in the eastern half of the

county, which contains all of the five incorporated jurisdictions, the Tohono O'odham Nation, Pascua Yaqui Tribe, San Xavier District, and a large, urbanized unincorporated area. Approximately 85 percent of the county's land is federal, state or Native American owned (http://www.pagnet.org/RegionalData/Demographics/).

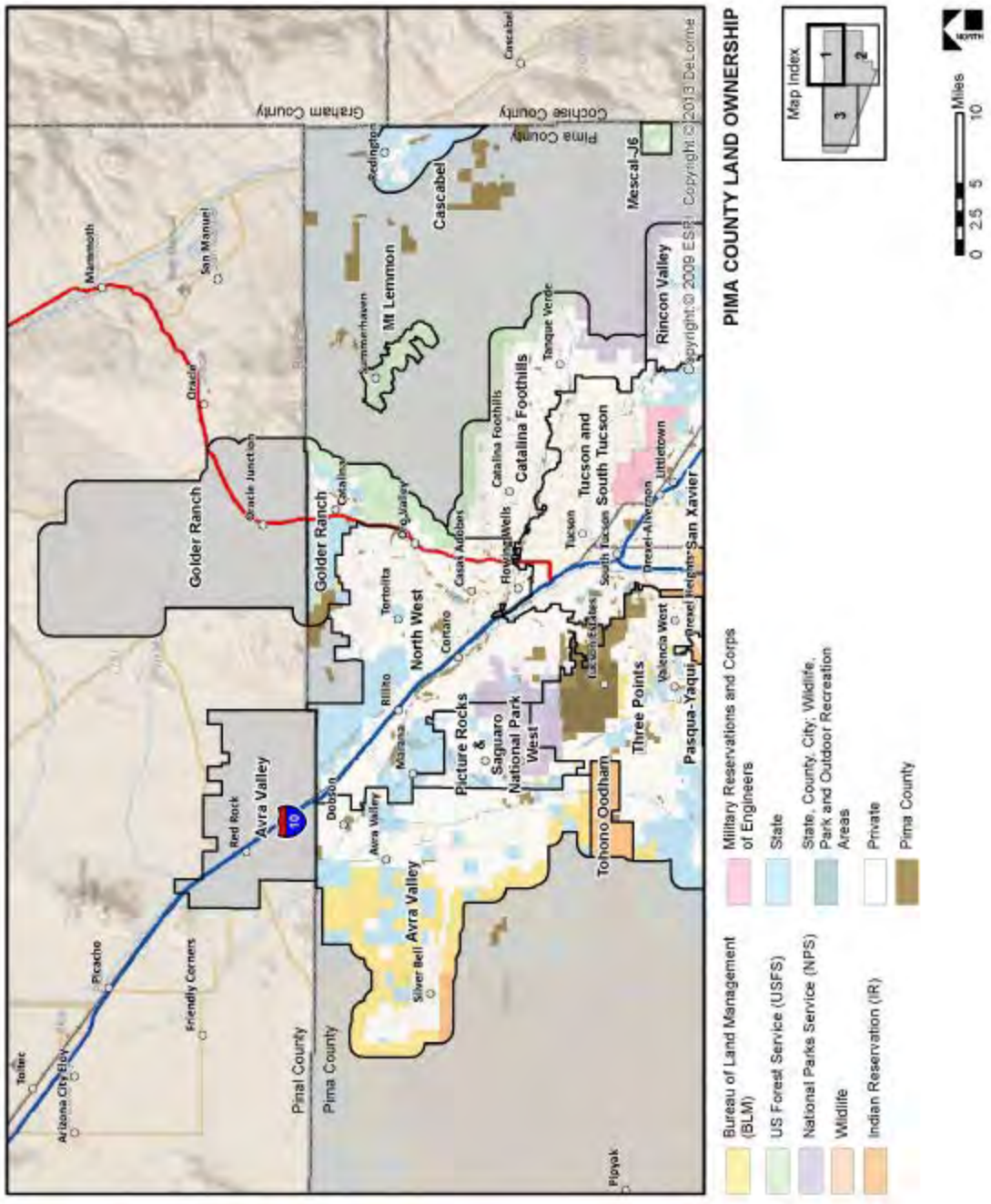

Figure 2.1a. Pima County CWPP Landownership, North

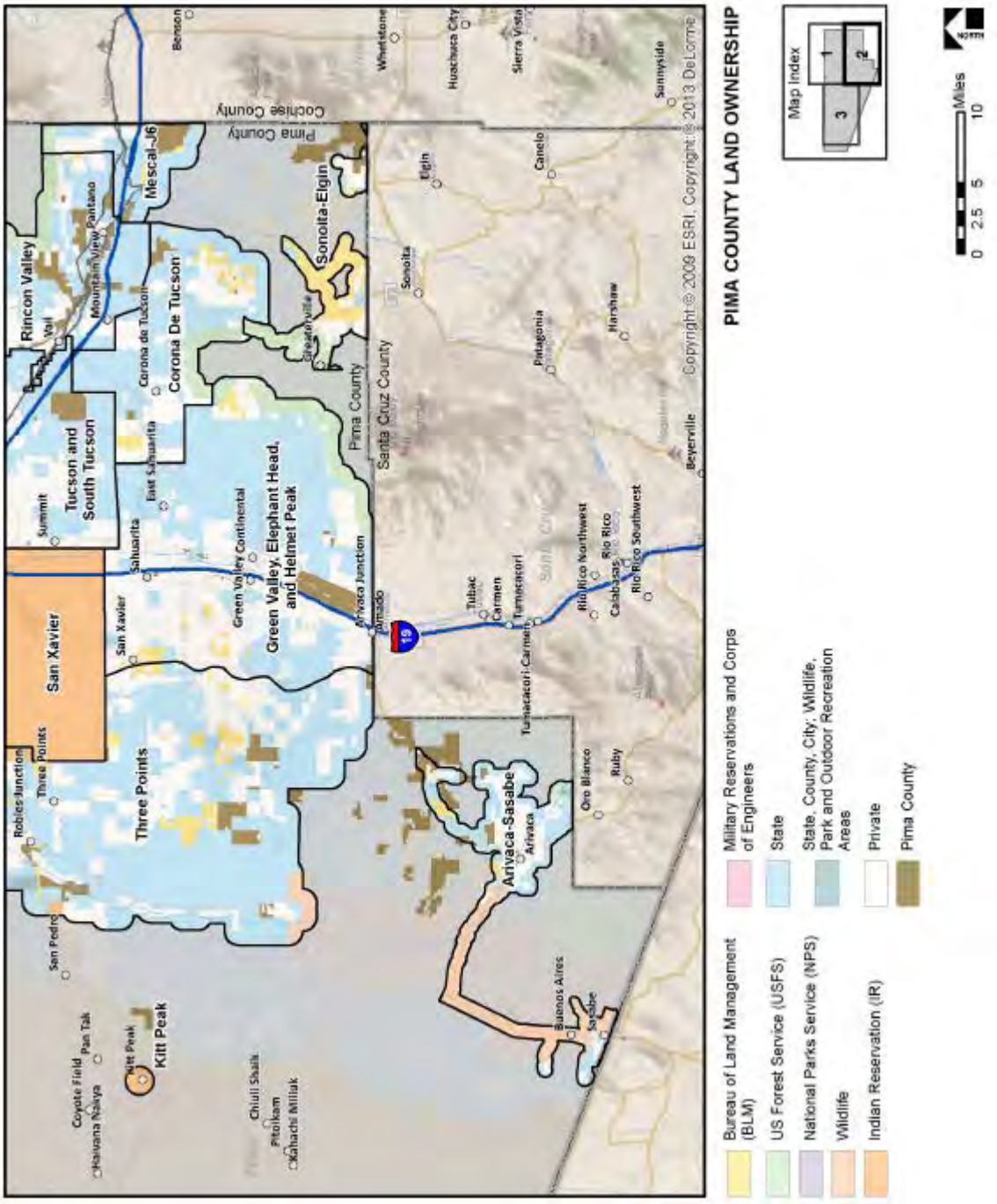

Figure 2.1b. Pima County CWPP Landownership, South

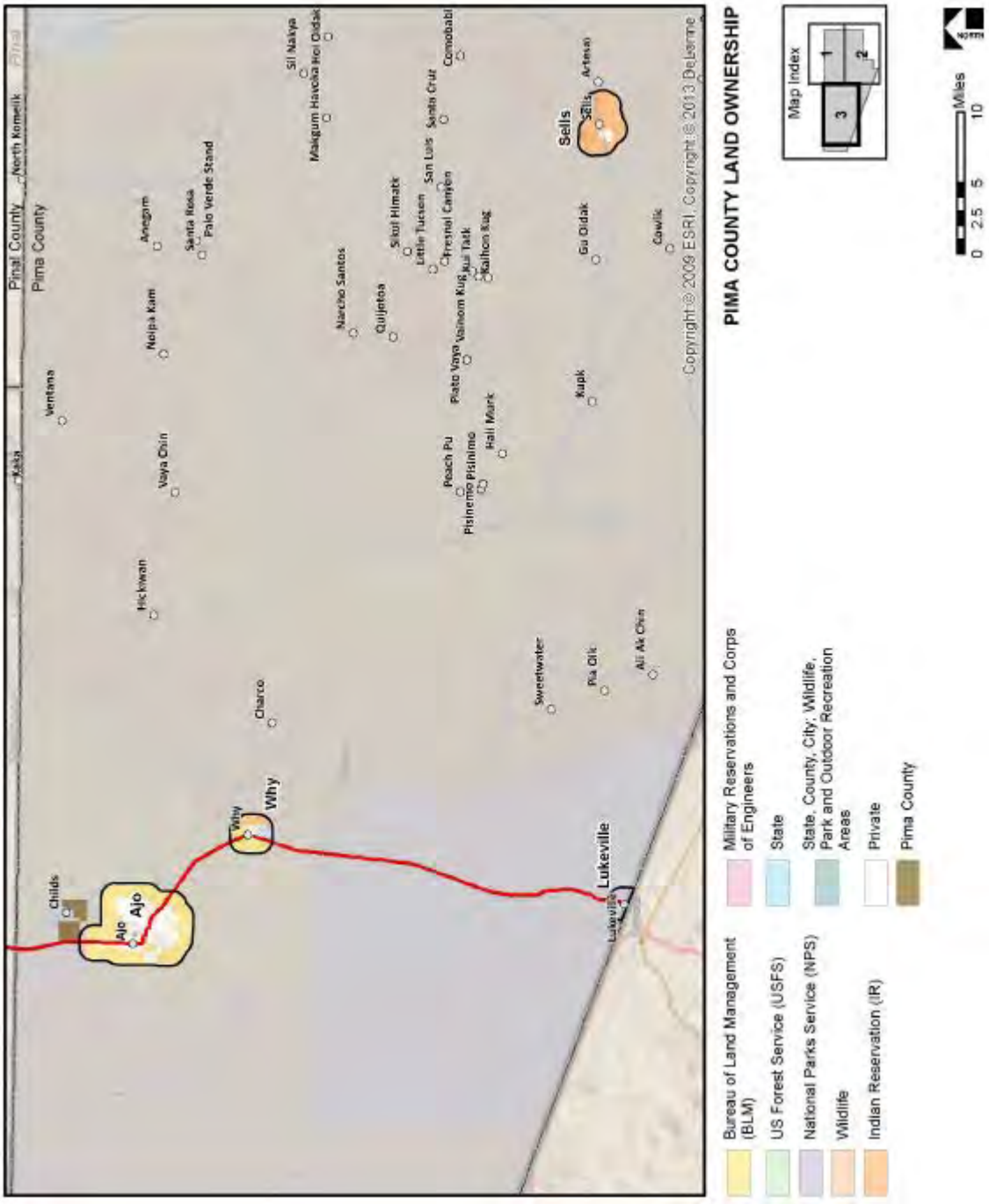

Figure 2.1c. Pima County CWPP Landownership, West

The 2010 population estimate for Pima County was reported as 980,263 residents living in 442,484 housing units. This represents an approximate 48 percent increase in population over the 666,880 residents reported in the 2000 census. Growth is anticipated to continue in both urban and rural settings in Pima County (http://quickfacts.census.gov/qfd/states/04/04019.html).

Some portions of the Pima County analysis area are included within the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007), which distinguishes nine forested landscapes. A portion of one of these identified forested landscapes, the Sky Islands, occurs in Pima County.

The Sky Islands region is located at the confluence of four major bioregions—the southern Rocky Mountains, the northern Sierra Madre Mountains, the Sonoran Desert, and the Chihuahuan Desert. The Sky Islands region of the *Statewide Strategy for Restoring Arizona's Forests* is circumscribed by the Gila Mountains to the north, the Baboquivari Mountains to the west, and the Mexican border to the south. Landscape vegetation within the Sky Islands ranges from cold, wet, spruce-fir forests above 8,000 feet to mixed conifer and ponderosa pine forest occurring at 6,500 to 8,000 feet to the Madrean encinal oak woodlands at elevations occurring from 3,600 to 6,500 feet (Governor's Forest Health Councils 2007:109). Due to high levels of topographical complexity and gradient within the portion of the Sky Islands landscape within the Pima County analysis area, fire characteristics are variable. Single fires can cross multiple vegetation associations. Unnaturally high fuel loads and drought continue to contribute to high wildland fire risk. Recommendations for "Future Restoration Needs" (Governor's Forest Health Councils 2007:115) of the Sky Islands landscape applicable to the analysis area include (1) conducting educational outreach to stakeholders that will highlight the ecological and socioeconomic benefits of ecological restoration; (2) providing incentives and assistance for restoration of privately owned forests (or lands within the Pima County CWPP); (3) integrating restoration planning with long-term planning and zoning processes, which will require outreach and education to planning and zoning commissions; (4) encouraging Firewise landscaping and building in communities; and (5) encouraging the restoration-based harvesting of firewood as opposed to importing firewood from Mexico.

Wildland fire is identified as a critical issue within the *Arizona Forest Resource Assessment* (ASFD 2010a). Higher elevations of the Santa Catalina, Rincon, and Baboquivari mountains are focus landscapes for wildland fire, as derived from two primary datasets: (1) the 2004 *Arizona Wildland Urban Interface Assessment* report and (2) communities identified as at-risk by the Arizona State Forester. The analysis includes all risk components and is constructed to be compatible with all influencing factors identified in the *Arizona Forest Resource Assessment* (ASFD 2010a).

The climate of Pima County is varied—ranging from semiarid desert shrub-scrub vegetative associations with relatively low precipitation, low humidity, and high summer temperatures to vegetative communities associated with the oak, pinyon-juniper, ponderosa pine, and mixed conifer woodlands with mild summers and cool winters. Precipitation averages 12 inches per year in Tucson but is variable throughout the county and occurs primarily during two rainy periods—summer rainfall, which usually occurs in local torrential convection showers, and winter rainfall, which is usually slow and can occur over several days. The average maximum annual air temperature ranges from a high of 99 to a low of 64 degrees Fahrenheit, while minimum annual temperatures range from 38 to 73 degrees Fahrenheit.

The majority of federally managed public lands outside tribal trust lands, national parks and monuments, and national wildlife refuges in Pima County are administered by the BLM and locally managed through the BLM, Gila District, Tucson Field Office. In accordance with the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* and the *Wildland Fire Suppression (Including Wildland Fire Use) and Rehabilitation in Riparian and Aquatic Habitats* (USDI BLM 2004a and USDI BLM 2004b), BLM-administered public lands are assigned to one of two land use allocations for fire management. Allocation 1 lands include areas where fire is desired and there are few or no constraints for its use. Wildland fire may be used to achieve resource objectives, such as improved watershed or wildlife habitat. Where fuel loading is high and conditions are not initially suitable for wildland fire, fuel loads may be reduced by mechanical, chemical, or biological means to acceptable levels and to meet resource objectives. Allocation 2 lands include areas where mitigation and suppression are required to prevent direct threats to life or property. It also includes areas where fire never played a large role in ecosystem management and where unplanned ignitions would have negative effects on resources. In these areas BLM will implement programs to reduce unwanted ignitions and emphasize prevention, detection, and rapid suppression. The *Gila District Fire Management Plan* (USDI BLM 2010) refers to these two land use allocations and identifies areas where wildland fires can be managed for than one fire management objective and that mechanical, biological, or chemical means may be used to maintain nonhazardous levels of fuels to reduce the hazardous effects of unplanned wildland fires and meet resource objectives. The Fire Management Plan will also identify areas for exclusion from fire (through fire suppression), chemical, mechanical, and/or biological treatments. In addition to both land use allocations, BLM will undertake education, enforcement, and administrative fire-prevention measures to reduce human-caused fire.

National forest lands are administered by the CNF and consist of two FMUs: FMU 1–FS lands, except southwestern desert scrub vegetation type, and FM2–southwestern desert scrub vegetation type (USDA FS 2005, 2010):

> **FMU 1** – Forest-wide, except within in the southwestern desert scrub (Upper Sonoran Desert) vegetation type. This FMU includes a full range of responses, from aggressive initial attack to managing natural ignitions to achieve desired Land and Resource Management Plan objectives when risk is within acceptable limits.
>
> **FMU 2** – Generally, this FMU is located at elevations less than 4,500 feet on the Santa Catalina, Santa Rita, Galiuro and Tumacacori Ecosystem Management Areas (EMAs). In this FMU, resource protection is the only objective, as it contains non-fire adapted vegetation. The vegetation type on the Coronado this applies to is the Southwestern Desert scrub, which contains the following species: saguaro (*Carnegiea gigantea*), palo verde (*Cercidium* spp.), creosote bush (*Larrea tridentata*), ocotillo (*Fouquieria splendens*), and brittle bush (*Encelia* spp.). Due to the limitations of accurate mapping, on-scene resources will need to identify the vegetation type at both the point of ignition and in the direction of likely spread, prior to making resource objective decisions

NPS suppresses all fires in desert vegetation types because they are not adapted to fire, and fires cause unacceptable resource damage. Saguaro National Park fire management goals include giving primary consideration to firefighter, employee, and public safety; managing fire to minimize threats of unacceptable

effects of fire to property outside the park and sensitive cultural and natural resources; and restoring and maintaining fire-adapted ecosystems through the ecologically appropriate use of fire. In the WUI, Saguaro National Park can use herbicides and manually remove invasive plant species (especially buffelgrass) to protect park resources and private property.

Organ Pipe Cactus National Monument fire management goals involve protecting human life and property and employing strategies to suppress all wildland fires within monument boundaries that minimize costs and resource damage consistent with values at risk. The monument is currently undergoing a planning effort to potentially broaden and increase fuel treatment possibilities.

A. Fire Regime and Condition Class

Before European settlement of North America, fire played a natural (historical) role in the landscape. Five historical fire regimes have been identified based on the average number of years between fires (fire frequency) combined with the severity (amount of overstory replacement) of fire on the dominant overstory vegetation (Table 2.2).

Table 2.2. Fire Regime Information

	Frequency	Severity[a]
Regime I	0–35 years	Low
Regime II	0–35 years	High
Regime III	35–100 years	Low
Regime IV	35–100 years	High
Regime V	200+ years	High

Source: FRCC Guidebook Version 3.0, Sept. 2010. http://www.fire.org/niftt/released/FRCC_Guidebook_2010_final.pdf p.15.
[a]Low = less than 75% of the dominant overstory vegetation replaced. High = greater than 75% of the dominant overstory vegetation replaced (stand replacement).

The condition class of wildland habitats describes the degree to which the current fire regime has been altered from its historical range, the risk of losing key ecosystem components, and the vegetative attribute changes from historical conditions. The following descriptions of condition classes are provided by the Arizona State Forester (2007:3):

> Condition Class 1:
>
> Fire regimes are within a historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within the historical range.
>
> Condition Class 2:
>
> Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.

Condition Class 3:

Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

The Pima County analysis area covers 5,877,578 acres, including 142,917 acres of land classified as developed and low-density open space and barren landscape (<3% of analysis area acres), 32,573 acres of unclassified lands (<1% of analysis area), and 24,680 acres of agricultural land (<1% of analysis area acres). The analysis area includes 4,007,788 acres (69% of analysis area acres) of Fire Regime Condition Class (FRCC) I lands, 850,206 acres (15% of analysis area acres) of FRCC II lands, and 814,480 acres (14% of analysis area acres) of FRCC III lands, as described in *Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management* (Schmidt et al. 2002).

Because condition-class categories are based on coarse-scale data that are intended to support national-level planning, any interpolation of national data for localized conditions may not be valid (FRCC Interagency Working Group 2005a, 2005b) due to invasive perennial and annual grasses, exotic forbs, and woody-species encroachment in native habitats altering local fire regimes. Therefore, local agencies are asked to provide data for localized vegetative conditions that reflect an accurate, current FRCC (USDA FS 2000). In addition to effects of invasive grasses and perennial woody species, the Southwest has experienced widespread and intense drought in recent years (Karl et al. 2009). Record wildfires occurring in the last decade are being driven by rising temperatures and related reductions in spring snowpack and soil moisture (Westerling et al. 2006). If the Southwest becomes warmer and drier, as projected by many climate models, the wildland fire season is anticipated to increase in length and severity driven by rising spring and summer temperatures and related reductions in spring snowpack and soil moisture (Karl et al. 2009; Westerling et al. 2006). If periods of extended drought and warmer temperatures become more common in Pima County, increases in wildland fire occurrences—particularly in higher-elevation vegetation associations and severity can be anticipated. The amount of land disturbance causing the growth of flammable annuals (pigweed [*Amaranth* spp.], mustards, and thistles) and invasive grasses (such as buffelgrass [*Pennisetum ciliare*], red brome [*Bromus rubens*], and Mediterranean grass [*Schismus barbatus*]) in the analysis area can rapidly alter the potential of a vegetation association to support unwanted wildland fire. In addition, increasing woody-species invasions, especially saltcedar (*Tamarix* spp.) within the riparian corridors, indicate that the perennial and ephemeral riparian, upland, and desert grassland habitats no longer conform to components of Condition Class 1 lands. Invasive nonnative plants have severe ecological impacts on vegetative structure (Arizona Wildlands Invasive Plant Working Group [AZ-WIPWG] 2005). Therefore, local conditions indicate that the majority of wildland habitats within the analysis area may actually fall within Condition Classes 2 and 3.

As reported in the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007:46), the majority of the Sky Islands landscape (92%) has been classified as Condition Classes 2 and 3 in which there is a "moderate to high risk of losing key ecosystem components

to fire." Within the Sky Islands landscape, fire exclusion combined with recent drought has exacerbated heavy fuel loading in some areas that in turn increases the probability of uncharacteristic wildfire.

The desired future condition of federal land within the Pima County CWPP area is to return to or maintain wildland within Condition Class 1, as described in *Fire Regime and Condition Class (FRCC) Interagency Handbook Reference Conditions* (2005a):

> Open park-like savanna grassland, or woodland, or shrub structures maintained by frequent surface or mixed severity fires . . . Surface fires typically burn through the understory removing fire-intolerant species and small-size classes and removing less than 25 percent of the upper layer, thus maintaining an open single-layer overstory of relatively large trees . . . Mosaic fires create a mosaic of different-age, postfire grassland, savannah woodlands, or open shrub patches by leaving greater than 25 percent of the upper layer (generally less than 40 hectares [100 acres]). Interval[s] can range up to 50 [years] in systems with high temporal variability.

Desired future conditions for Sonoran Desert habitats "are for an adequate cover and mix of natural plant species that have good vigor" and for riparian habitats the "Desired Future Condition are that annual weeds cover and density is controlled and ladder fuels and downed woody debris are limited or not present. Disturbances such as livestock grazing, mining and off road vehicle travel, that can potentially reduce natural vegetation cover and vigor, are managed to maintain adequate cover and mix of natural plant species" (USDI BLM. 2004a).

However, a growing body of evidence shows that climate has changed substantially since 1900, that this change is accelerating, and that even greater change is likely to occur in the next 100 years (USDA 2012) and such climate change will alter natural ecosystems and affect their ability to provide goods and services (USDA 2012). Additionally, post wildfire conditions and fire management activities can create ideal opportunities for invasions by nonnative plants undermining the benefits of fire management actions (Brooks and Lusk. 2008). While it may be possible to maintain or revert some areas to historical fire regimes during the life of this plan, land management agencies recognize that due to the effects of climate change, urbanization, increasing human use, increasing distribution and abundance of invasive plant species, and continued expansion of the wildland interface, currently described historical fire regimes and plant communities may not be achievable in the larger landscape in both fire- and non-fire-adapted vegetation associations in the future.

B. Fuel Hazards

The arrangement of vegetative fuel, relative flammability, and potential of vegetation to support wildland fire varies throughout the analysis area. Wildland fuel hazards depend on a specific composition, type, arrangement, or condition of vegetation such that if the fuel were ignited, an at-risk community or its infrastructure could be threatened. Table 2.3 identifies the vegetative associations in the analysis area that were evaluated for vegetative fuel hazards. Historically, fire played an important role in keeping woody species in check and light ground fuels low (USDI BLM 2004b:3–8; Gori and Enquist 2003). However, with the suppression of natural wildfires within the last century, fire return intervals have increased, increasing fuel loading. In addition, invasion by nonnative plant species (such as salt cedar, buffelgrass, red brome, and Mediterranean grass) have introduced fire into desert areas that were formerly nearly fire-proof and

converted them into grasslands (Schmid and Rogers 1988; Stevens and Falk 2009) while salt cedar is invading riparian areas and increasing fuel load and volatility (Brooks 2008).

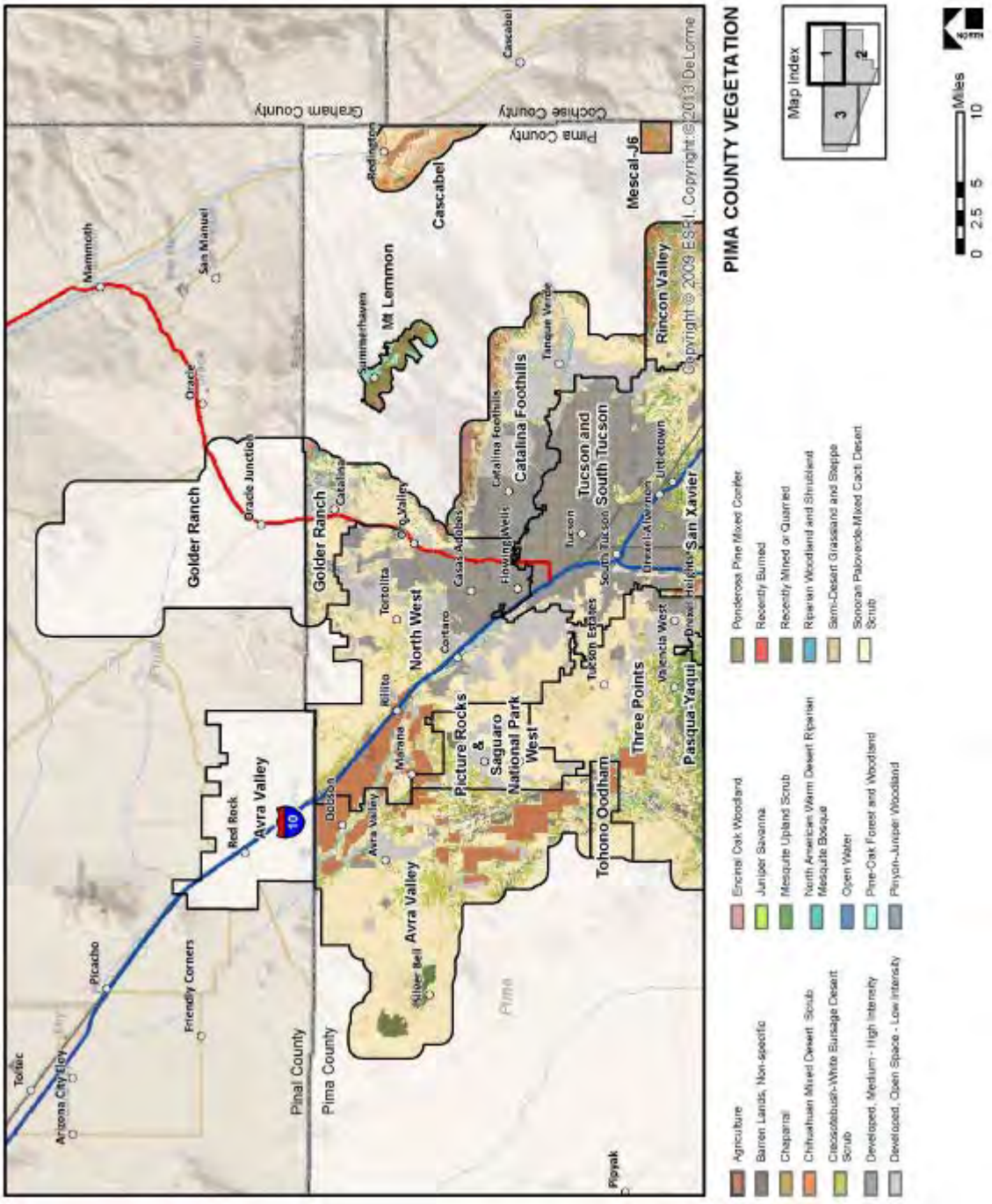

Figure 2.2a. Landcovers of the Pima County WUI, North

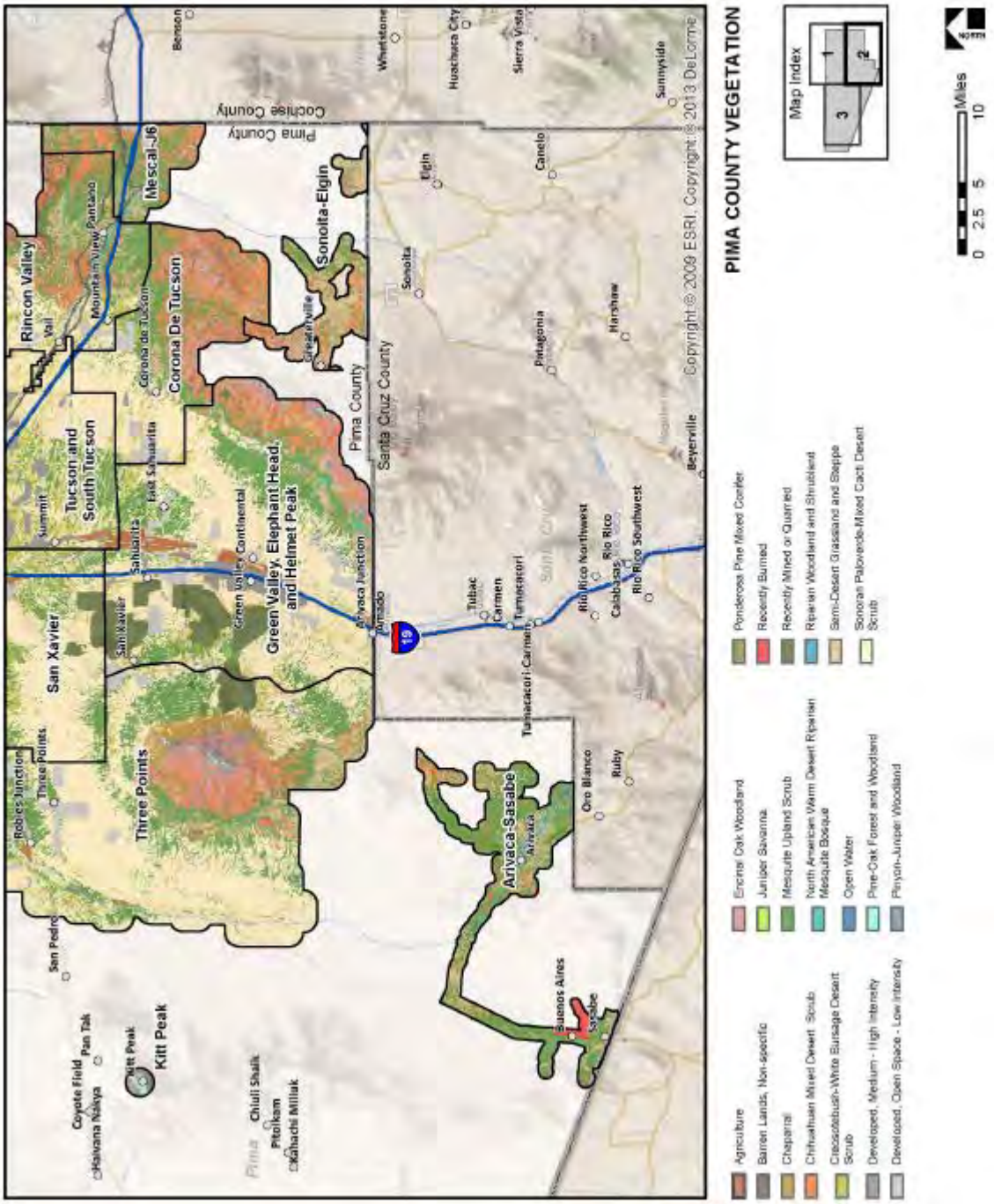

Figure 2.2b. Landcovers of the Pima County WUI, South

Figure 2.2c. Landcovers of the Pima County WUI, West

The vegetation associations within the analysis area were identified and mapped using Southwest Regional Gap Analysis Project (SWReGAP) data (USGS 2005; NatureServe 2004) (Figures 2.2a–2.2c). These datasets provide the level of landscape description and vegetative landcover detail necessary for aligning wildland fuel flammability with existing vegetation. The major distinguishing types for each Pima County vegetation association were field verified.

Vegetation data for the community of Summerhaven and the Mount (Mt.) Lemmon WUI was derived from the Catalina Rincon FireScape program. The current vegetative landscape of the Catalina Mountains has been mapped in great detail according to several different criteria. The recent work by the FireScape program allows for much greater detail and fire behavior modeling based on current landcover, geology, topography, and land form. The Core Teams incorporated the data from ecological units, which are patches of the landscape that share similar vegetation cover (http://www.azfirescape.org/catalina/landscape_types), into the risk assessment of the Mt. Lemmon WUI. This detailed data allows for site-specific fire behavior modeling within each ecological unit. Each separate ecological unit then may show several fuel models based on these varying biophysical conditions. The data used to map FireScape products (for example, fuel models, fire behavior models) were obtained from the Catalina Rincon FireScape program and are embedded in Table 2.3 to be comparable with SWReGAP landcover data used for other community WUI landcover descriptions, fire behavior models, and vegetative fuel risk ratings.

The existing arrangement and flammability of vegetation associations largely determine wildland fire behavior. Areas at risk from wildland fire were determined by evaluating vegetative fuels on federal and nonfederal land in the analysis area through spatial analysis using geographic information system (GIS) technology in a series of overlays. For the analysis area, the vegetation type, density, and distribution were analyzed to help categorize areas at highest risk for fire intensity and spread from wildland fuels.

Vegetative data for predicting wildfire behavior was quantified by developing descriptions of associated fuel properties that are described as fuel models. The fuel model (as described by Anderson 1982; Scott and Burgan 2005) and vegetation fuel fire-risk rating within the analysis area are shown in Table 2.3.

Table 2.3. Fuel Model, Fire-Danger Ratings, and Intensity Levels on Vegetative Associations in the WUI

Fuel Type	Vegetation Association	Wildfire Risk Rating[a]	Anderson Fuel Model	Fire-Danger Rating Model[b]	Flame Length (ft)	Fire Intensity Level from Fire-Danger Rating Model[e]	Rate Of Spread ft/hr (ch/hr)	Fire Behavior Fuel Model[c]	Flame Length (ft) Low Dead Fuel Moisture	Fire Intensity Level from Fire Behavior Fuel Model[e]	Rate of Spread ft/hr (ch/hr)— Low Dead Fuel Moisture	Acre (%)
Desert shrub-scrub	Creosotebush, mixed desert, and thorn scrub	L	1,2	T	4–6	4	2310–5150 (35–78)	GR1	0.5–1.7	GR1: 1	GR1, 0–990 (0–15)	80,250
								GR2	1.0–8.0	GR2: 1–4	GR2, 0–7920 (0–15)	(5%)
								SH1	0.2–0.7	SH1,1	SH1, 7–132 (0– 2)	
	Sonoran paloverde-mixed cacti desert scrub (25, 26, 27, 28, 29)[d]	M	1,3	L and T	4–6	3	2310–5150 (35–78)	GR1	0.5–1.7	GR1,1	GR1, 0–990 (0–15)	641,402
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7920 (0–120)	(41%)
								GR4	1.0-22	GR4, 1-4	GR4, 0-33,000 (0-500)	
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0->6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–132 (0– 2)	
								SH4	1.0-16	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 2-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 2-6	SH 7, 0-11889 (0-180)	
								TL2	4.0->25.0	TL2, 2-6	TL2, 0-132 (0-2)	
								TL6	1.0-7.0	TL6, 1-4	TL6, 2-1650 (2-25)	
								TU2	1.0–8.0	TU2, 1-5	TU2, 0-5,280 (0-80)	
	Creosotebush-white bursage desert scrub	L	1	L and T	4–6	3	2110–5150 (32–78)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	99,170
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0.1–1.7)	(6%)
	Chihuahuan Mixed-desert scrub (1,2,3)[d]	L	1,2	L and T	4–6	3	2310–5150 (35–78)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	
								GR2	1.0–8.0	GR2, 1–4	GR2, 0–7920 (0–120)	
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 2-5	GS2, 0->6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0.1–1.7)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
Shrublands	Mesquite upland scrub Mesquite grasslands (9, 10, 11, 12, 13, 14, 15)[d]	M	1,3	B and T	4–12	6	5150–6860 (78–104)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	230,189
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7920 (0–120)	(15%)
								GR4	1.0-22	GR4, 1-6	GR4, 0-33,000 (0-500)	
								GR7	5.0-45	GR7, 3-6	GR7, 1-33,000 (0-500)	
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH2	1.0–4.5	SH2, 1-3	SH2, 0–1188 (0–18)	
								SH4	1.0-16	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0–>25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL2	4.0->25.0	TL2, 3-6	TL2, 0-132 (0-2)	
								TU2	1.0–8.0	TU2, 1-4	TU2, 0-5,280 (0-80)	

Table 2.3. Fuel Model, Fire-Danger Ratings, and Intensity Levels on Vegetative Associations in the WUI

Fuel Type	Vegetation Association	Wildfire Risk Rating[a]	Anderson Fuel Model	Fire-Danger Rating Model[b]	Flame Length (ft)	Fire Intensity Level from Fire-Danger Rating Model[e]	Rate Of Spread ft/hr (ch/hr)	Fire Behavior Fuel Model[c]	Flame Length (ft) Low Dead Fuel Moisture	Fire Intensity Level from Fire Behavior Fuel Model[e]	Rate of Spread ft/hr (ch/hr)— Low Dead Fuel Moisture	Acre (%)
												Continued
Grasslands	Semi-desert grassland and steppe	L	1,2	F and T	4–6	3	2310–5150 (35–78)	GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	70,377
								GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	(4%)
								GR2	1.0–8.0	GR2, 4	GR2, 0–7920 (0–120)	
								GR4	1.0-22	GR4, 1-6	Gr4, 0-33,000 (0-500)	
Woodlands	Chaparral (19)[d]	H	4, 6	B and T	6–19	4–6	2110–4950 (32–75)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	12,299
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7920 (0–120)	(1%)
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0–>25.0	SH7, 3-6	SH7, 0-11889 (0-180)	
								TL8	1.0-8.0	TL8, 1-4	TL8, 0-2640 (0-40)	
								TU2	1.0–8.0	TU2, 1-4	TU2, 0-5,280 (0-80)	
	Encinal Oak Woodland Desert oak transition (4, 5, 6, 9)[d]	M	1,3	B and T	2.6–6	4	495–2310 (7.5–35)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	34,453
								GR2	1.0–8.0	GR2 , 1-4	GR2, 0–7920 (0–15)	(1%)
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0.– 2)	
								SH5	4.0–>25.0	SH5 , 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
	Pinyon-juniper Woodland Oak-pinyon-juniper woodlands (20, 21, 22, 23)[d]	H	2,3	F	6-19	4-6	2110-4950 (32-75)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	12,815
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	(1%)
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3, 0-198 (0-3)	
								TL8	1.0-8.0	TL8, 1-5	TL8. 0-2640 (0-40)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	

Table 2.3. Fuel Model, Fire-Danger Ratings, and Intensity Levels on Vegetative Associations in the WUI

Fuel Type	Vegetation Association	Wildfire Risk Rating[a]	Anderson Fuel Model	Fire-Danger Rating Model[b]	Flame Length (ft)	Fire Intensity Level from Fire-Danger Rating Model[e]	Rate Of Spread ft/hr (ch/hr)	Fire Behavior Fuel Model[c]	Flame Length (ft) Low Dead Fuel Moisture	Fire Intensity Level from Fire Behavior Fuel Model[e]	Rate of Spread ft/hr (ch/hr)— Low Dead Fuel Moisture	Acre (%)
												Continued
	Juniper savanna Juniper mesquite grasslands	M	2,6	F	6-8	4	2110-2310 (32-75)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	639 (0%)
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	
Timber	Ponderosa Pine Mixed conifer (16, 17, 24)[d]	H	2,9	E and T	2.6->8	4-5	495-2310 (7.5-35)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	4,624 (0.2%)
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0–>25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
								TL6	1.0-7.0	TL6, 1-4	TL6 0-1650 (2-25)	
								TL8	1.0-8.0	TL8, 1-5	TL8, 0-2,649 (0-40)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	
								TU2	1.0–8.0	TU2, 1-4	TU2, 0-5,280 (0-80)	
								TU5	2.0-13.0	TU5, 2-6	TU5, 0-2,772 (0-42)	
												Continued

Table 2.3. Fuel Model, Fire-Danger Ratings, and Intensity Levels on Vegetative Associations in the WUI

Fuel Type	Vegetation Association	Wildfire Risk Rating[a]	Anderson Fuel Model	Fire-Danger Rating Model[b]	Flame Length (ft)	Fire Intensity Level from Fire-Danger Rating Model[e]	Rate Of Spread ft/hr (ch/hr)	Fire Behavior Fuel Model[c]	Flame Length (ft) Low Dead Fuel Moisture	Fire Intensity Level from Fire Behavior Fuel Model[e]	Rate of Spread ft/hr (ch/hr)— Low Dead Fuel Moisture	Acre (%)
	Pine-oak Forest and Woodland (7, 8)[d]	M	2,9	F and E	2.6-8	4-5	495-2310 (7.5-35)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	3,323 (0.2%)
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	
								GR4	1.0-22.0	GR4, 1-6	GR4, 0-33,000 (0-500)	
								GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0-25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
								TL8	1.0-8.0	TL8, 1-4	TL8, 0-2,649 (0-40)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	
								TU5	2.0-14.0	TU5, 2-6	TU5, 0-2,772 (0-42)	
Deciduous Southwest Riparian	North American Warm Desert Riparian Mesquite Bosque	H	6,9	E and T	2.6–12	6	495–2110 (7.5–32)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	10,319 (0.6%)
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	
								GR4	1.0-22.0	GR4, 1-6	GR4, 0-33,000 (0-500)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0-25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
								TL8	1.0-8.0	TL8, 1-4	TL8, 0-2,649 (0-40)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	

Continued

Table 2.3. Fuel Model, Fire-Danger Ratings, and Intensity Levels on Vegetative Associations in the WUI

Fuel Type	Vegetation Association	Wildfire Risk Rating[a]	Anderson Fuel Model	Fire-Danger Rating Model[b]	Flame Length (ft)	Fire Intensity Level from Fire-Danger Rating Model[e]	Rate Of Spread ft/hr (ch/hr)	Fire Behavior Fuel Model[c]	Flame Length (ft) Low Dead Fuel Moisture	Fire Intensity Level from Fire Behavior Fuel Model[e]	Rate of Spread ft/hr (ch/hr)— Low Dead Fuel Moisture	Acre (%)
	Invasive Southwest Riparian Woodland and Shrub (18)[d]	H	4	G and T	19	6	4950 (75)	GR1	0.5–1.7	GR1, 1	GR1, 0–990 (0–15)	1,944 (0.1%)
								GR2	1.0–8.0	GR2, 1-4	GR2, 0–7,920 (0–15)	
								GR4	1.0-22	GR4, 1-6	GR4, 0-33,000 (0-500)	
	Riparian Woodland and Shrubland (18)[d]	H	8 and 9	E and T	2.6-6	4-6	495-2110 (7.5-32)	GS1	1.0–6.0	GS1, 1-3	GS1, 0–3960 (0–60)	
								GS2	1.5->10.0	GS2, 1-5	GS2, 0-6600 (0-100)	
								SH1	0.2–0.7	SH1, 1	SH1, 7–112 (0– 2)	
								SH4	1.0-16.0	SH4, 1-6	SH4, 0-11880 (0-180)	
								SH5	4.0-25.0	SH5, 3-6	SH5, 0–16500 (0–250)	
								SH7	4.0->25.0	SH7, 3-6	SH 7, 0-11889 (0-180)	
								TL1	0.0-0.5	TL1, 1	TL1, 0-66 (0-1)	
								TL2	0.3–1.0	TL2, 1	TL2, 0-132 (0-2)	
								TL3	0.4-1.3	TL3, 1	TL3 0-198 (0-3)	
								TL6	1.0-7.0	TL6, 1-4	TL6, TL6 0-1650 (2-25)	
								TL8	1.0-8.0	TL8, 1-4	TL8, 0-2,649 (0-40)	
								TU1	1.0-4.0	TU1, 1-3	TU1, 0-990 (0-15)	
								TU2	1.0–8.0	TU2, 1-4	TU2, 0-5,280 (0-80)	
Other	Agriculture	L	NA	NA	NA	NA	NA	NB3	NA	NA	NA	45,269 (3%)
	Developed, Open Space–Low Intensity	L	NA	NA	NA	NA	NA	NB1	NA	NA	NA	117,627 (8%)
	Developed, Medium–High Intensity	L	NA	NA	NA	NA	NA	NB1	NA	NA	NA	157,603 (10%)
	Barren Lands, Non-Specific	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	18,745 (1%)
	Recently mined or quarried	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	36,186 (2%)
	Recently Burned	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	1,847 (0%)
	Open water	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	513 (0%)
											Total	100%

Source: National Fire Danger Rating System (USDA FS 1983; Burgan 1988).

[a]L = low, M = moderate, H = high, NA = not applicable.

[b]See Appendix B for the National Fire Danger Rating System definitions.

[c]Fire Behavior Fuel Models are designed for wildland vegetation and do not accurately predict fire behavior when structures are involved

[d]Ecological Unit Map Legends included in vegetation associations from http://www.azfirescape.org/catalina/ecounit_map

[e]Fire Intensity Level (FIL) an expression of fireline intensity based on flame length as an indicator of fire intensity, FIL1 = 0-2' Flame length (FL in feet): FIL2 = 2.1 - 4' FL; FIL3 = 4.1 - 6' FL; FIL4 = 6.1 - 8' FL; FIL5 = 8.1-12 'FL, FIL6 > 12'FL

The Arizona State Forester (2007:1) defines the term *at-risk community* as follows:

> **EVALUATE RISK TO COMMUNITIES:** Not all structures and/or communities that reside in an "interface" area are at significant risk from wildland fire. It is a combination of factors, including the composition and density of vegetative fuels, extreme weather conditions, topography, density of structures, and response capability that determines the relative risk to an interface community. The criteria listed below are intended to assist interagency teams at the state level in identifying the communities within their jurisdiction that are at significant risk from wildland fire. The application of these risk factors should allow for greater nationwide consistency in determining the need and priorities for Federal projects and funding.

Wildland fire behavior potential in the analysis area is consistent with the Risk Classification Situations 1, 2, and 3 as described by the Arizona State Forester (2007:1–2):

> Risk Factor 1: Fire Behavior Potential
>
> Situation 1: In these communities, continuous fuels are in close proximity to structures. The composition of surrounding fuels is conducive to crown fires or high intensity surface fires. Likely conditions include steep slopes, predominantly south aspects, dense fuels, heavy duff, prevailing wind exposure and/or ladder fuels that reduce fire fighting effectiveness. There is a history of large fire and/or high fire occurrence.
>
> Situation 2: In these communities, intermittent fuels are in proximity to structures. Likely conditions include moderate slopes and/or rolling terrain, broken moderate fuels, and some ladder fuels. The composition of surrounding fuels is conducive to torching, spotting, and/or moderate intensity surface fires. These conditions may lead to moderate fire fighting effectiveness. There is a history of some large fires and/or moderate fire occurrence.
>
> Situation 3: In these communities, fine and/or sparse fuels surround structures. There is infrequent wind exposure and flat terrain to gently rolling terrain. The composition of surrounding fuels is conducive to low intensity surface fires. Fire fighting generally is highly effective. There is no large fire history and/or low fire occurrence.

Pima County is composed of three major land resource areas (Natural Resources Conservation Service [NRCS] 2011): Southeast Arizona Basin and Range, Sonoran Basin and Range, and Mogollon Transition. The Southeastern Arizona Basin and Range division is composed of mountain ranges that trend southeast to northwest and has relatively smooth valleys between the mountains extending to the Continental Divide in New Mexico. The Sonoran Basin and Range region is in the Sonoran Desert section of the Basin and Range province of the Intermontane Plateaus and is characterized by many short, fault-block mountain ranges trending southeast to northeast that rise abruptly from the smooth, gently sloping desert valley floors. Elevation ranges from 980 to 3,600 feet in most areas, with mountains reaching 4,590 feet. The Mogollon Transition region is within the Mexican Highland section of the Basin and Range province of the Intermontane Plateaus. The area is characterized by canyons and structural troughs and valleys with elevations ranging from 3,000 to 5,500 feet in most areas, with mountains reaching 5,100 to 7,500 feet.

Vegetative production within these major land resource areas ranges from over 4,000 lb per acre in highest-elevation sites in the >12-inch precipitation zone during favorable precipitation years to <50 lb per

acre in lower desert scrub–mudstone hills range sites in the <7-inch precipitation zone during unfavorable precipitation years. Precipitation ranges from 7 to 14 inches annually though as much as 20 inches of precipitation may occur in highest elevations. More than half of the precipitation occurs as high-intensity convective thunderstorms during July, August and September producing a winter-summer rainfall ratio of 40:60. Warm-season rains (July–September) originate in the Gulf of Mexico and are usually brief and intense. Cool-season rains (December–March) originating in the Pacific Ocean are generally frontal, widespread, long, and less intense. May and June are the driest months of the year, with many natural fire ignitions occurring before the monsoon rains. Humidity is generally low, with mostly mild winters and hot summers in lower elevations to mild summers and cold winters in higher elevations. During May and June temperatures can exceed 100 degrees Fahrenheit. Cool-season vegetation growth begins in early spring and matures in early summer. Warm-season vegetation initiates growth after the summer rains and may remain green throughout the year in lower elevations.

The analysis area includes 6 major vegetative fuel types composed of 20 major vegetation associations (including agricultural lands), 3 mostly nonvegetation associations, and 2 open-space residential developed landcovers, recently burned lands, as well as open water (NatureServe 2004, http://www.azfirescape.org/catalina/landscape_types). Each vegetative community is assigned to an array of fuel models that predicts the rate of spread, flame length, and fire-intensity levels possible for each vegetation association during an average fire season under average weather conditions. Assigning a fuel model to each vegetation association within the analysis area will help predict wildfire behavior and thus proper suppression response (for detailed fuel model descriptions, see Anderson 1982; Scott and Burgan 2005).

The mean fire return interval is highly variable among vegetation associations across the analysis area. Habitat or stand replacement wildfires or wildfires resulting in a major loss of habitat components, in conjunction with drought, will be reduced in frequency and intensity in lower desert habitats. However, moist periods may increase fire frequency and intensity in desert habitats due to increased production of annual grasses and forbs and increased annual growth of perennial grasses and shrubs (FRCC Interagency Working Group 2005b), in synergy with increased production of invasive grasses and forbs. Total wildland fuel load ranges from less than 500 lb per acre in desert and scrub/shrub types to over 20 tons/acre in dense woodland habitats. Buffelgrass fuel loads have been documented to reach 4 tons per acre in undisturbed desert in Saguaro National Park and over 5 tons per acre in old agricultural fields in Avra Valley (McDonald 2009).

Vegetation Associations

The Desert Shrub-Scrub vegetation association is the largest natural landcover within the analysis area; it occurs on drier upland sites and includes areas of bare ground and rock habitats supporting a variety of grass, herbaceous, scrub, and shrub species (Photo 2.1). This major vegetative fuel type ranges from lower desertscrub-creosotebush-bursage associations to mixed desert scrub types to paloverde-mixed cacti desertscrub association. The Desert Shrub-Scrub association constitutes 820,822 acres (52%) of WUI acres. During normal rainfall years and the typical fire season, the majority of the lowest-elevation associations (mixed desert scrub and creosotebush-white bursage associations) do not support high-intensity wildfires with high rates of spread, and many wildfires self-extinguish from a lack of contiguous

ground or aerial fuels. However, during periods of extraordinary rainfall in the fall, winter, and spring months, the growth of winter annuals and forbs, in synergy with the presence of invasive grasses and forbs (for example, buffelgrass, Mediterranean grass, red brome, and mustards), can produce areas with the potential for extreme rates of spread and enough intensity to ignite overstory vegetation. Buffelgrass is increasing at an exponential rate in Sonoran Desert habitats, and it responds mostly to precipitation received in summer months (Olsson et al. 2012).

Photo 2.1. Desert Shrub-Scrub Vegetation Association

The Shrublands vegetation association includes the mesquite upland scrub and mesquite grasslands occurring in the upland vegetative type within the analysis area, accounting for 230,189 acres (15%) of WUI acres (Photo 2.2). The xeroriparian area within this association provides movement corridors and foraging areas for a variety of wildlife species. Adjacent vegetation associations are often a mix of semidesert grassland and desert scrub. The understory of the shrub types will vary from a mix of nonnative grass with some areas of native grasses, depending on canopy closure. Areas of higher canopy closure (>60%) support little herbaceous and perennial grass cover, which limits fine fuels needed for fire laddering and limits rate of spread. Stands of mature upland mesquite habitats can include trees with trunks and limbs greater than 6 inches diameter at breast height, providing habitat for a variety of cavity-nesting bird species. This shrubland association also provides recreational use, day use, and camping areas. Plant communities dominated by mature mesquites may include native or invaded grass understory, creating areas of open woodlands and savannas to areas of high canopy.

Photo 2.2. Shrublands Vegetation Association

The Woodlands vegetation association includes the chaparral, pinyon-juniper, oak-pinyon-juniper, Madrean pine-oak, juniper savannas, juniper mesquite grasslands, transitional desert oak, encinal oak, and desert oak woodlands (Photo 2.3). The Madrean pine-oak forest and woodland are composed of Madrean pines including Arizona pine (*Pinus arizonica*), Apache pine (*Pinus engelmannii*), and Chihuahua pine (*Pinus leiophylla)* with an understory of chaparral species. Fires in the Madran Pine-oak forest and woodlands may be more frequent than ponderosa pine forests and woodlands (NatureServe 2004).The woodland association fuel type covers 60,206 acres (4%) of WUI acres and is the third largest upland vegetative fuel type within the analysis area.

Photo 2.3. Woodlands Vegetation Association

A major vegetative association of shrubland fuel types includes Mogollon chaparral. This ecological system occurs across central Arizona, western New Mexico, southwestern Utah, and southeast Nevada. It often dominates along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts. It occurs on foothills, mountain slopes, and canyons in drier habitats below the encinal woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt, or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as oak, sumac, and ceanothus. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Substrates are normally shallow/rocky and shaley soils at lower elevations.

The woodland vegetation associations include Madrean encinal oak woodlands which are the defining feature of the Sky Islands mountains (Governor's Forest Health Councils 2007: 107) occurring on foothills, canyons, bajadas, and plateaus in Mexico, extending north into sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition normally occurring at higher elevations and within moister habitats than Mogollon chaparral (Photo 2.4). Lower-elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral, or, sometimes, desertscrub. Common evergreen oak species include Emory, Arizona white, and scrub live oak. Other species include Manzanita, chaparral species, and, at higher elevations, pinyon and juniper species. The grass layer usually prominent between trees is grassland or steppe that is dominated by warm-season grasses typical of semidesert grasslands. This association can also be composed of stands dominated by shrubby Madrean oaks, typically with a strong grass layer and, in some instances, invasive grasses and forbs. In transition areas with drier chaparral systems, stands of chaparral are not dominated by the Madrean encinal association; however, it may extend down along drainages.

Photo 2.4. Madrean oak/conifer/manzanita on Hills with Extensive Rock Outcrops
(http://www.azfirescape.org/content/madrean_oakconifermanzanita_hills_and_mountains_extensive_rock_outcrops)

The Deciduous Southwest Riparian vegetation association consists of the North American warm-desert riparian mesquite bosque, southwest invasive riparian woodland and shrub, and riparian woodland and shrubland associations (Photo 2.5). This vegetative association covers 12,263 acres (less than 1%) of WUI acres. The Pima County analysis area includes the riparian corridor of the Santa Cruz and a small section of the San Pedro River near the community of Redington. This ecological system consists of low-elevation riparian corridors along intermittent streams in valleys of southern Arizona into adjacent New Mexico and Mexico. Dominant trees include mesquite species, and dominant shrubs include desert broom and desert willow. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop with high local densities of mesquites being dependent on an annual rise in the water table for growth and reproduction. This association can be intermixed with an understory of grasses and shrubs and often includes areas of near monocultures of saltcedar. This vegetation association may be underrepresented because of some xeroriparian association acres included with the shrubland associations. In general, riparian areas have characteristics that reduce the frequency and severity of fire relative to the surrounding uplands. These characteristics include less steep slopes, surface water, saturated soils, shade, fewer lightning ignitions, cooler air temperatures, lower daily maximum temperature, higher relative humidity, higher fuel moisture content, and lower wind speed. However, there tend to be more human-caused ignitions in these areas. Late seral-stage riparian vegetation supports wildland fire similar to the surrounding potential natural vegetation group (PNVG) when a stand replacement fire occurs in surrounding PNVG during extreme drought and wind events. Late seral-stage riparian and bosque habitats can support nonreplacement fire in greater proportion of total fire frequency than surrounding PNVGs (FRCC Interagency Working Group 2005b: PNVG Code RIPA).

Photo 2.5. Deciduous Southwest Riparian Vegetation Association

The Timber-Type vegetation association is found only in the Mt. Lemmon WUI but does occur in higher elevations of the Sky Islands throughout Pima County. The timber fuel type is composed of the mixed conifer and ponderosa pine vegetation associations (Photo 2.6). The mixed conifer vegetation group is a transitional forest and therefore best thought of as a continuum that follows a moisture gradient driven by

elevation and aspect. The mixed conifer associations will have less ponderosa pine than the warm/dry slopes and exposures; however, ponderosa pine will occur in small groups or isolated places usually in open areas, at the edges of meadows, and along ridges (LFRA_Region_SW_Model_Descriptions_Aug08). The mixed conifer association is found along the summit of the Santa Catalina Mountains ranging from 7,500 feet elevation to the summit at 9,157 feet. About two-thirds of the mixed conifer association occurs on 18 percent or steeper north-facing slopes dominated by Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and southwestern white pine (*Pinus strobiformis*). South-facing slopes and flats make up the remaining one-third of the mixed conifer association and include areas of primarily Ponderosa pine (*Pinus ponderosa*) and white pine with silverleaf oak (*Quercus hypoleucoides*). Many of these drier stands burned during the 2003 Aspen fire, including the southern aspects of Marshall Gulch, Carter Canyon, and Upper Sabino Canyon along the highway from Summerhaven to Ski Valley, as well as the slopes below Sykes Knob and Inspiration Rock (http://www.azfirescape.org). Ponderosa pine associations will have a dominant overstory of ponderosa pine with mixed co-dominant and understory vegetation associations such as silverleaf oak, netleaf oak (*Quercus rugosa*), Arizona white oak (*Quercus arizonica*), and Emory oak (*Quercus emoryi*) or a grassy understory of bunchgrasses such as Arizona fescue (*Festuca arizonica*), mountain muhly (*Muhlenbergia montana*), and June grass *(Koeleria macrantha)*. The ponderosa vegetation associations ranges from approximately 4,875 feet to over 8,600 feet in elevation on a variety of topographic features, including mountains, mesas, and canyons. In the Catalinas the ponderosa pine association includes the town of Summerhaven and upper Sabino Canyon.

Photo 2.6. Timber-Type Vegetation Association

The Desert Grasslands vegetation association is primarily represented by the semi-desert grassland and steppe association (Photo 2.7). This is the smallest of the naturally occurring vegetative associations, covering 70,377 acres (4%) of WUI acres. This ecological system consists of a broadly defined desert grassland, mixed shrub-succulent, or tree savannas that are typical of the borderlands of Arizona, New Mexico, and northern Mexico, but it extends west to the Sonoran Desert, north into the Mogollon Rim, and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. Diverse perennial grasses typically characterize this association. Common grass species include grama grasses*, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia,* and succulent species of *Agave,* and *Yucca*, and tall shrub/short tree species of mesquite and various oaks. Many of the historical

desert grassland and savanna areas have been converted, some to mesquite upland scrub types from woody species invasions through intensive grazing and other land uses.

Photo 2.7. Desert Grasslands Vegetation Association

Included within the total analysis area are residential and open-space community lands occurring in the developed areas of the community.

As depicted in Figures 2.2a–2.2c, the SWReGAP landcover shows that within the CWPP approximately 275,230 acres (18%) of lands evaluated for wildland fire potential are "developed," with at least 20 percent of the landcover consisting of nonpervious surfaces. However, private lands within the analysis area account for approximately 46 percent of all WUI lands. Therefore, much of the analysis area lands analyzed include private lands that are predominantly naturally landscaped. Developed, Open Space–Low Intensity lands include areas with some constructed surfaces, but mostly consist of native vegetation associations. Impervious surfaces account for less than 20 percent of total cover and most commonly include large-lot single-family housing units or multiple-acre private lands in single ownership, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. These areas most commonly include single-family housing units. Developed, Medium–High Intensity lands include areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50 to 79 percent of the total cover. These areas most commonly include single-family housing units, including highly developed areas where people reside or work in high numbers—examples include apartment complexes, and commercial/industrial areas. These lands are generally considered at low risk for wildland fire. However, the threat of fire (structural or wildland ignition) spreading from developed lands to wildlands has been considered in determining risk within the analysis area. In addition, wildland fires can ignite areas with high-density homes, and the structures themselves can then carry a fire, especially in strong winds (Rehm et al. 2002).

Several fuel hazard components, including vegetation type and density, previously burned areas, and slope and aspect, were analyzed for wildland fire potential. For example, some areas of the WUI can be heavily dissected, with some areas having slopes exceeding 20 percent that are heavily vegetated. Slopes greater than or equal to 20 percent and areas with south-, southwest-, or west-facing slopes in areas of high

wildland fuels were identified as having greater risks because of fuel-ladder fire effects and convectional preheating of vegetative fuels associated with steep terrain and decreased humidity associated with the microclimates created by southerly exposed aspects. Areas with moderate fuel hazards on slopes greater than or equal to 20 percent are considered a high fuel hazard, while the same fuel type on slopes less than 20 percent is still considered a moderate fuel hazard. During extraordinary rainfall years, when rainfall is above average during the fall, winter, and spring months, increased germination and growth of Mediterranean grass, and other invasive annual grasses and forbs, can result in more continuous fine fuel cover. The areas within the WUI that are heavily infested with invasive perennial grasses such as buffelgrass can have altered fire behavior from increased fuel loading from less than one ton per acre to over 5 tons per acre. This change in fine-fuel continuity can result in increased flame heights, faster rates of spread and increased intensity levels in desert shrub-scrub and shrubland habitats that do not normally sustain wildland fire. These areas of low-risk vegetation associations, including lower-elevation desert shrub-scrub associations in combination with “thermic semiarid soils” (Hendricks 1985 p 93), will be favored by some invasive grasses (Hauser 2008; Rogstad 2008) and will, under these extraordinary circumstances, become areas of extremely high wildfire risk.

During a normal fire season, low-risk vegetative associations will be enhanced to a moderate level by influencing effects of slope and aspect; in a similar manner, moderate-risk vegetative associations will increase to high risk from these same influencing factors. (Figures 2.3a–2.3c). Other untreated or unburned areas that fall under the category of moderate ground fuels and that do not overlap areas with steep slopes or with south, southwest, or west aspects are considered a moderate risk from fuel hazards. All other areas have a low risk from fuel hazards, including the areas that have been treated or burned within the last decade. The wildland fuel hazards component influence was compiled to depict areas of high, moderate, and low wildland fire potential based on vegetation type, density, and arrangement and to show areas with high wildfire risk and therefore of greater wildland fire risk during years of extraordinary rainfall and enhanced fire conditions creating extreme fire behavior. Visual representations of these fuel hazard components during extreme fire seasons are mapped in Figures 2.4a–2.4c. Table 2.4 identifies these various fuel hazards components and their assigned values.

Table 2,4. Fuel Hazard Components

Component	Influence[a]
Vegetation type and density	
Woodlands and timber in Fuel Models 2,3 4,6, and 9; Deciduous Riparian >100 stems/acre; or moderate fuel types in slopes ≥20%	H
Upland Shrubland associations in Fuel Models 1 and 3 and desert shrublands and grasslands 2, 3, and 6	M
Desert Scrub associations, barren land types, and agriculture and developed areas	L
Burned areas	L
Slopes ≥20%	H
Aspect (south-, southwest-, or west-facing slopes)	M

Source: Logan Simpson Design Inc.
[a] H = high, M = moderate, L = low

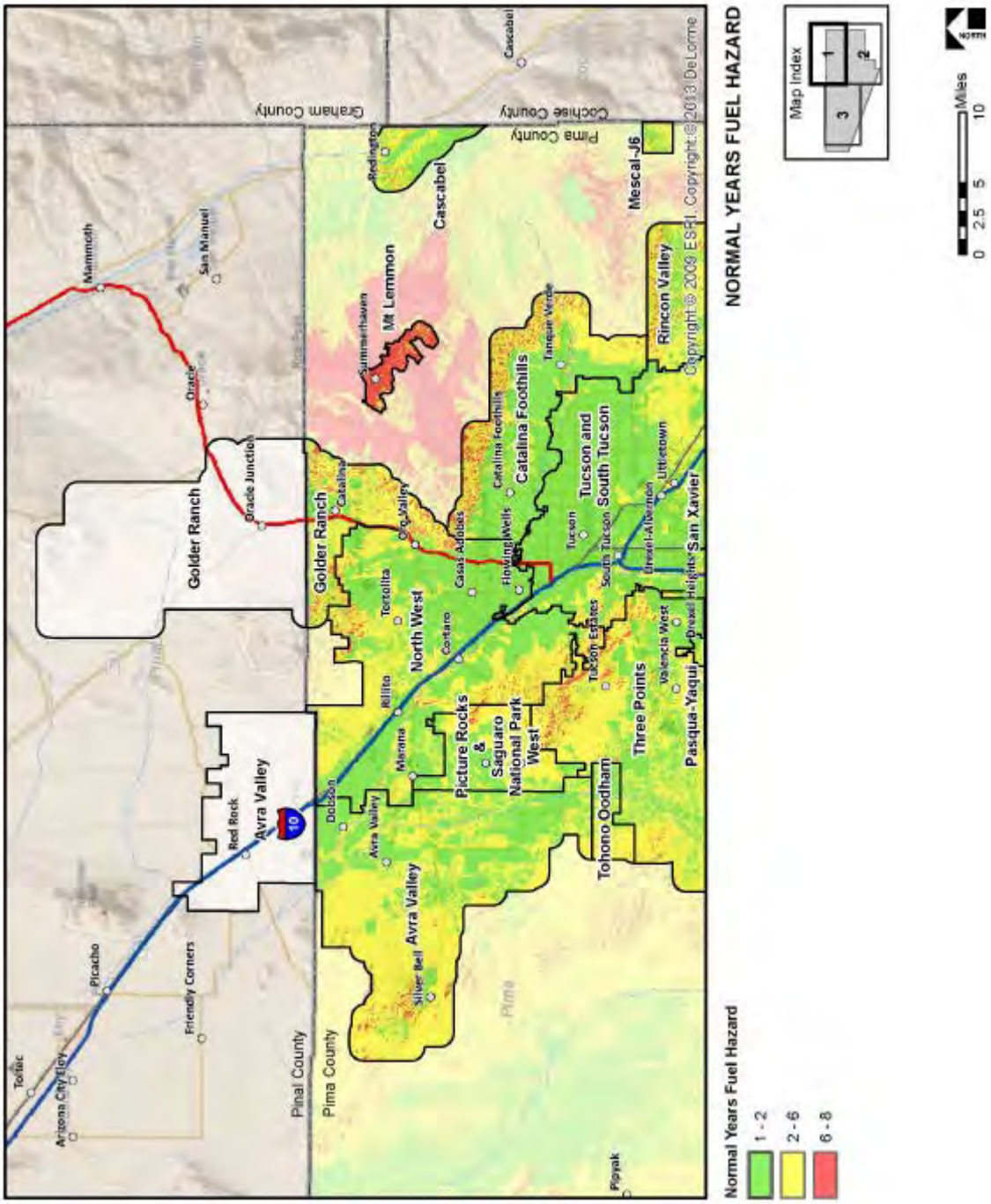

Figure 2.3a. Normal-Year Fuel Hazard of the Pima County WUI, North

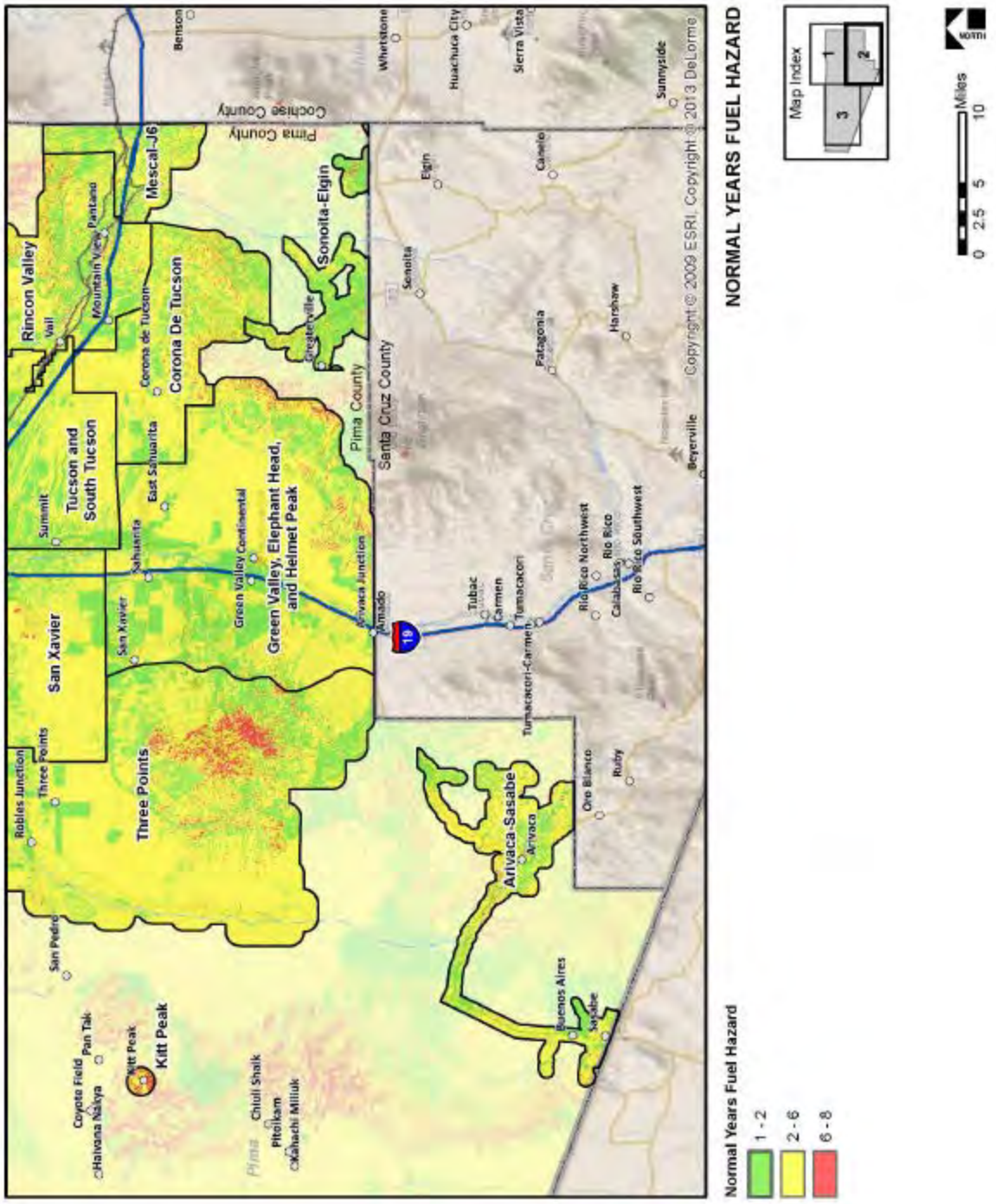

Figure 2.3b. Normal-Year Fuel Hazard of the Pima County WUI, South

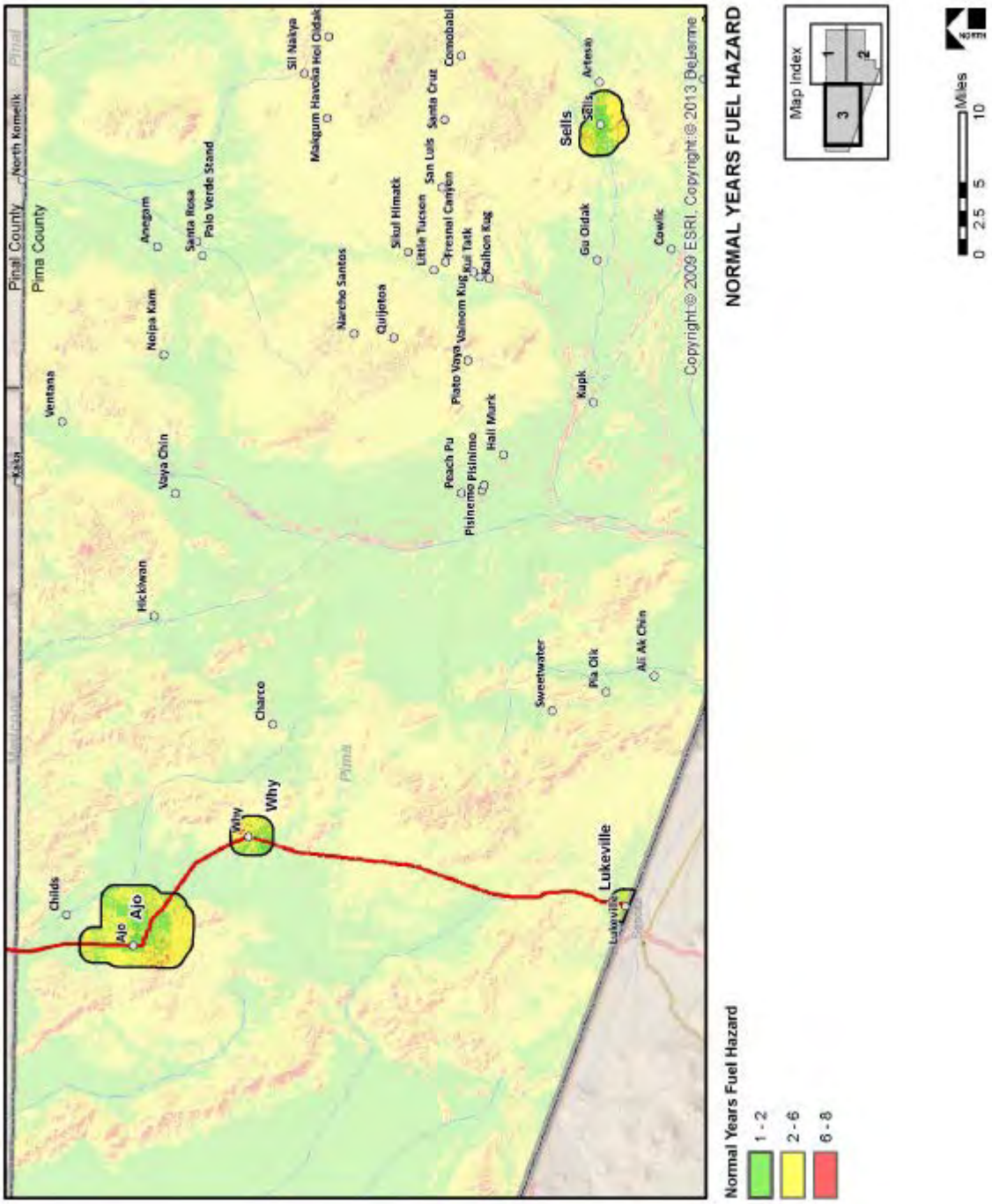

Figure 2.3c. Normal-Year Fuel Hazard of the Pima County WUI, West

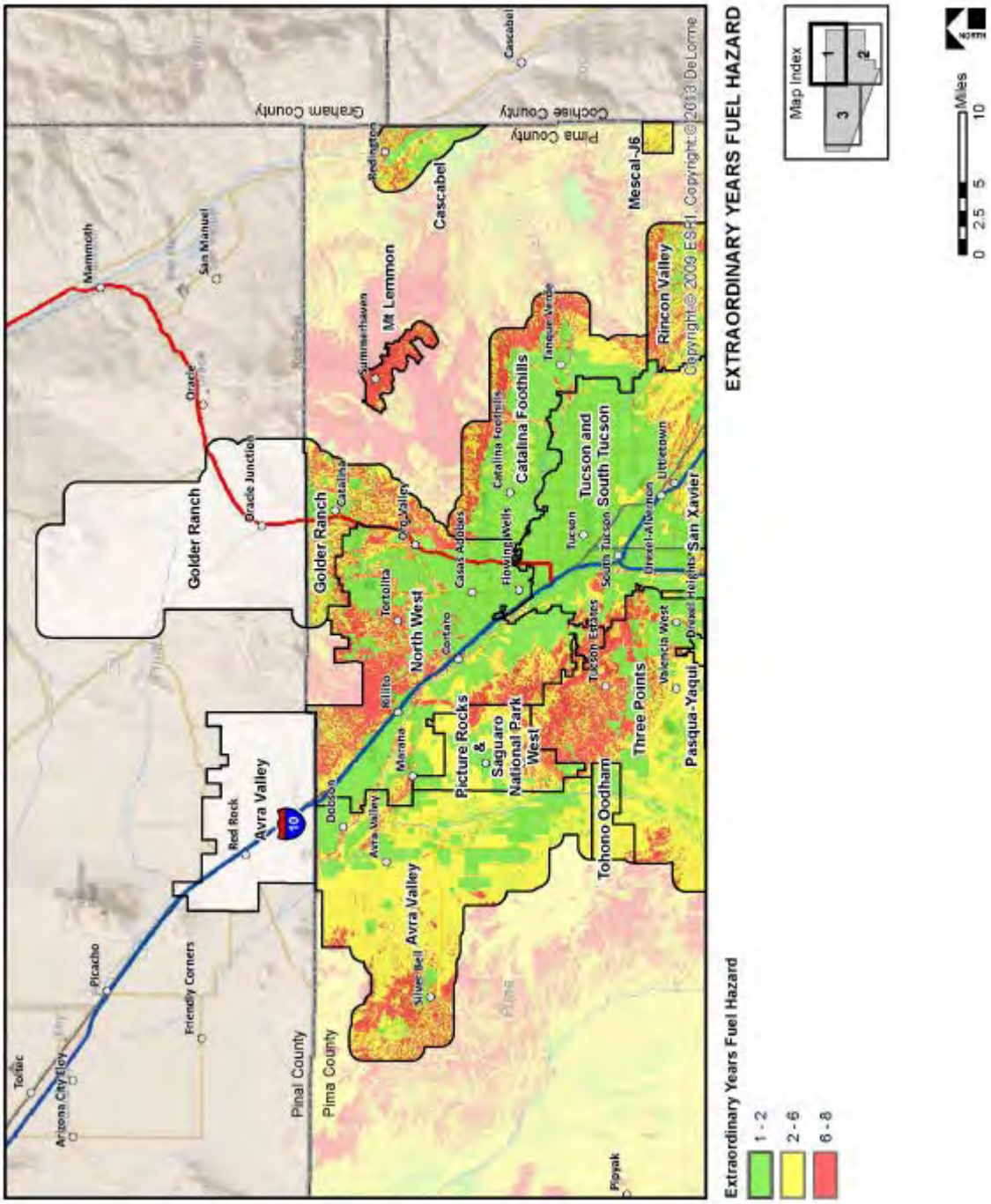

Figure 2.4a. Extraordinary-Year Fuel Hazard of the Pima County WUI, North

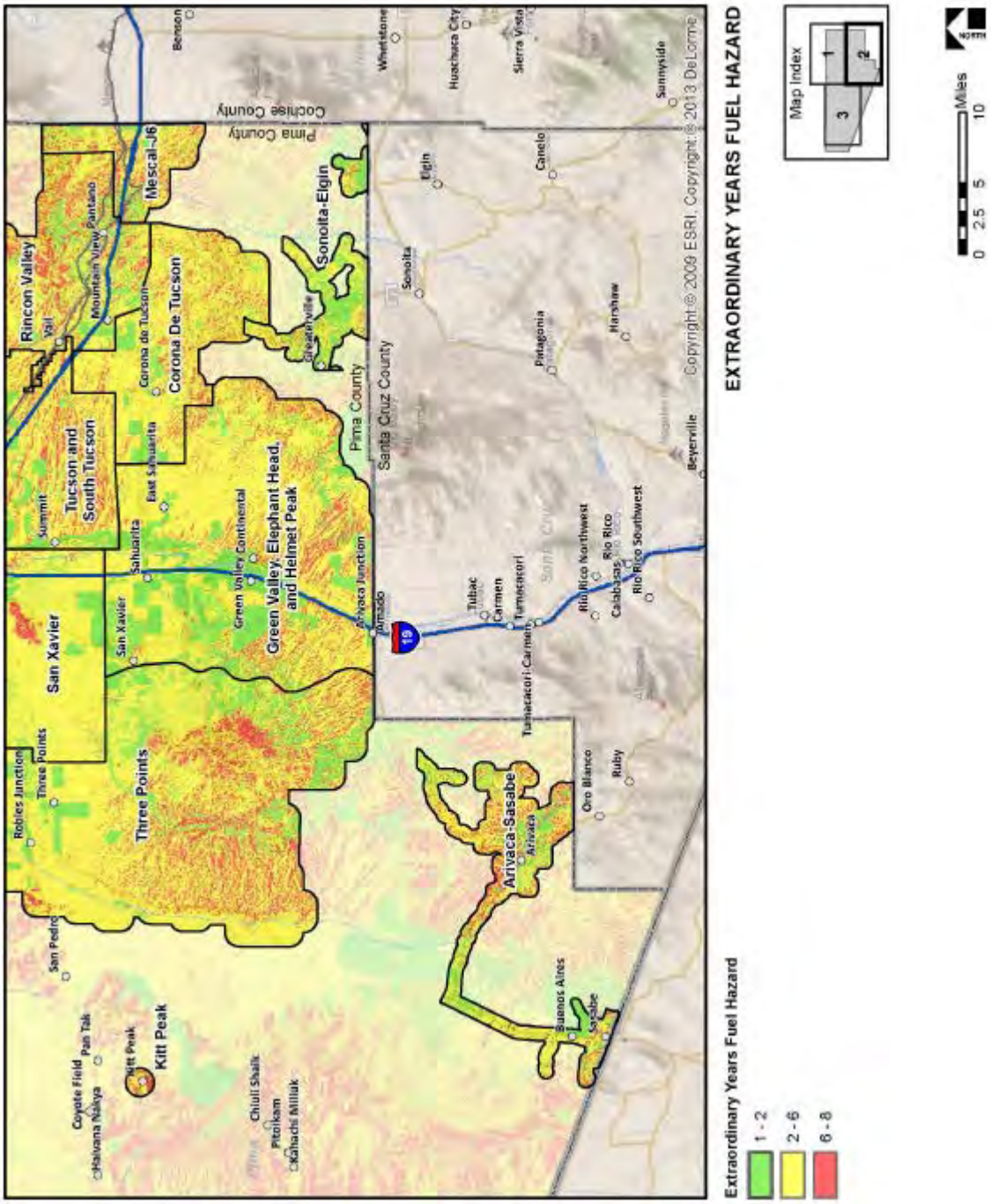

Figure 2.4b. Extraordinary-Year Fuel Hazard of the Pima County WUI, South

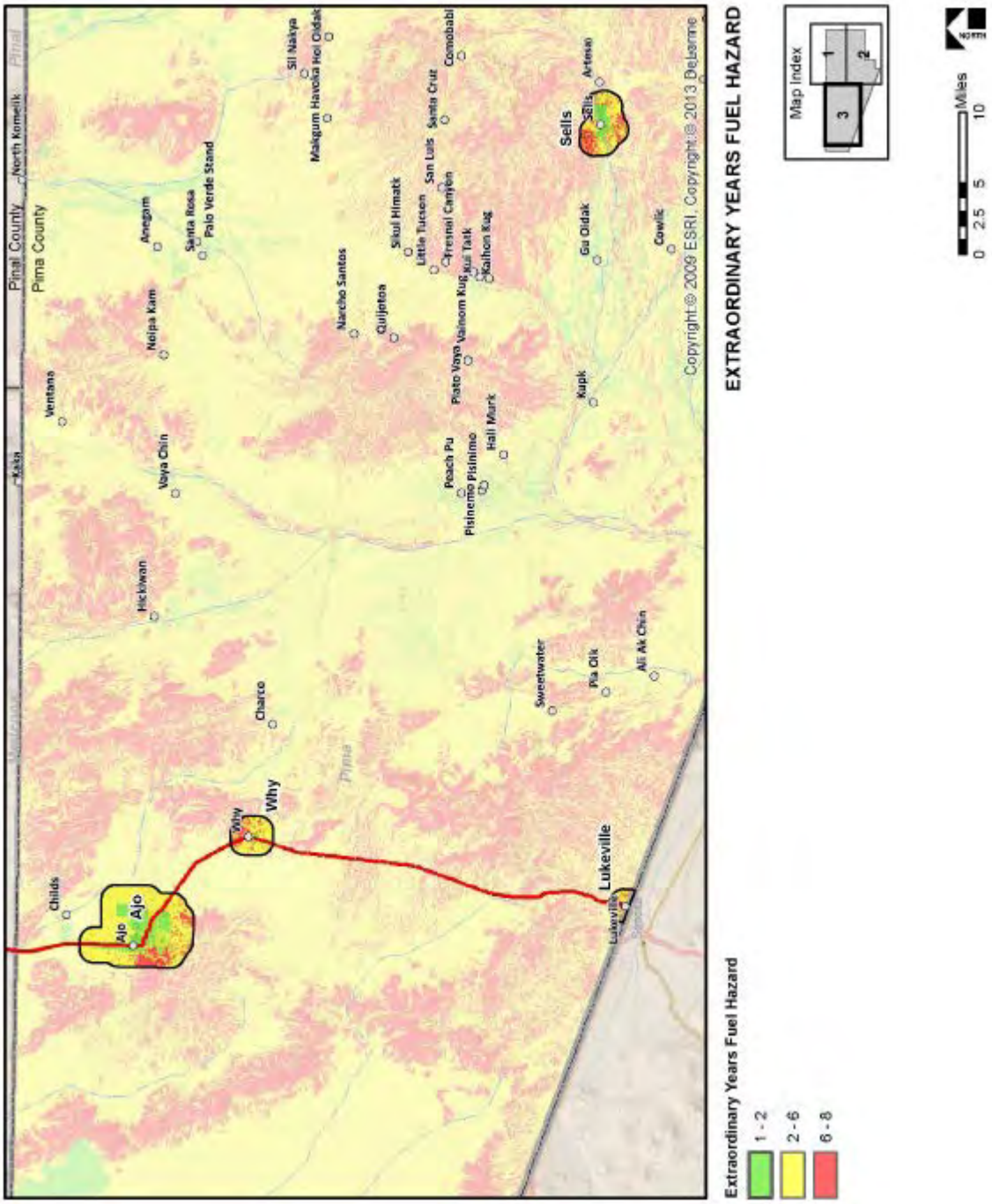

Figure 2.4c. Extraordinary-Year Fuel Hazard of the Pima County WUI, West

Riparian corridors, shrublands, and vegetation associations occurring in steep slopes with a south or southwest aspect are the greatest wildland fuel hazards within the CWPP. Saltcedar-invaded and early-seral-stage riparian habitats constitute a second major wildland fire risk vegetative association. Shrubland areas constitute the next greatest wildland fire risk, in relation to high slopes and south or southwest aspects. In invaded riparian vegetation associations where riparian deciduous tree species are located, total wildland fuels can exceed 20 tons per acre and produce flame lengths greater than 6 feet above the overstory with a rate of spread of over 525 feet (8 chains) per hour. In addition, some shrublands with heavy invasions of nonnative grasses can produce wildfires of high intensity and high rates of spread that are capable of igniting adjacent overstory vegetation. Buffelgrass infestations that comprise a 25 percent landcover will produce approximately 1 ton of fuel; at 50 percent landcover, infestations can produce up to 3 tons of fuel, and at 80 percent landcover, they can produce over 5 tons of fuel that can produce flame lengths in excess of 25 feet and rates of spread in excess of 700 chains per hour with a mid-flame wind speed of 15 mph (Grissom 2010). Buffelgrass readily invades disturbed habitats such as trails, roadways, utility easements and desert washes and also invades undisturbed desert (Photo 2.8). Areas with heavy infestations of buffelgrass will significantly alter wildland fire behavior increasing severity with high rates of spread and flame heights from native vegetation. This potentially leads to devastating fires that can convert the ecologically rich Sonoran Desert into a more monotypic exotic grassland environment. Buffelgrass fires are highly detrimental to cacti and native trees and can eliminate them from the landscape. The occurrence of fire in ecosystems that evolved in the absence of fire often can lead to species loss and future restructuring of plant and animal interactions, favoring fire-adapted exotic species over natives (Hobbs and Huenneke 1992). Such wildfires do not significantly impact the buffelgrass stands which can come back more vigorously than before the fire (Cox et al. 1990). Areas of known buffelgrass invasions in 2009 for the Tucson basin are shown in Figure 2.5 (SABCC 2010). As additional investigations into buffelgrass invasions are completed, areas of buffelgrass infestations where landcover is 50 percent or higher should be defaulted to high wildland fire risk.

Photo 2.8. Roadway with Heavy Buffelgrass Infestation

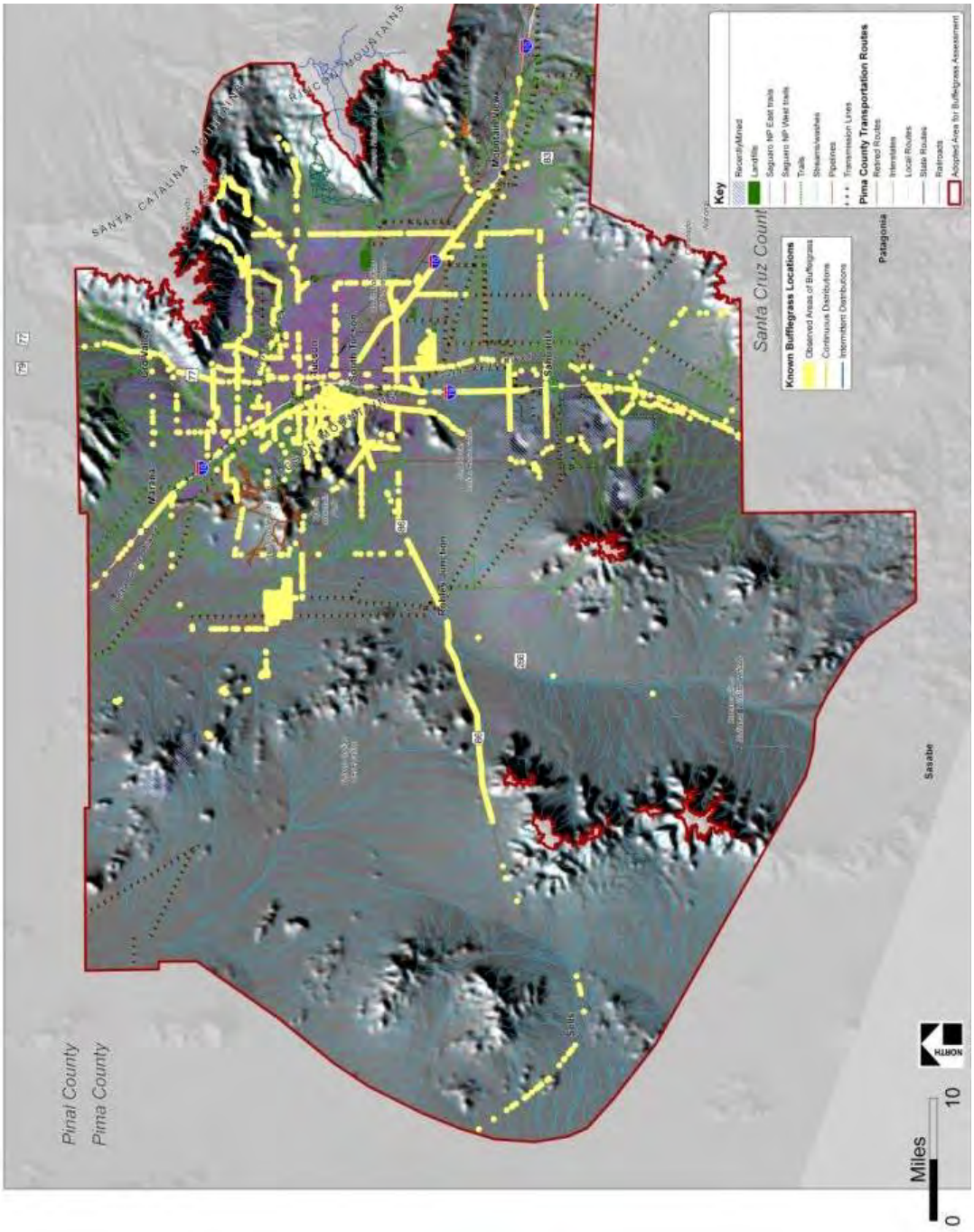

Figure 2.5. Areas of Known Buffelgrass Invasions (2009) in the Tucson Basin

Moderate wildland fuel risk is associated with the ecotone of the riparian and desert upland vegetation associations. In areas where shrub canopy exceeds 35 percent, light fuels produced by the herbaceous understory are reduced because of overstory shading and competition from overstory shrub species. Under extreme fire conditions, upland shrub communities can carry crown fires with moderate intensities and high rates of spread. Lower wildland fire risk occurs in desert scrub communities in which total fuel loading is low with no continuous arrangement of ground or aerial fuels. Desert upland vegetation associations are not fire-dependent communities, and wildfires within desert vegetation associations will be suppressed during years of above-normal rainfall when wildfires occurring in these vegetative associations may not self-extinguish.

C. Conditions of Ignition and Past Fire Occurrence

Past regional wildfire events are important for determining the potential of an area to support wildland fire. Because of the combination of current drought conditions and a regional history of fires, there will be wildland fire ignitions within the CWPP planning area that must be suppressed. The fire history of the CWPP, including recent large wildfires that have occurred within or close to the analysis area, has been included in this analysis to determine the most likely areas for either natural or human wildland fire ignition. Table 2.5 details the high, moderate, and low positive-influence values assigned to fire-start incidents. These include concentrated areas of lightning strikes and human-caused ignitions. High-potential areas have the greatest number of fire starts per square mile. Wildland fire ignition data is obtained from the Federal Wildland Fire Occurrence Internet Mapping Service (IMS) Web site and database (http://wildfire.cr.usgs.gov/firehistory/) and from the Arizona State Forester's Office. The Federal Fire Occurrence IMS is an interactive GIS for use in the wildland fire and GIS community. The datasets used in this GIS are based on official fire occurrence data collected from five federal and state agencies that have been merged into one fire history point layer. According to these data, 3,226 wildfire ignitions have been reported within the analysis area since 1980. There were nine large fires which burned approximately 137,000 acres in the 6-year period of 2002 through 2007. The areas with the greatest potential for fire ignition, either from natural or human (though unplanned) causes, are found within the communities of Sells and Summerhaven and along the eastern edge of Pima County. Visual representations of these large wildfire and ignition-point locations are mapped in Figures 2.6a–2.6c.

Table 2.5. Ignition History and Wildfire Occurrence

Wildfire Occurrence	Value	Sum of Acres
0–2 fire starts/square mile	L	1,377,947
2–4 fire starts/ square mile	M	174,781
>4 fire starts/square mile	H	26,964

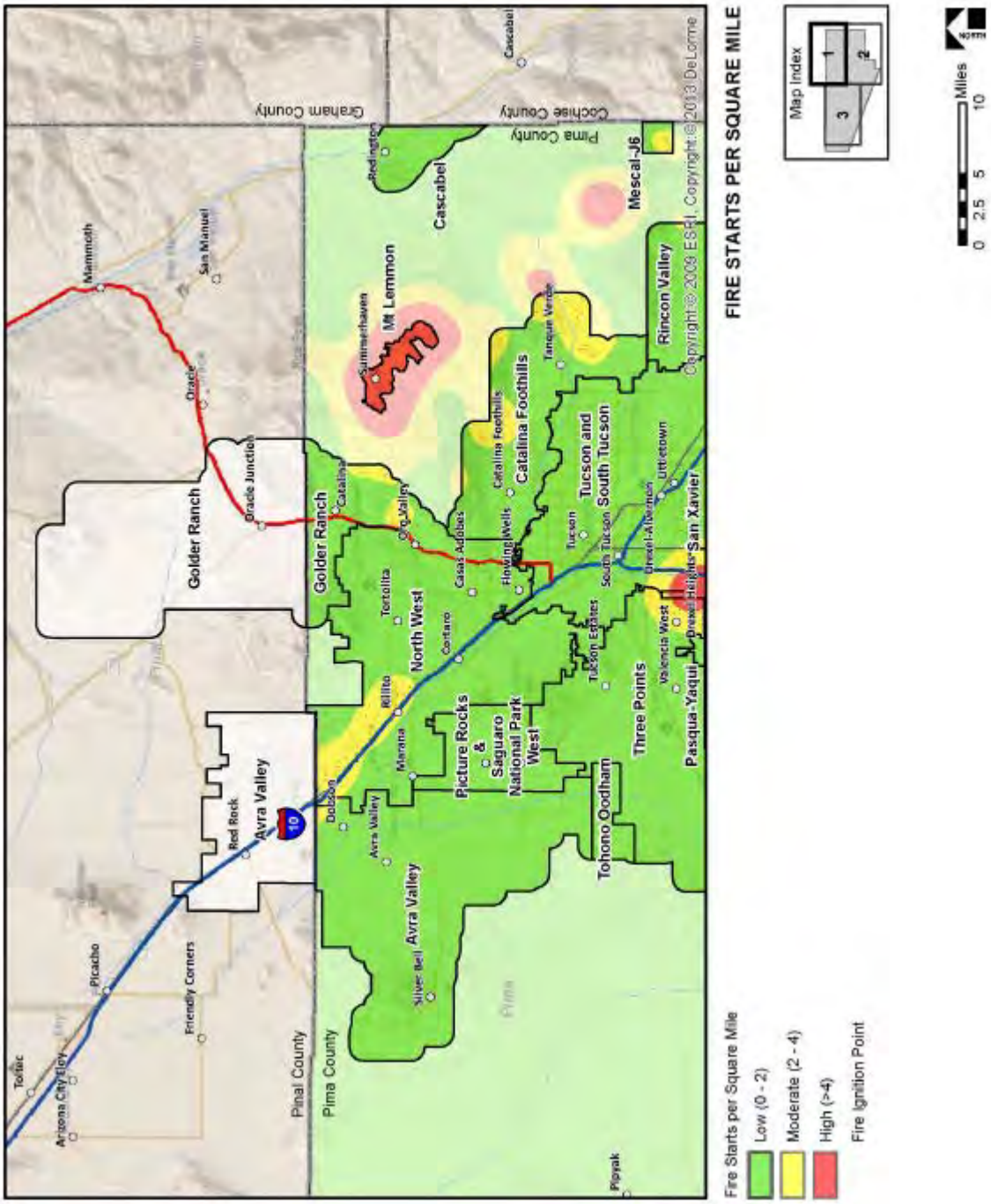

Figure 2.6a. Wildland Fire Ignition History, North (http://wildfire.cr.usgs.gov/firehistory and ASFD 2009)

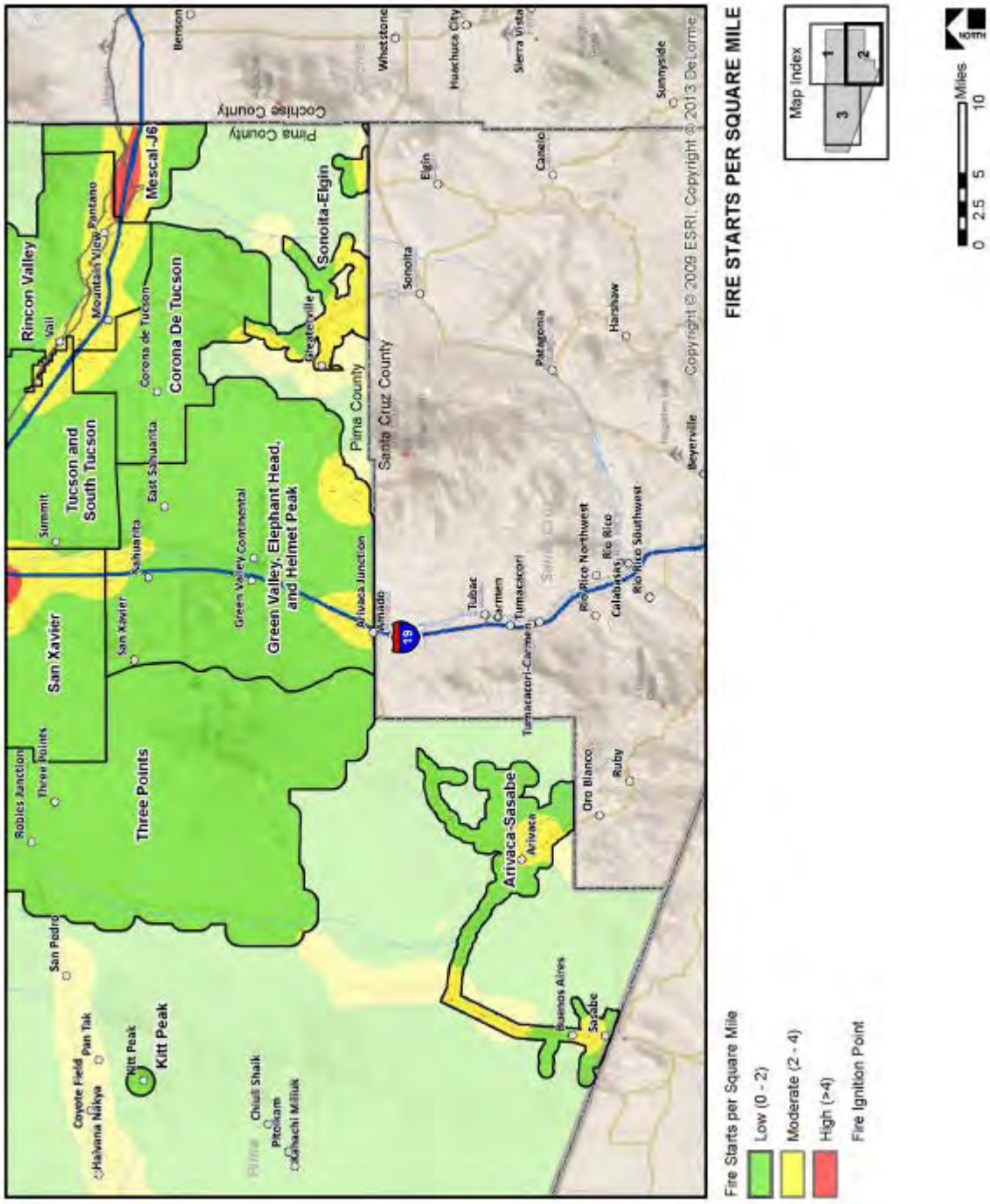

Figure 2.6b. Wildland Fire Ignition History, South (http://wildfire.cr.usgs.gov/firehistory and ASFD 2009)

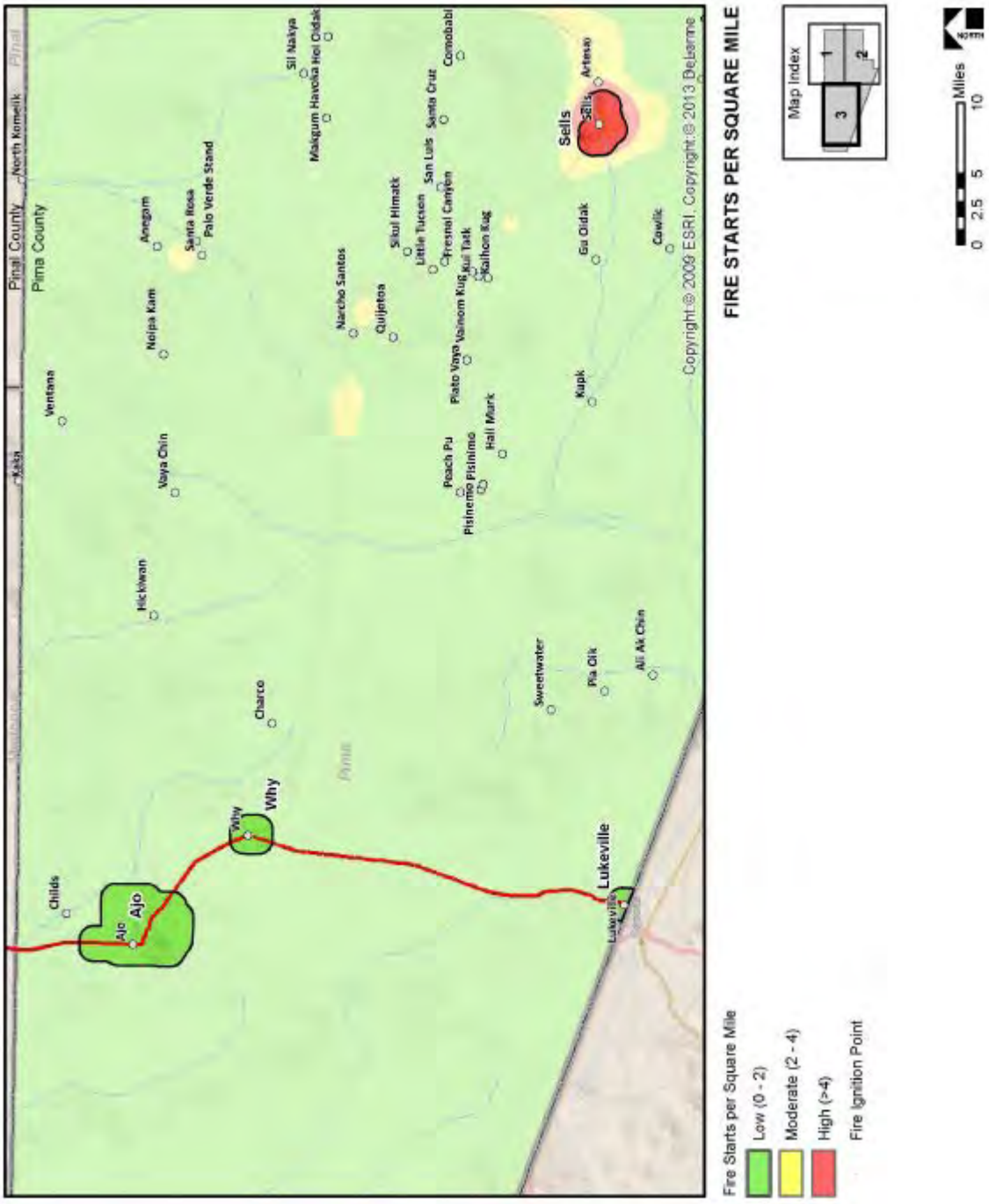

Figure 2.6c. Wildland Fire Ignition History, West (http://wildfire.cr.usgs.gov/firehistory and ASFD 2009)

D. Community Values at Risk

Valued at-risk community resources include private and community structures, communication facilities, power lines, local recreation areas, cultural and historic areas, sensitive wildlife habitat, watersheds, natural resources, and air quality. The community values were determined based on the sum of five components: housing density, Insurance Services Office (ISO) ranks, vacant lands, preserve lands, and sensitive species habitats as derived from Pima County Map Guide data (http://gis.pima.gov/maps/mapguide/). High community values include areas where more than three of these influencing factors occur collectively on the landscape. Areas where at least one but less than three of these factors occur on the landscape were assigned moderate values, and areas where these factor do not appear on the landscape were not assigned values.

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. These areas of cumulative risk are of greatest concern to Pima County. In accordance with "Risk Factor 2: Risk to Social, Cultural and Community Resources" identified by the Arizona State Forester (2007:2), the Pima County analysis area does include lands consistent with Risk Factor 2, Situations 1, 2, and 3, as follows:

> Risk Factor 2: Risk to Social, Cultural and Community Resources
>
> Situation 1: This situation most closely represents a community in an urban interface setting. The setting contains a high density of homes, businesses, and other facilities that continue across the interface. There is a lack of defensible space where personnel can safely work to provide protection. The community watershed for municipal water is at high risk of being burned to other watersheds within the geographic region. There is a high potential for economic loss to the community and likely loss of housing units and/or businesses. There are unique cultural, historical or natural heritage values at risk.
>
> Situation 2: This situation represents an intermix or occluded setting, with scattered areas of high-density homes, summer homes, youth camps, or campgrounds that are less than a mile apart. Efforts to create defensible space or otherwise improve the fire-resistance of a landscape are intermittent. This situation would cover the presence of lands at risk that are described under state designations such as impaired watersheds or scenic byways. There is a risk of erosion or flooding in the community of vegetation burns.
>
> Situation 3: This situation represents a generally occluded setting characterized by dispersed single homes and other structures that are more than a mile apart. This situation may also include areas where efforts to create a more fire-resistant landscape have been implemented on a large scale throughout a community or surrounding watershed.

1. Housing, Businesses, Essential Infrastructure, and Evacuation Routes

The analysis identifies high-risk areas—including the major community cores and portions of I-10, I-19, US 60, State Route (SR) 77, SR 86, SR 83, SR 85, and SR 286,—as the focus of commercial

development. Residential community development is occurring throughout the analysis area in a mix of high-density, single-family, and multi-acre parcels. Parcel data developed by Pima County was reviewed to determine the distribution of private lands and lands uses within the analysis area. These data were then portioned into risk categories depending on the level of development and presence of natural landcover types. This includes areas of highly developed lands that lack significant open space or natural landcovers; moderately developed private lands where an intermingling of public and private lands occur and the major portion of the landscape comprise natural landcover types; and lightly developed private lands where the majority of landcover is composed of natural landcover. Areas of highest development were considered at moderate risk of wildfire, areas of moderate development are considered at high risk of wildfire, and areas of light or no development are considered at low risk of structure/infrastructure loss due to wildfire. Therefore, structures associated with housing and commercial development located in isolated subdivisions and in more dispersed areas of the analysis area with higher ISO ratings are at highest risk.

2. Preserve and Sensitive Lands

Recreational features within and adjacent to the analysis area—including camping and recreation areas associated with several regional parks; designated camping and recreation areas in Saguaro National Park, on the CNF, and on BLM-managed public lands; wildlife areas; and major FS trailheads—are located throughout Pima County. These parks and recreational areas provide scenic vistas of deep canyons, dry washes, sheer cliffs, distant mountain ranges, colorful soils and rock formations, and mosaics of different vegetation, particularly of the iconic saguaro cactus.

These features are environmental, economic, and aesthetic resources for the surrounding communities and provide year-round recreational opportunities. Because of the benefits that these recreation areas provide to local citizens and community visitors and the potential for increased human-caused wildfire ignitions with increased recreational use, these areas have been analyzed as community values and have an increasing influence factor on wildland fire risk.

The analysis area also includes known and potential habitat areas for several threatened, endangered, and sensitive species and lands acquired by the City of Tucson and Pima County in support of their proposed habitat conservations plans currently under review by the USFWS. The land-management agencies use accepted conservation strategies to mitigate risk to these species by implementing programs that meet natural resource management goals and objectives and to maintain conservation values. Wildland fuel and vegetative restoration treatments within sensitive species habitat may require additional site-specific analysis due to the extraordinary circumstances created by the presence of sensitive species or their habitats. Before any vegetation treatment by the NPS, BLM, or CNF, an assessment will be conducted by the appropriate agency biologist. Site-specific evaluations of individual recommended wildland fuel mitigation projects will determine whether sensitive wildlife species and habitats would benefit from habitat-enhancing treatments that would lessen the threat of catastrophic wildland fire in the vegetative communities of the analysis area while also protecting the recreational values that local residents and visitors associate with the community. The presence of sensitive wildlife and botanical species habitats, in conjunction with areas of high recreational value and human use, have an increasing influence factor on wildland fire risk.

3. Local Preparedness and Protection Capability

For many years, the ISO has conducted assessments and rated communities on the basis of available fire protection. The rating process grades each community's fire protection on a scale from 1 to 10 (1 is ideal and 10 is poor) based on the ISO's Fire Suppression Rating Schedule. Five factors make up the ISO fire rating: water supply—the most important factor—accounts for 40 percent of the total rating, while type and availability of equipment, personnel, ongoing training, and the community's alarm and paging system account for the remaining 60 percent of the rating. Some areas within the Pima County analysis area are not within a fire district; the ISO rating for these areas is 10. Other communities and municipalities within the analysis area are within a fire department or district and have ISO ratings ranging from 1 to 9; these areas are included in the overall risk analysis as reducing the potential of catastrophic wildland fire. ISO ratings will vary within each fire department's or district's service area, depending on housing densities and distance of structures isolated (usually 3 to 5 miles) from a fire station.

The wildland and structural fire response within the analysis area is provided by local fire departments and districts. BLM, CNF, ASFD, BANWR, Tohono O'odham, Pascua Yaqui, and local fire departments and districts provide support for initial wildland fire attack for areas within the Pima County analysis area. Initial-attack response from additional local fire departments and districts can occur under the authority of automatic-aid system and mutual-aid agreements between individual departments or under the intergovernmental agreements (IGAs) that individual fire departments and districts have with the Arizona State Forester and adjacent fire departments and districts.

Land use in the planning area consists primarily of residences; military ranges and airfields; agriculture; livestock production; community businesses; and community services, such as hospitals, schools, organized-sports facilities, and airports. Surrounding areas are dominated by state lands; NPS, BLM, and CNF lands; and private properties. Land uses within or close to the analysis area include fuelwood cutting, hunting, and other recreational activities (for example, hiking, bird watching, nature study, photography, and off-road-vehicle use). State lands occur on the periphery of the communities and often surround developed private land parcels. State lands are administered by ASLD, are managed for a variety of uses, and account for 15 percent (861,623 acres) of the analysis area. State lands within and adjacent to the analysis area could be identified for sale for residential and commercial development or leased for commercial land development.

The primary block of federal land in the Pima County CWPP area consists of portions of BLM lands located throughout the analysis area, with NPS and CNF lands located in the northern, eastern, and southern portions of the analysis area. Pima County provides extensive outdoor recreational opportunities. The open space provided by federal lands and recreational opportunities, in association with the significant wildlife habitats found within the county, provide the quality-of-life amenities that many county residents desire to protect and enhance.

Table 2.6 identifies the different values given to these community value components. Visual representations of these community value components are mapped in Figures 2.7a–2.7c.

Table 2.6. Community Values

Component	Value[a]	WUI Acres (% of WUI)
Recreation areas and infrastructure in the analysis area ≥500 and <1,000 households/square mile	H	289,526 (18)
Housing and business structures and infrastructure in the analysis area ≥1,000 households/square mile	M	859,858 (54)
All other areas	L	430,162 (27)

Source: Logan Simpson Design Inc.

[a]H = high; M = moderate; L = low

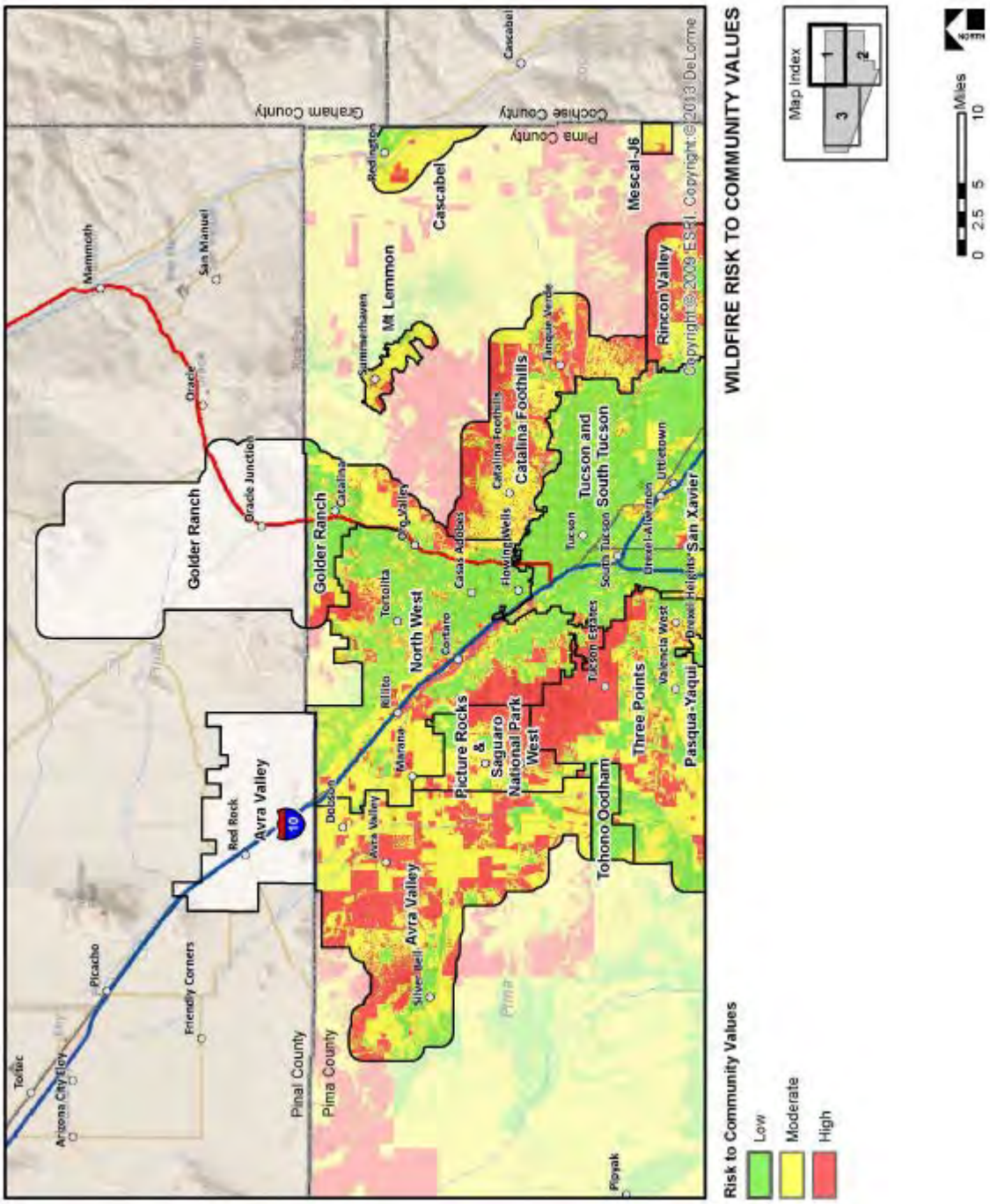

Figure 2.7a. Wildfire Risk to Community Values, North

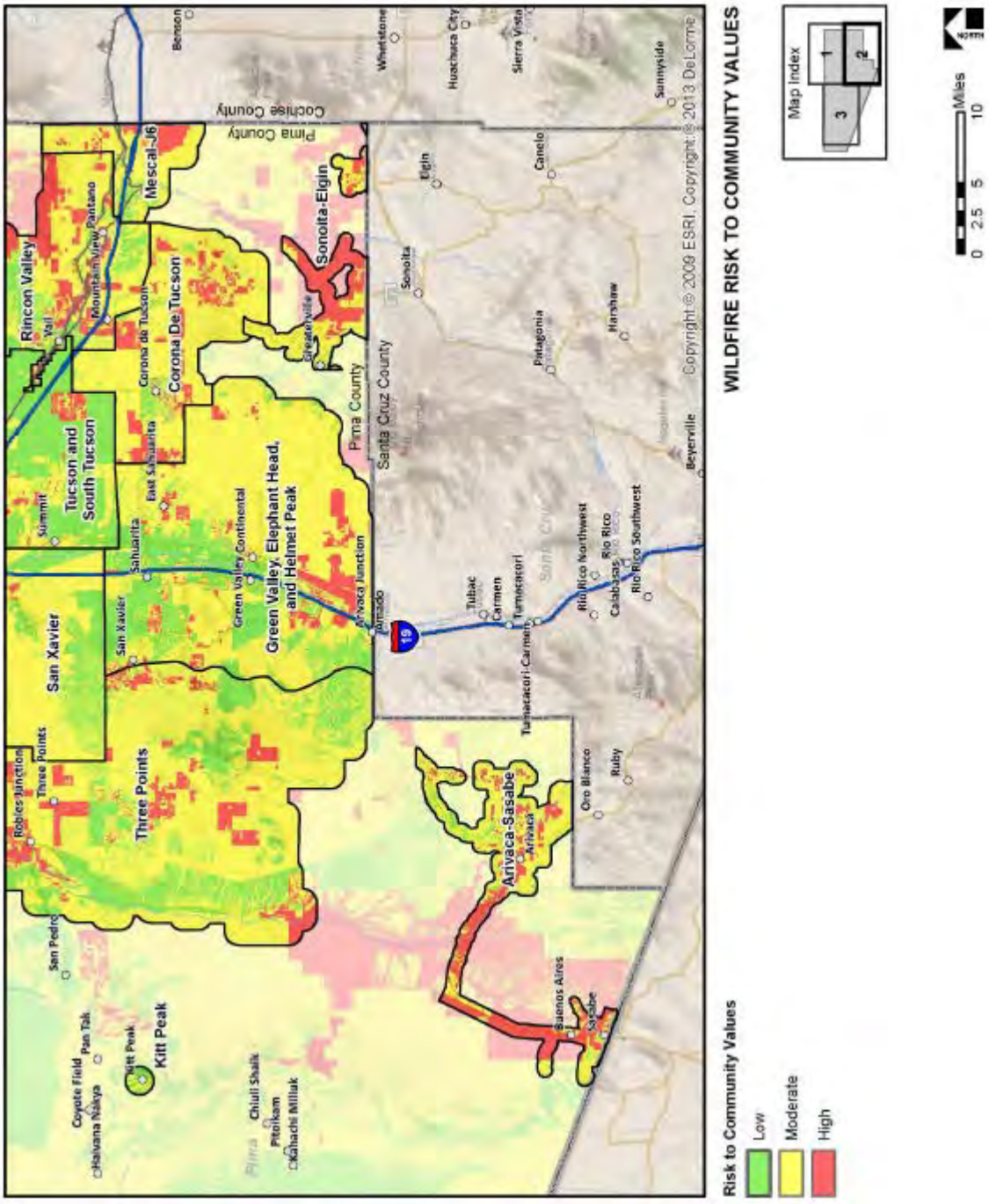

Figure 2.7b. Wildfire Risk to Community Values, South

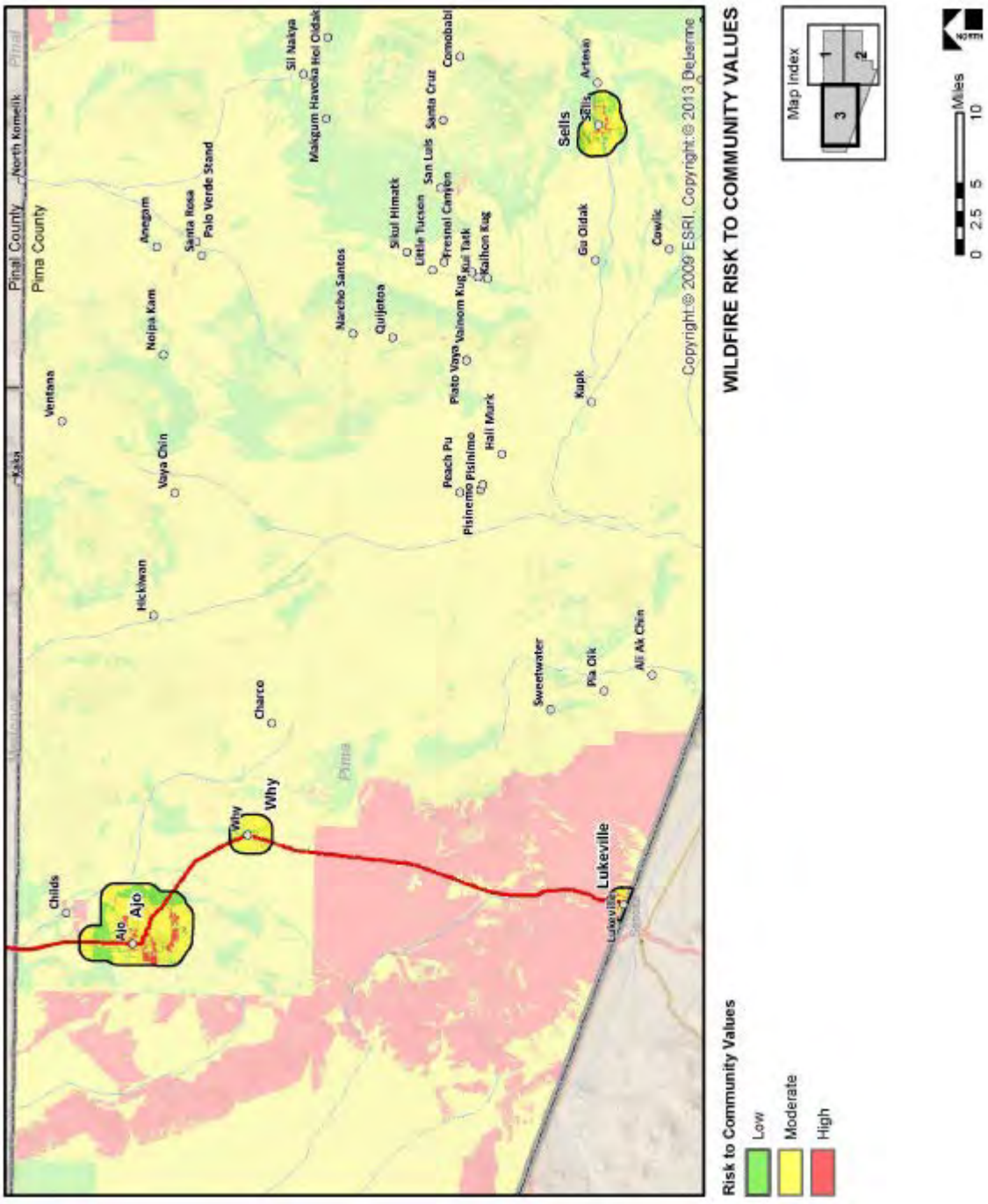

Figure 2.7c. Wildfire Risk to Community Values, West

E. Summary of Community Assessment and Cumulative Risk Analysis

Pima County and local jurisdictions recognize the consequences of disasters and the need to reduce the impacts of natural and human-caused hazards. The County and jurisdictions also know that with careful selection, mitigation actions in the form of projects and programs can become long-term, cost-effective means for reducing the impact of natural and human-caused hazards.

In addition, largely unincorporated areas of the analysis area that are not under the jurisdiction of a fire department or fire district and that may or may not be serviced by individual fire protection are included with the nearest community sub-analysis area and potential wildland fire risk rating.

Community WUI Descriptions and Risk Rating

Arivaca Community WUI

The Arivaca Community WUI is composed of lands within and immediately adjacent to the Arivaca Fire District boundary, the community of Sasabe, lands immediately adjacent to SR 286, Arivaca Road, and Ruby Road that serve as emergency evacuation and fire response corridors. In 2007 the PCOEM and the Arivaca Fire District completed the *Arivaca-Sasabe Community Wildfire Protection Plan*. The Arivaca Fire District provides structural and wildland fire protection to the community, while the BANWR provides wildland fire protection to the community of Sasabe through an agreement with the ASLD. The 2007 Arivaca-Sasabe CWPP analyzed 50,752 acres for wildfire risk. The BANWR is a signatory to the Arivaca Sasabe Community Wildlife Protection Plan and continues to support implementation of priority recommendations of the Arivaca Sasabe CWPP and those of the Pima County CWPP. The Pima County CWPP incorporates by reference the 2007 Arivaca-Sasabe CWPP. The Arivaca-Sasabe CWPP area has an estimated population in 2010 of 695 residents in Arivaca occupying 492 housing units. The 2010 population estimate for the community of Sasabe is 545 residents occupying 50 housing units. The 2010 population residing within the census tract which includes these communities is estimated at 3,600 residents in approximately 1,800 housing units. (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml/Census tract 43.16). The Arivaca Fire District has an ISO rating of 10. The Pima County CWPP estimates that 14 percent of the 2013 Arivaca Community WUI is at high risk and 71 percent is at moderate risk for unwanted wildland fire. The majority of wildfire starts around the communities of Arivaca and Sasabe have occurred within the riparian corridor of Arivaca Creek in and adjacent to the community of Arivaca. Wildland fire also occurs in the vicinity of Sasabe within the upland vegetative types primarily within the vicinity of Altar Wash and SR 286.

This Arivaca Community WUI does include areas of high risk in lower elevations and in grassland and mesquite vegetation associations during extreme rainfall years. Wildfire ignitions within the Arivaca Community WUI are low. Public use within the WUI is considered moderate in undeveloped areas and high within the BANWR. The risk to community values is considered high due to proximity of the BANWR. The WUI is mostly composed of large developed private land parcels and residential lots within the communities. The combination of low housing density on large private land parcels intermixed with invaded vegetative associations and a high ISO rating creates areas of high risk to community values. Due to areas of high wildfire risk, a low ignition history, and a relatively high density of community values, the overall wildland fire risk rating of the sub-WUI is high.

The Arivaca Fire District and CWPP cooperators are not recommending revisions to the CWPP goals and objectives or fuel mitigation and fire prevention strategies and priorities. The Pima County CWPP signatories support the priority recommendations of the Arivaca-Sasabe CWPP. The Pima County CWPP assimilates by reference the Arivaca-Sasabe CWPP and recommends reviewing that CWPP for detailed risk assessment and mitigation recommendations.

Avra Valley Community WUI

The Avra Valley Community WUI is composed of lands within the Avra Valley Fire District boundary and public and private lands immediately adjacent the fire district boundary, including portions of the community of Marana.

The primary transportation corridors in the Avra Valley Community WUI include I-10 east of the WUI; Sandario, Anway, Trico, and Sanders Roads from the south and north; and Avra Valley Road and Trico Marana Road from the east. The Union Pacific Railroad parallels I-10 traversing the Avra Valley Community WUI from east to west. These roadways include the major business corridors in the WUI. Fire protection services in the Avra Valley Community WUI are provided by the Avra Valley Fire District. The Avra Valley Fire District is capable of responding to structure fires, wildland fires, emergency medical calls, motor vehicle accidents, and hazardous material calls. The Avra Valley Community WUI has an estimated population of 12,450 residents occupying approximately 4,500 housing units (http://factfinder2.census.gov census blocks 44.19 and 44.25) over a 325-square-mile area. The fire district is composed of 3 fire stations that are staffed 365 days a year and is currently building their fourth fire station which estimated to be completed in November 2013. The Avra Valley Fire District has a current ISO rating of 5/9. Subsequent to the 2013 ISO re-rating the Avra Valley Fire District ISO rating will change to 3/8B in July 2013.

Major vegetation associations include desert wash/xeroriparian corridors, creosote bush-bursage desert scrub types with paloverde-mixed cacti desert scrub, and mesquite upland associations occurring in higher elevations of the Silver Bell, Waterman, and Roskruge mountains. The areas of highest wildfire risk are located along the foothills of the Silver Bell, Waterman, and Roskruge mountains and along the Brawley Wash xeroriparian corridor. This portion of the WUI does include areas of high risk in lower elevations during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Wildfire ignitions within the Avra Valley Community WUI are low. Public use within the WUI is considered low to moderate in undeveloped areas. The WUI is mostly composed of large developed private land parcels. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and a high ISO rating creates areas of high community value risk. The Avra Valley Community WUI analyses found that 4 percent of the WUI is at high risk and 74 percent of the WUI at moderate risk for wildland fire. Due to a moderate wildfire risk, a low ignition history, and a relatively high density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Ajo Community WUI

The Ajo Community WUI is composed of private and public lands within 1 mile of developed areas of the community of Ajo, including the Ajo Municipal Airport. The Cabeza Prieta National Wildlife Refuge is

adjacent to the Ajo Community WUI. The Organ Pipe Cactus National Monument lies south of the WUI; however, Ajo provides many services to the visitors of this national monument. The Pima County CWPP analyzed 23,957 acres within the Ajo Community WUI for the potential risk to wildland fire. The Ajo-Gibson Volunteer Fire Department provides fire protection services to the community of Ajo and to portions of western Pima County. The primary transportation corridor in the community of Ajo is SR 85 from the north and south. The SR 85 corridor is the major business corridor in the WUI. The 2010 estimated population of the Ajo census-designated place is 3,304 residents occupying 2,175 housing units.

Major vegetation associations include desert wash/xeroriparian corridors and creosote bush-bursage desert scrub types with paloverde-mixed cacti desert scrub occurring in higher elevations of the Little Ajo Mountains. The areas of highest wildfire risk are located along the foothills of the Little Ajo Mountains to the south of the community of Ajo. This portion of the WUI does include areas of high risk in lower elevations to the north and east of the community during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Wildfire ignitions within the Ajo Community WUI are low. Public use within the WUI is considered moderate due to the adjacent Cabeza Prieta National Wildlife Refuge. The WUI is mostly composed of large developed private land parcels with traditional home lots found in the community center. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and areas with a high ISO rating creates areas of high risk to community values. The Pima County CWPP analyses determined that 2 percent of the Ajo Community WUI is at high risk and 55 percent is at moderate risk for wildland fire. Due to areas of moderate to high wildfire risk, a low ignition history, and a moderate density of community values, the overall wildland fire risk rating of the Ajo Community WUI is moderate.

Cascabel Community WUI

The Cascabel Community WUI is composed of private lands along the San Pedro River riparian corridor, including the community of Cascabel and developed lands in the vicinity of Redington. In 2006 the *Cascabel Community Wildfire Protection Plan* was developed and approved by the Pima County Board of Supervisors. The 2006 Cascabel CWPP was a cooperative effort between the citizens of Cascabel, the Cascabel Fire Department, The Nature Conservancy in Arizona, Redington Natural Resources Conservation District, ASFD, BLM, and Cochise County in Arizona. The 2006 CWPP was restricted to developed lands within the San Pedro River riparian corridor within the Cascabel Fire Department boundary in Cochise County. The Pima County CWPP expands the community WUI along the San Pedro River riparian corridor into Pima County, including developed lands in the vicinity of Redington approximately 12 miles north of the community of Cascabel. The 2006 CWPP wildfire risk assessment found areas of high risk associated with invaded vegetation within the San Pedro riparian corridor. The 2006 Cascabel CWWP analyzed 16,350 acres within Cochise County for the risk of wildfire. The Pima County CWPP analyzed an additional 13,599 acres, beginning immediately north of the 2006 CWPP and extending north along the San Pedro River riparian corridor to developed lands north of the Redington area. The 2006 Cascabel CWWP found that 34 percent of the Cascabel WUI is at high risk for wildland fire. The Pima County CWPP found 3 percent of the Pima County Cascabel Community WUI to be at high risk and 51 percent to be at moderate risk for wildland fire. With the exception of the WUI boundary, revised vegetative landcover descriptions, and associated fuel models, the goals and objectives of the 2006 CWPP

are still valid; therefore, they have been included in the Pima County CWPP by reference and have been expanded to include the Cascabel Community WUI within Pima County. The primary transportation corridor in the Cascabel Community WUI is San Pedro Road, which provides access from the south through the community of Pomerene and from SR 77 through San Manuel from the north. There are no retail businesses within the WUI; the closest amenities are located in San Manuel approximately 12 miles north of Redington. The Cascabel Volunteer Fire Department provides fire protection (both structure and wildland) to the southern portion of the community WUI including Pima County and to the area immediately south of Redington. The northern portion of the community WUI is not within a fire district and is assigned an ISO rating of 10. Major vegetation associations within the Cascabel Community WUI area include the warm-desert riparian mesquite bosque and warm-desert riparian woodland and shrublands within the riparian corridor, with mesquite uplands and Sonoran paloverde-mixed cacti shrub associations occurring in adjacent uplands. The major wildfire risk within the Cascabel WUI is within the invaded areas of the San Pedro riparian corridor, though there are areas of high vegetation risk associated with upland associations during years of extraordinary rainfall. Wildfire ignitions within the Cascabel Community WUI are low. Public use within the WUI is considered moderate from off-highway-vehicle use, hiking trails, and undeveloped areas of the WUI. The WUI has an overall low community value rating. Due to the complexity of wildland fuels, limited access, intermixed recreation sites, the Cascabel Community WUI is rated at moderate risk to wildland fire.

Catalina Foothills Community WUI

The Catalina Foothills Community WUI is composed of private and public lands that are mostly north and east of the City of Tucson Fire Department boundary and southeast to about the northern border of Saguaro Park East, including the Hidden Valley, Tanque Verde, Sabino Vista Volunteer, and Tucson Country Club Estates fire districts. Actual fire services with the Catalina Foothill Community WUI, is provided under contact to the Rural Metro Fire Department. The Sabino Canyon Trail, one of the heaviest recreational use trails in the CNF, is located in the WUI, along with Saguaro National Park East bordering the WUI to the southeast. The Pima County CWPP analyzed 72,529 acres within the Catalina Foothills Community WUI for the potential risk to wildland fire. The Rural Metro Fire Department maintains eight fire stations staffed by firefighters and emergency medical personnel. Rural Metro Fire Department is the sole fire protection agency for the Catalina Foothills, including the fire districts of Mountain Vista, Hidden Valley, Sabino Vista, Tanque Verde, and Tucson Country Club Estates. The Rural Metro Fire Department maintains three fire stations and an administrative office within the Catalina Foot hills Community WUI. Unlike fire-district residents who pay for their fire protection services through property taxes, residents, business owners, and property owners in the unincorporated areas of Pima County are responsible for setting up an account directly with Rural Metro. This means that fire protection and emergency services are not paid for through taxes and that residents are responsible for establishing fire service directly with Rural Metro Fire Department. The fire department maintains an ISO rating of 4 in the Sabino Vista Fire District, a rating of 3 in the Tucson Country Club Estates Fire District, and a rating of 3 in the Mountain Vista Fire District. The Tanque Verde Fire District has not yet been rated.

The primary transportation corridors in the WUI communities are River Road, an east-west corridor at the southern end of the WUI, and Skyline/Sunrise Road, an east-west corridor in the central portion of the WUI.

Sunrise/Skyline and River road corridors are the major business corridors in the WUI. The 2010 estimated population for the Catalina Foothills Community WUI includes 22 census tracts with a total estimated population of approximately 75,000 residents occupying approximately 36,000 housing units. The Catalina Foothills Community WUI analysis area includes approximately 115 square miles.

Major vegetation associations include desert wash/xeroriparian corridors and paloverde-mixed cacti desert scrub in lower elevations, with desert oak transition associations occurring in higher elevations toward the foothills of the Santa Catalina Mountains. The areas of highest wildfire risk are located along the numerous desert washes originating from the foothills of the Santa Catalina and terminating at Tanque Verde and Rillito creeks. The northern portion of the WUI does include areas of high risk in the foothills of the Santa Catalina Mountains due to heavy fuel loads, invasive grasses, and winter annuals occurring in areas of steep slopes. Wildfire ignitions within the Catalina Foothills Community WUI are moderate to low, with high wildfire ignitions occurring above the WUI. Public use within the WUI is considered high due to the high use of Sabino Canyon and other community and CNF trails in the WUI. The WUI is mostly composed of large developed private land parcels of high assessed value. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and some areas with a high ISO rating and some with moderate wildfire ignition history creates areas of high risk to community values. The Pima County CWPP analyses determined that 22 percent of the Catalina Foothills Community WUI is at high risk and 47 percent is at moderate risk for wildland fire. Due to areas of high wildfire risk, a moderate ignition history, and a high density of community values, the overall wildland fire risk rating of the Catalina Foothills Community WUI Community WUI is high.

Corona de Tucson Community WUI

The Corona de Tucson Community WUI is composed of lands within the Corona de Tucson Fire District boundary and public and private lands immediately adjacent the fire district boundary. The Corona de Tucson Community WUI lies immediately north of the Santa Rita Mountains within the CNF and adjacent to the north boundary of the Santa Rita Experimental Range managed by the University of Arizona. The primary transportation corridors in the Corona de Tucson Community WUI are Houghton Road connecting to I-10 to the north and Sahuarita Road connecting to SR 83 to the east and to I-19 to the west. The major retail businesses within the WUI are located at or near the intersection of Houghton and Sahuarita roads. Fire protection services in the Corona De Tucson Community WUI are provided by the Corona De Tucson Fire Department. The Corona De Tucson Fire Department was established approximately 35 years ago and provides 24-hour, 7-day staffing with employees who have advanced-life-support training and employees who have Firefighter II certification from the Arizona state fire marshal. The Corona De Tucson Fire Department provides a wide range of services, from fire protection, emergency medical services, desert pest removal, vehicle/home lock-out, child car-seat installation assistance, CPR training, wildland firefighting, residential sprinkler program services, and many others. The Corona De Tucson Fire Department is supported by the taxpayers of Corona De Tucson, Arizona. Fire protection service is provided when available to the nearby un-incorporated areas of Vail, Arizona, for a fee and/or subscription.

The 2010 estimated population of the Corona de Tucson census-designated place is 5,675 residents occupying 2,165 housing units. The Pima County CWPP analyzed 125 square miles as the Corona de Tucson Community WUI. The 2010 census block for the Corona de Tucson Community WUI analyzed for

the Pima County CWPP is composed of 8,521 residents occupying 3,307 housing units. The Corona de Tucson Fire District has an ISO rating of 5 in proximity to the Fire Stations 180 and 182. Outlying areas of the district have an ISO rating of 8.

Major vegetation associations include desert wash/xeroriparian corridors, semi-desert grassland, mesquite uplands, paloverde-mixed cacti desert scrub, and mid-elevation desert shrub associations occurring in higher elevations of the foothills of the Santa Rita Mountains. The areas of highest wildfire risk are located along the foothills of the Santa Rita Mountains and within the numerous xeroriparian areas flowing to the northwest and terminating in the Santa Cruz River. This portion of the WUI does include areas of high risk in lower elevations during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, Lehmann lovegrass, and buffelgrass. Wildfire ignitions within the Corona de Tucson Community WUI are generally low, though high ignition history is present immediately north of the WUI along the I-10 corridor. Public use within the WUI is considered low in undeveloped areas. The WUI is mostly composed of large developed private land parcels with more traditional home lots present in the community core. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and some areas of low ignition history and some with a high ISO rating creates areas of moderate risk to community values. The Pima County CWPP analyses determined that 3 percent of the Corona de Tucson Community WUI is at high risk and 87 percent is at moderate risk for wildland fire. Due to areas of moderate wildfire risk, a low ignition history, and a relatively low density of community values, the overall wildland fire risk rating of the Corona de Tucson Community WUI is moderate.

Green Valley-Elephant Head-Helmet Peak Community WUI

The Green Valley-Elephant Head-Helmet Peak Community WUI is composed of private and public lands within and adjacent to the Green Valley, Elephant Head, and Helmet Peak fire districts, located mostly south of the city of Tucson generally adjacent to the I-19 corridor including the communities of Sahuarita, and Green Valley, and south along I-19 to Arivaca junction. The Helmet Peak Fire Department provides fire protective services to developed lands immediately south of the San Xavier Indian Reservation. Fire services within the Green Valley-Elephant Head-Helmet Peak Community WUI are provided by the Green Valley-Elephant Head-Helmet Peak Fire Departments. The 2010 population of Green Valley is estimated to be 21,391 residents occupying 17,322 housing units. The estimated population of the Helmet Peak area from the 2010 census (census block 43.27) is 4,815 residents occupying 2,446 housing units. The 2010 population of Sahuarita is estimated to be 25,259 residents occupying 10,615 housing units. The 2010 population estimate of the Arivaca junction area is 1,090 residents occupying 388 housing units (http://factfinder2.census.gov/, accessed March 2013). The Green Valley Fire Department was established in 1975, and provides fire protection and emergency services to more than 40,000 constituents residing in a 40-square-mile area within Green Valley and portions of the town of Sahuarita. The Green Valley Fire Department operates out of 4 stations, covering both residential and commercial areas, and maintains an ISO rating of 4 and 6. The Helmet Peak Fire Department covers about 35 square miles in the area of South Mission and Helmet Peak roads, east of I-19 and south of the San Xavier Indian Reservation. The Helmet Peak Fire Department maintains 30 members and answers about 130 calls per year, mainly brush fires and emergency services. The Helmet Peak Fire Department portion of the WUI is considered to have an ISO

rating of 10. The Elephant Head Fire Department was established in 1994 and provides fire protection services to approximately 5,800 residents in the Arivaca Junction, Lakewood, Half-way Trailer Park, and Elephant Head communities. The Elephant Head Fire Department has 33 volunteers serving in various roles with 14 firefighters trained in structure fires, 10 emergency medical technicians (EMTs), 5 first responders trained in basic life-saving techniques, and 7 support personnel who are board members. The Elephant Head Fire Department volunteers respond to an average of about 350 calls per year, including structure fires, brush fires, vehicle fires, and medical emergencies. The Elephant Head portion of the WUI is considered to have an ISO rating of 10. The Pima County CWPP analyzed 208,440 acres within the Green Valley-Elephant Head-Helmet Peak Community WUI for the potential risk to wildland fire.

The primary transportation corridors in the WUI communities are I-19 and South Mission Road, providing a north-south corridor, and Sahuarita Road, providing access from the east. The I-19 and Sahuarita Road corridors are the major business corridors in the WUI.

Major vegetation associations include desert wash/xeroriparian corridors, creosotebush-white bursage desert scrub, and paloverde-mixed cacti desert scrub in lower elevations, with desert juniper transition associations occurring in higher elevations toward the foothills of the Santa Rita Mountains to the east and Sierrita Mountains to the west of the WUI. The areas of highest wildfire risk are located along the numerous desert washes originating from the mountain foothills. A moderate history of wildfire ignitions occurs along I-19 immediately north of Sahuarita; all others areas of the WUI have a low ignition history. Public use within the WUI is considered low; however, access to the west slopes of the Santa Rita Mountains and to the CNF originates from I-19 in this WUI. The WUI is composed of a mix of large developed private land parcels and traditional housing subdivisions of varied assessed value. The combination of mixed housing density, intermixed with areas of vegetative associations with low fire potential, and some areas with a high ISO rating and some with low wildfire ignition history creates areas of low risk to community values. The Pima County CWPP analyses determined that 3 percent of the Green Valley-Elephant Head-Helmet Peak Community WUI is at high risk and 66 percent is at moderate risk for wildland fire. Due to areas of low-moderate wildfire risk, areas of moderate ignition history, and a low density of community values, the overall wildland fire risk rating of the Green Valley-Elephant Head-Helmet Peak Community WUI Community WUI is moderate.

Golder Ranch Community WUI

The Golder Ranch Community WUI is composed of lands within and immediately adjacent to the Golder Ranch Fire District boundary. In 2007 the PCOEM and the Golder Ranch Fire District completed the *Catalina Community Wildfire Protection Plan*. In 2009 the Pinal County Office of Emergency Management and Golder Ranch Fire District participated in the development and approval of the *Pinal County Community Wildfire Protection Plan*. These two CWPPs encompass the Golder Ranch Fire District boundary and adjacent lands within both Pima and Pinal counties. The Golder Ranch Fire District serves a 210-square-mile area with a population of nearly 65,000 residents. Included in this district are the communities of Oro Valley, Catalina, and SaddleBrooke and southern Pinal County.

The 2007 Catalina CWPP planning area analyzed 22,504 acres of land including Catalina State Park, Pima County, CNF, ASLD, and private lands. The 2009 Pinal County CWPP includes that portion of Golder

Ranch Fire District north of Pima County, including Oracle Junction, developed lands in Falcon Valley, and SaddleBrooke Estates 2. The Pima County CWPP Golder Ranch Community WUI has expanded the Catalina analysis area to 31,095 acres through the addition of a 1-mile buffer along the CNF boundary and the lands adjacent to the Tortolita Mountain Park. The Pima County CWPP analyses confirm a wildland fire threat to the WUI from the heavily vegetated upland habitats along the foothills of the Catalina Mountains, the xeroriparian corridor of Cañada del Oro, and the associated drainages where heavy xeroriparian vegetation associations occur in relation to higher slopes and southerly and southwesterly exposures increase wildfire risk. The Pima County CWPP determined that 8 percent of the Golder Ranch WUI is at high risk and 49 percent is at moderate risk for unwanted wildland fire. The lands within the Golder Ranch Community WUI that are located within 5 miles of a Golder Ranch fire station have an ISO rating of 3.

The Catalina and Pinal County CWPPs outlined vegetative fuel reduction priorities, as well as wildfire prevention priorities. The Golder Ranch Fire District, community members, and the CNF have been working to complete fuel-reduction priorities within the WUI. The Golder Ranch Fire Department and CWPP cooperators are not recommending revisions to the CWPPs' goals and objectives or fuel mitigation and fire prevention strategies and priorities. The Pima County CWPP signatories support the priority recommendations of the Catalina and Pinal County CWPPs.

The Pima County CWPP assimilates by reference the Catalina CWPP and that portion of the Pinal County CWPP which includes the Golder Ranch Fire District and adjacent lands.

Kitt Peak WUI

The Kitt Peak WUI is identified as a "community at risk" with a "moderate WUI risk rating" in the 2009 Arizona State Forester's *Arizona-Identified Communities at Risk* for Pima County (http://www.azsf.az.gov/). The Kitt Peak WUI includes the National Observatory, visitor center, and picnic areas. Kitt Peak is located 56 miles southwest of Tucson, Arizona, in the Schuk Toak District on the Tohono O'odham Nation. The Kitt Peak National Observatory is part of the National Optical Astronomy Observatory and supports the most diverse collection of astronomical observatories on Earth for nighttime optical and infrared astronomy and daytime study of the Sun (http://www.noao.edu/kpno).

Kitt Peak has an elevation of 6,875 feet and is the highest point in the Quinlan Mountains. Major vegetation associations include desert wash/xeroriparian corridors and paloverde-mixed cacti desert scrub within the lower elevations of the Quinlan Mountains. The higher elevations of Kitt Peak are composed of the Madrean pine-oak woodlands. The areas of highest wildfire risk are located within the higher vegetative fuel loads of the pine-oak woodlands. Wildfire ignitions within the Kitt Peak WUI are low but there have been several large fires nearby. Public use within the WUI is considered high due to the high public visitation and significant scientific values of the observatory. There is no formal fire protection for Kitt Peak; therefore, the WUI is assigned an ISO rating of 10. The Pima County CWPP analyses of the 2,009-acre Kitt Peak WUI determined that 63 percent is at moderate risk for wildland fire. Due to areas of moderate wildfire risk, a low ignition history, and a high density of community values, the overall wildland fire risk rating of the Kitt Peak Community WUI is moderate.

Lukeville Community WUI

The Lukeville Community WUI is composed of private and public lands within 1-mile of developed areas of the community of Lukeville, including the Lukeville Port of Entry border crossing into Sonoyta, Sonora, Mexico. Lukeville is the terminus of SR 85 and is located entirely within the Organ Pipe Cactus National Monument. SR 85 provides access to the community and existing services are located along the SR 85 corridor. The town of Ajo provides most services to the visitors of the Organ Pipe National Monument and residents of Lukeville. The 2010 US census estimated a population of 39 residents occupying 24 housing units within the community WUI. The Pima County CWPP analyzed 1,741 acres within the Lukeville Community WUI for the potential risk to wildland fire. The Lukeville Community is not within a fire district and is assigned an ISO rating of 10.

Major vegetation associations include desert wash/xeroriparian corridors, creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub occurring in higher elevations to the west of the community in the Sonoyta Mountains. The Lukeville Community WUI does include areas of high risk in lower elevations to the north and east of the community during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and mustards. Wildfire ignitions within the Lukeville Community WUI are low. Public use within the WUI is considered moderate due to the adjacent Organ Pipe National Monument and traffic associated with the port of entry. The WUI is mostly composed of small developed private land parcels with traditional home lots found in the community center. The combination of low housing density, intermixed with invaded vegetative associations, and areas with a high ISO rating create areas of moderate risk to community values. The Pima County CWPP analyses determined that 3 percent of the Lukeville Community WUI is at high risk and 87 percent is at moderate risk for wildland fire. Due to areas of moderate wildfire risk, a low ignition history, and a moderate density of community values, the overall wildland fire risk rating of the Lukeville Community WUI is moderate.

Mescal-J6 Community WUI

The Mescal-J6 Community WUI is composed of private and public lands within and adjacent to the Mescal-J6 Fire District, located in eastern Pima County adjacent to I-10 at the Pima County–Cochise County border. The Mescal-J6 Fire District provides fire, rescue, and emergency services to the Mescal, J6, Skyline, Empire Acres, and Salcido Acres communities. The Mescal-J6 Fire District also covers the Titan and Dark Star road areas just west of the Benson City limits and I-10 from Mileposts 302 to 289 for fire response. The Mescal-J6 Fire District covers approximately 14 square miles with a total response area of approximately 225 square miles. The Mescal-J6 Fire District responds to wildland fires throughout Southern Arizona in accordance with requests from ASLD, FS, and BLM. The Mescal-J6 Fire District still operates in a strictly volunteer capacity with no full-time personnel employed. The Mescal-J6 Fire District responded to 365 calls for service in 2011 and has responded to 288 calls for service as of September 4, 2012. The 2010 population of the Mescal-J6 Community WUI is estimated to be 9,464 residents occupying 5,049 housing units (http://factfinder2.census.gov/, accessed March 2013). The Mescal-J6 Community WUI is considered to have an ISO rating of 10. The Pima County CWPP analyzed 30,378 acres within the Mescal-J6 Community WUI for the potential risk to wildland fire.

The primary transportation corridors in the WUI communities are I-10 traversing the WUI from the east and west, Mescal Road to the north, and South J6 Ranch Road to the south providing a north-south corridor in the WUI. The Union Pacific Railroad parallels I-10 to the north. The major business and community services are located adjacent to the I-10 frontage road or to Mescal and South J6 Ranch roads.

Major vegetation associations include desert wash/xeroriparian corridors, Apacherian-Chihuahuan mesquite upland scrub, Apacherian-Chihuahuan semi-desert grasslands and steppe, and Chihuahuan-creosotebush mixed desert and thorn scrub vegetations in lower elevations, with desert-oak transition associations occurring in higher elevations toward the foothills of the Rincon Mountains to the northwest of the WUI. The areas of highest wildfire risk are located along the numerous desert washes and grassland fan terraces originating from the mountain foothills. This portion of the WUI does include areas of high risk in lower elevations during extreme rainfall years within the desert grasslands, particularly from increased light fuels produced from winter annual and perennial native and invasive grasses. Areas with a high and moderate history of wildfire ignitions occur along I-10 and within the northern portion of the WUI in the eastern foothills of the Rincon Mountains within the vicinity of Happy Valley. Public use within the WUI is considered low. The WUI is composed of a mix of large developed private land parcels and traditional housing subdivisions of varied assessed value. The combination of mixed housing density, intermixed with areas of vegetative associations with high fire potential, and some areas with a high ISO rating and high wildfire ignition history create areas of high risk to community values. The Pima County CWPP analyses determined that 23 percent of the Mescal-J6 Community WUI is at high risk and 71 percent is at moderate risk for wildland fire. Due to areas of high-moderate wildfire risk, areas of high ignition history, and a low density of community values, the overall wildland fire risk rating of the Mescal-J6 Community WUI is high.

Mt. Lemmon Community WUI

The Mt. Lemmon Community WUI is composed of private lands within the Mt. Lemmon Fire District boundary and within FS lands managed by the CNF adjacent to and within the fire district boundary. The community of Summerhaven, which includes the Loma Sabino Pines tract, comprises a majority of the private land. The WUI portion on FS land includes Mt. Lemmon Ski Valley, recreation residence tracts (Fern Ridge, Soldier Camp, Bear Wallow, Willow Canyon), organization camps (Organization Ridge), observatories and communications sites (Radar Base/Radio Ridge, Mt. Bigelow), and CNF administrative sites (Palisades, Sollers Point). There are also numerous national forest recreation areas along the General Hitchcock Highway. The Mt. Lemmon Community WUI lies adjacent to and includes part of the 56,933-acre Pusch Ridge Wilderness area. In 2004 the *Mt Lemmon Wildland-Urban Interface Plan for Forest Health Wildland Fire Management* was developed and approved by the Pima County Board of Supervisors.

The 2004 WUI Plan was a cooperative effort between the citizens of Mt. Lemmon, Mt. Lemmon Fire Department, Trees for Mount Lemmon, Pima County, ASLD, and CNF. Subsequent to the adoption of the 2004 WUI Plan, Pima County adopted and has continued to adopt revised editions of the International WUI Code that is applicable to a Rural Forest Village which under the Pima County Comprehensive Plan included Summerhaven in this special land use designation. The goal of the 2004 WUI Plan “to create a healthy, vigorous forest and simultaneously reduce potential for a return of catastrophic wildlife fire” remains current. With the exception of the WUI boundary, revised vegetative landcover descriptions, and

associated fuel models, the goals and objectives of the 2004 WUI Plan are still valid have been included in the Pima County CWPP by reference.

The primary transportation corridor in the Mt. Lemmon Community WUI is the General Hitchcock (Mt. Lemmon) Highway, which connects Summerhaven to the Tucson Basin. The major retail businesses within the WUI are located in the community of Summerhaven. TRICO Electric Cooperative is the utility provider for the community of Summerhaven and is included as a cooperator in the Mt Lemmon Community WUI. The Pima County CWPP cooperators are supportive of the revision of the 2004 Mount Lemmon CWPP boundary that has been collaboratively developed by the 2004 Cooperators and the Arizona FireScape project. The 2013 WUI is modified to follow topographic features and trails encircling the community at approximately the 8,000-foot mean sea level contour. The 2013 proposed Mount Lemmon WUI boundary is more logical because it follows the topography and developed features instead of a straight line through rugged country. It follows access for firefighters and fuel maintenance crews so they can enter the area and start action to more readily identify, suppress, or manage wildland fire. It also defines an area for preventive treatment to better protect lives and property. Portions of the revised boundary are adjacent to and within the northern and eastern sections of the Pusch Ridge Wilderness boundary. The approval and concurrence of the Pima County CWPP will serve as revising the 2004 Mount Lemmon WUI boundary to the 2013 WUI boundary as depicted in Figure 2.8. The Pima County CWPP analyzed 12 square miles as the Mt. Lemmon Community WUI, as depicted in Figure 2.8. The Mt. Lemmon Fire District provides fire protection (both structure and wildland), emergency medical services, rescue, and public assistance to the community WUI centered in the community of Summerhaven. Established in 1979 as a fully volunteer agency, the district has grown into a combination department with a fire chief and a full-time staff of officers, firefighters, and paramedics, as well as over a dozen volunteers. The 2010 estimated population of the Mt. Lemmon census-designated place is 40 full-time residents; however, the community is estimated to have 259 housing units. The Mt. Lemmon Fire District has an ISO rating of 5. Major vegetation associations within the Mt. Lemmon WUI are derived from the ecological units developed by the FireScape program (http://www.azfirescape.org/catalina/landscape_types). Major vegetation associations include the Madrean pine-oak, ponderosa pine, and mixed conifer forest. The Mt. Lemmon Community WUI is the only Pima County community WUI which includes the ponderosa pine, mixed conifer, and Madrean pine-oak forest vegetation associations. As evidenced by previous wildfires, these vegetation types can support extreme fire behavior. Wildfire ignitions within the Mt. Lemmon Community WUI are common, with an average of 13 fires per year. Public use within the WUI is considered high in residential areas, recreation sites, and undeveloped areas of the WUI. The wildland fire risk influencing factor of housing density may not accurately reflect community values risk due to the high recreation capacity, recreational development, communication towers, and research facilities. Due to the complexity of wildland fuels, limited access, intermixed recreation sites, communication and research facilities, and private residents, the Mt. Lemmon Community WUI is rated at high risk for wildland fire.

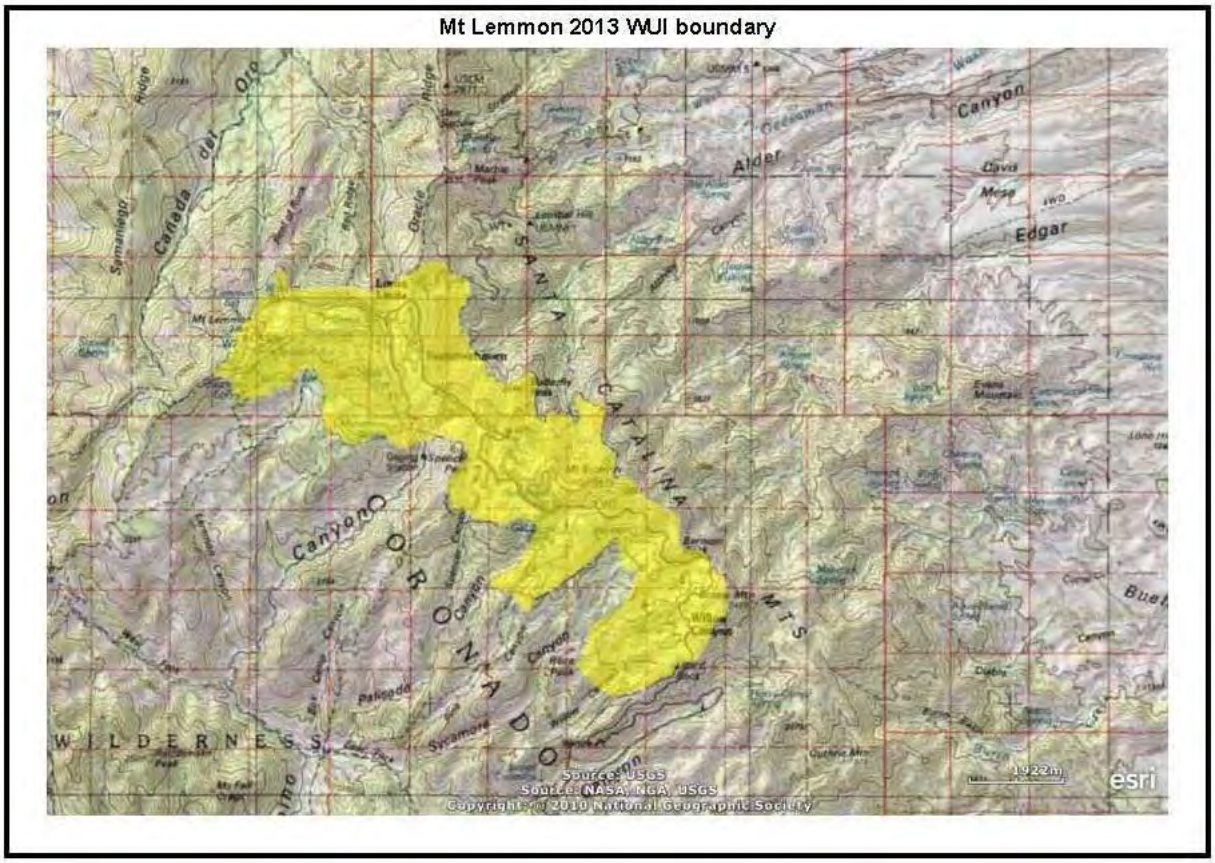

Figure 2.8. Mt. Lemmon Community WUI Analysis Area

Northwest Community WUI

The Northwest Community WUI is composed of lands within the Northwest Fire District boundary and public and private lands immediately adjacent the fire district boundary, including portions of the communities of Oro Valley and Marana.

The primary transportation corridors in the Northwest WUI include I-10 from the northwest to southeast; Tangerine Road in the northeast; Silver Bell Road paralleling I-10; and Avra Valley, Sanders, and Trico-Marana roads in the west. These roadways include the major business corridors in the WUI. The Northwest Community WUI is composed of 236 square miles and includes private and public lands that are located within a fire district. Fire protection services in the Northwest Community WUI are provided by the Northwest Fire District. The district currently provides emergency and community services to 110,000 residents and 3,300 commercial occupancies over a 140-square-mile area. The district is composed of 10 fire stations that are staffed 365 days a year with 192 firefighters who are paramedics or EMTs, along with a seasonal wildland team which responds locally as well as nationally to wildland fires. Full staffing for the in-district brush trucks normally begins in April each year and is staffed through August or when sufficient

monsoon moisture has occurred. The wildland team has one or two trucks staffed daily, with at least one full-time person and one or two seasonal employees. The wildland team responds to fires in the CNF, as well as other agencies in southern Arizona if requested. In 2009, the in-district brush trucks responded to 42 public-assistance calls and 20 brush-fire calls and have assisted, when possible, with some of the district's structure fires.

Major vegetation associations within the WUI community include the paloverde-mixed cacti desert scrub, with mesquite upland and chaparral associations occurring in higher elevations to the north of the community. Portions of the riparian corridors of Cañada de Oro, Rillito, and Santa Cruz rivers occur in the WUI. The areas of highest wildfire risk are located along xeroriparian corridors and the foothills of the Tucson, Catalina, and Tortolita mountains. These areas of highest wildfire risk include desert wash/xeroriparian corridors and creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub and mesquite upland associations occurring in higher elevations of the Tucson, Catalina, and Tortolita mountains. Parts of the Santa Cruz River riparian corridor and the Canada del Oro are heavily infested with the highly flammable, non-native tree, salt cedar. This portion of the sub-WUI does include areas of high risk along I-10 from Cortaro Road north to the Pima-Pinal county boundary, and the foothills of the Tucson, Catalina, and Tortolita mountains have a moderate wildfire risk during extraordinary rainfall years. Wildfire ignitions within the Northwest Community WUI are low with the exception of the area adjacent to I-10 at the Pima-Pinal county boundary. However, the adjacency of the Northwest Community WUI to the Ironwood National Monument and public use along the Santa Cruz River corridor is considered as moderate to high human use in undeveloped areas of the sub-WUI. The Pima County CWPP analyses classified 10 percent of the Northwest Community WUI at high risk and 44 percent at moderate risk for wildland fire. Due to a moderate to high wildfire risk, a moderate ignition history, and a moderate to high density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Pascua Yaqui Community WUI

The Pascua Yaqui Tribe is located in Pima County on less than 2 square miles in the southwestern part of the Tucson metropolitan area. Private lands within the communities of Drexel Heights and Valencia West border the Pascua Yaqui Tribe on the north, east, and west, and the San Xavier Indian Reservation borders the tribe on the south. The 2010 population estimate for the Pascua Yaqui Tribe is 4,247 residents occupying 939 housing units (shttp://factfinder2.census.gov/census tract 9410). On September 18, 1978, the Pascua Yaqui Tribe of Arizona became a federally recognized Indian tribe. The tribe has a status similar to other Indian tribes of the United States, making it eligible for specific services due to the federal trust responsibility that exists between the United States and American Indian tribes. Fire protection services for the tribe are provided by the Pascua Pueblo Fire Department. The Pascua Yaqui Tribe maintains one fire station with three engines, consisting of two Type 1 engines and one Type 6 engine, for response to wildland fires. In 2012, the BIA Salt River Agency developed a fire management plan (2012a) and a fuels management plan (2012b) that included analyses of the Pascua Yaqui Tribe. The 2012 *Fuels Management Plan* shows the Pascua Yaqui Tribe to be an intermix of variable housing density primarily in the northern portion of the Pascua Yaqui Tribe and open lands composed of native vegetation in the southern portion. Major vegetation associations within the Pascua Yaqui Tribe include desert wash and North American warm-desert riparian systems (32 acres), Apacherian-Chihuahuan mesquite upland scrub

(14 acres), Sonoran mid-elevation desert scrub (10 acres), and Sonoran paloverde-mixed cacti desert scrub associations (665 acres). The 2012 *Fuels Management Plan* shows three fire-behavior fuel models that represent the majority of predicted fire behavior within the Pascua Yaqui Tribe. These include Northern Forest Fire Lab Fuel Model 1 (GR1), which is composed of grass and grass forb fuels; Fuel Model 2 (GS1), which is composed of a mix of grass and shrubs; and Fuel Model 4 (SH5), which consists of dead and down woody fuels under a tree canopy within the riparian corridors. All wildland fires on the Pascua Yaqui Tribe are subject to initial-attack response with the desired tactics and strategies employed to meet land-management direction. The Pima County CWPP analyzed 1,392 acres of WUI lands within and adjacent to the Pascua Yaqui Tribe for the potential for wildland fire. The Pima County CWPP found that portions of the WUI do include areas of high risk in lower elevations during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Wildfire ignitions within the Pascua Yaqui Tribe WUI are low. Public use within the WUI is considered low to moderate in undeveloped areas. The combination of low to higher housing density on large land parcels, intermixed with invaded vegetative associations, and proximity to expanding private land developments creates areas of high risk to community values. The Pascua Yaqui Tribe WUI analyses found 33 percent of the WUI to be at moderate risk for wildland fire. Due to a moderate wildfire risk, a low ignition history, and a relatively moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate to low.

Picture Rocks Community WUI

The Picture Rocks Community WUI is composed of lands within the Picture Rocks Fire District boundary and public and private lands immediately adjacent to the fire district boundary, next to the west and north boundaries of Saguaro National Park.

The primary transportation corridor in the Picture Rocks Community WUI is Belmont and Twin Peaks roads west of Silverbell Road. Sandario, Anway, Trico, and Sanders roads provide north-south access to the WUI, while Orange Grove and Twin Peaks roads provide east-west access. These roadways include the major business corridors in the WUI. Fire protection services in the Picture Rocks Community WUI are provided by the Picture Rocks Fire District. The 2010 estimated population of the Picture Rocks census-designated place is 9,563 residents. However, the district currently provides emergency and community services to these residents over a 33-square-mile area (http://picturerocksfire.org) including providing fire protection services to Saguaro National Park via an IGA. In 2001 the Picture Rocks Fire Department began staffing five personnel per shift. The Picture Rocks Fire District serves a population estimated to be over 9,000 residents and has an ISO rating of 5 in proximity of Station 120 and an ISO rating of 8 in outlying areas of the district.

Major vegetation associations include desert wash/xeroriparian corridors and creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub and mid-elevation desert shrub associations occurring in higher elevations of the Tucson, Waterman, and Roskruge mountains. The areas of highest wildfire risk are located along the foothills of the Tucson and Waterman mountains and along the Brawley Wash xeroriparian corridor. This portion of the WUI does include areas of high risk in lower elevations during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Wildfire ignitions within the Picture

Rocks Community WUI are low. Public use within the WUI is considered moderate in undeveloped areas and high within the Saguaro National Monument. The WUI is mostly composed of large developed private land parcels. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and areas with a high ISO rating creates areas of high risk to community values. The Pima County CWPP analyses determined that 10 percent of the Picture Rocks Community WUI is at high risk and 53 percent is at moderate risk for wildland fire. Due to areas of moderate to high wildfire risk, a low ignition history, and a relatively high density of community values, the overall wildland fire risk rating of the Picture Rocks Community WUI is high.

Rincon Valley Community WUI

The Rincon Valley Community WUI is composed of lands within the Rincon Valley Fire District boundary and public and private lands immediately adjacent the fire district boundary. The Rincon Valley Community WUI lies mostly north of I-10, to the south and west of the Rincon Mountain Wilderness within the CNF and adjacent to the south boundary of Saguaro National Park. The Rincon Valley Community WUI includes the communities of Vail and Mountain View. The Rincon Valley Community WUI also includes the 2,000-acre Colossal Cave Mountain Park, which is administered for Pima County by the Pima County Parklands Foundation and receives substantial public visitation. The primary transportation corridors in the Rincon Valley Community WUI are I-10, which provides east-west access to the WUI, and Wentworth/Colossal Cave Road leading north from I-10. The major retail businesses within the WUI are located in or near the community of Vail. Fire protection services in the Rincon Valley Community WUI are provided by the Rincon Valley Fire District. The Rincon Valley Fire District Wildland Fire Program is designed to promote wildland fire safety within the district, while equipping and preparing fire crews for responding to wildland fires. Every Rincon Valley Fire District firefighter has basic wildland firefighter training, as established by the National Wildfire Coordinating Group. Rincon Valley Fire District maintains a cooperative agreement with the ASFD. This agreement allows Rincon Valley Fire District to call upon additional local, state, and federal firefighting resources, including aircraft and firefighting hand crews, should a large wildfire threaten the district. This agreement also obligates Rincon Valley Fire District to respond when requested to wildland fires across Arizona and the United States, provided the district has adequate staffing. Rincon Valley maintains a team of specialized firefighters who respond to these incidents on fire engines, water tenders, and ambulances. Rincon Valley Fire District was formed in 1985 by residents of the southeast metropolitan Tucson area to ensure that the community received consistent, high-quality emergency services at a reasonable cost. The Rincon Valley Fire District currently provides emergency and community services to 20,000 residents over a 50-square-mile area. The two stations are staffed 24 hours a day and 365 days a year with 37 full-time state-certified firefighters who are paramedics or EMTs. The 2010 estimated population of the Rincon Valley Community WUI is 21,753 residents occupying 8,308 housing units, with 10,208 of these residents and 3,754 of these housing units located within the community of Vail (http://factfinder2.census.gov/, accessed March 2013). The Rincon Valley Fire District has an ISO rating of 5. The Pima County CWPP analyzed 150 square miles as the Rincon Valley Community WUI.

Major vegetation associations include desert wash/xeroriparian corridors, Sonora-Mohave creosote bush-white bursage desert scrub, semi-desert grassland, mesquite uplands, paloverde-mixed cacti desert scrub and mid-elevation desert shrub associations occurring in the foothills of the Rincon Mountains. The areas

of highest wildfire risk are located along the foothills of the Rincon Mountains and within the numerous xeroriparian areas flowing to the northwest and terminating in the Santa Cruz River, including Rincon Creek, Aqua Verde Creek, and Cienega Creek. Many of the major xeroriparian corridors in the Rincon Valley Community WUI have at least locally become infested with saltcedar. The addition of saltcedar to wildland fuels greatly increase fire intensity and behavior, increasing risk to public and fire fighters, and may result impacts to native vegetation associations. Additionally portions of the WUI include areas of high risk in lower elevations during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Areas of high and moderate wildfire ignitions are found adjacent to I-10 at the Wentworth/ Colossal Cave Road intersection and I-10 at SR 83 in the vicinity of Mountain View. Public use within the WUI is considered high in the vicinity of Colossal Cave Mountain Park and in undeveloped areas of SNP and CNF. The WUI is mostly composed of a mix of large developed private land parcels and traditional home lots present in the community of Vail and Mountain View. The combination of mixed housing density, intermixed with invaded vegetative associations, and areas of high ignition history with some areas of high ISO rating creates areas of moderate risk to community values. The Pima County CWPP analyses determined that 17 percent of the Rincon Valley Community WUI is at high risk and 66 percent is at moderate risk for wildland fire. Due to areas of high and moderate wildfire risk, areas of high ignition history, and a relatively high density of community values, the overall wildland fire risk rating of the Rincon Valley Community WUI is high.

Sonoita-Elgin Community WUI

The Sonoita-Elgin Community WUI is composed of lands within and immediately adjacent to the Sonoita Fire District boundary; the communities of Sonoita, Elgin, and Canelo; and lands immediately adjacent to SR 83, SR 82, and the Elgin-Canelo Road. In 2007 the Sonoita-Elgin Firewise Team produced the *Sonoita-Elgin Community Wildfire Protection Plan*, which the Pima County Board of Supervisors signed on July 5, 2007. The Pima County CWPP incorporates the 2007 Sonoita-Elgin CWPP by reference. The Sonoita-Elgin CWPP was a collaborative effort of the communities of Sonoita, Elgin, Canelo, Santa Cruz, and PCOEM, Sonoita-Elgin Fire District, BLM Gila District, CNF, ASFD, National Audubon Society Appleton-Whittell Research Ranch, Las Cienegas National Conservation Area, and local interested citizens. The 2007 CWPP analyzed 118,711 acres for potential risk to wildland fire and found that 57 percent of WUI lands are at high risk of wildland fire. The 2007 CWPP identified 25,596 acres in Pima County, of which 93 percent is at high or moderate risk for wildland fire. The 2007 CWPP cooperators are not recommending amendments to goals, objectives, analyses or the WUI boundary of the Sonoita-Elgin CWPP. Therefore, the Pima County CWPP adopts the 2007 CWPP by reference without amendments. The Sonoita-Elgin Fire District provides structural and wildland fire protection to the communities. The Sonoita-Elgin Fire District is a combination department comprising about 54 volunteer, career, and auxiliary personnel serving a 350-square-mile district. The Sonoita-Elgin Fire District holds a Certificate of Necessity to provide ambulance service that covers a 725 square miles of east Santa Cruz County. The Sonoita-Elgin Fire District provides wildland firefighters, structural firefighters, rescue, prevention, emergency medical services, and hazardous material first responders to the residents within the CWPP analysis area.

The 2010 estimated population of the Sonoita area is 1,268 residents occupying 719 housing units. The 2010 population estimate for the community of Elgin is 965 residents occupying 503 housing units. The

2010 population estimate of residents within the census tract which includes these communities is 5,304 residents occupying 2,107 housing units. (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml/Census_tract_46.09). The Sonoita-Elgin Fire District has an ISO rating of 8 for residents within 5 miles of the fire station, an ISO rating of 9 for residents within 10 miles of the station, and an ISO rating of 10 for those greater than 10 miles from the fire station. The Pima County CWPP estimates that 18 percent of the Pima County WUI acres are at high risk and 75 percent at moderate risk of wildland fire. An area with a history of moderate wildfire ignitions is located along SR 83 north of the community of Sonoita within Pima County. This Sonoita-Elgin Community WUI does include areas of high risk in lower elevations and in grassland and mesquite vegetation associations during extreme rainfall years. Public use within the WUI is considered high due to access roads leading to popular outdoor recreation sites (Box Canyon, Gardner Canyon) on the CNF and visitors to the Sonoita Creek Preserve and the Las Cienegas National Conservation Area. The WUI is mostly composed of large developed private land parcels and residential lots within the communities. The combination of low housing density on large private land parcels, intermixed with high risk vegetative associations, and areas with a high ISO rating creates areas of high risk to community values. Due to areas of high wildfire risk, areas of moderate ignition history, and a relatively high density of community values, the overall wildland fire risk rating of the Sonoita-Elgin WUI is high.

Three Points–Drexel Heights Community WUI

The Three Points–Drexel Heights Community WUI is composed of private and public lands that are mostly south and east of the city of Tucson, including the communities of Drexel Heights, Valencia West, Robles Junction, and Three Points. The BANWR borders the WUI to the south. The Pima County CWPP analyzed 335,259 acres within the Three Points–Drexel Heights Community WUI for the potential risk for wildland fire. The Three Points and Drexel Heights fire departments provide fire protection services to the communities of the Three Points–Drexel Heights Community WUI. The primary transportation corridors in the WUI communities are SR 86 and SR 286, which provide north, south and west access. The SR 86 and SR 286 corridors are the major business corridors in the WUI. The 2010 estimated population of the Drexel Heights census-designated place is 27,749 residents occupying 9,684 housing units. The 2010 estimated population of the Three Points-Robles Junction area is 5,581 residents occupying 2,487 housing units (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml/). The Drexel Heights Fire Department's present boundary includes 90 square miles of Tucson's southwest side; the department provides fire protection services to approximately 50,000 residents from five stations, responding to more than 6,000 incidents a year. Drexel Heights maintains an ISO rating of 5. The department also participates in automatic regional response agreements with other local fire departments. The Three Points Fire Department provides fire protection services from three stations to approximately 10,000 people living in an area of 209 square miles. The Three Points Fire Department maintains an ISO rating of 5 in areas adjacent to the fires stations and an ISO rating of 8 in outlying areas.

Major vegetation associations include desert grasslands, desert wash/xeroriparian corridors, and creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub and upland mesquite associations occurring in higher elevations toward the foothills of the Sierrita Mountains. The areas of highest wildfire risk are located along the numerous desert washes originating from the Sierrita Mountains

in the east and the Coyote mountains in the west that drain to the Altar Valley Wash. Altar Valley Wash bisects the WUI, draining to the north and terminating at the Santa Cruz River. The southeast portion of the WUI does include areas of high risk in the foothills of the Sierrita Mountains during extreme rainfall years. Wildfire ignitions within the Three Points–Drexel Heights Community WUI are low. Public use within the WUI is considered moderate due to the adjacent BANWR. The WUI is mostly composed of large developed private land parcels with traditional home lots found in the community center. The combination of low housing density on large private land parcels, intermixed with invaded vegetative associations, and outlying areas with a high ISO rating creates areas of high risk to community values. The Pima County CWPP analyses determined that 5 percent of the Three Points–Drexel Heights Community WUI is at high risk and 64 percent is at moderate risk for wildland fire. Due to areas of moderate to high wildfire risk, a low ignition history, and a moderate density of community values, the overall wildland fire risk rating of the Three Points–Drexel Heights Community WUI Community WUI is moderate.

Tohono O'odham Nation (Sells and San Xavier District Communities WUIs)

The Tohono O'odham Nation is located in western Pima County with the community of Sells serving as the Nation's capital. The San Xavier District is located just south of Tucson. Fire protection services are provided to these communities by the Tohono O'odham Fire Department. The Tohono O'odham Nation has a fully staffed and operational wildland fire management program which meets national interagency standards in all aspects of operations, training, qualifications, and safety. The Tohono O'odham Nation is a participating agency in the Southeast Arizona Management Zone under a joint-powers agreement with the BLM, CNF, NPS, and USFWS. The 2010 population estimate for the Tohono O'odham Nation within Pima County is 10,201 residents occupying 3,677 housing units (Tohono O'odham Nation. No Date). The 2010 population estimate for the community of Sells is 2,495 residents occupying 760 housing units (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml/). The *Tohono O'odham Nation Fire Management Plan* (Tohono O'odham Nation 2004) defines the WUI zone as:

> . . . a one-mile zone surrounding all major communities and on either side of State Highways 86 or 15. Kitt Peak Observatories, support structures and facilities are also designated as being within the Wildland Urban Interface FMU. The WUI FMU delineation on the Tohono O'odham Nation is based upon several factors. One of the most important factors is the concentration of structures in a single area (community) such that a single fire could damage or destroy multiple structures. The second factor is that areas around communities and along highways are areas where a large percentage of human caused fires occur. Although fire occurrence statistics are incomplete, Tohono O'odham Nation Fire Management Staff indicate that more than 60% of all fires occurring on the Nation are located within the WUI. The third factor is the prolific amount of invasive grass species that create hazardous fuel conditions around structures, communities and along highways.

The Tohono O'odham Nation Fire Management Plan lists 66 community WUIs, which include the community of Sells and the entire San Xavier District. The major transportation corridors for the Tohono O'odham Nation include SR 86 from Tucson, and Indian Reservation Route 15 south from I-8. Major retail businesses are located within the San Xavier District and the community of Sells. Major vegetation associations within the Tohono O'odham Nation include desert wash/xeroriparian corridors and creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub associations occurring in

foothills and bajadas. The Tohono O'odham Nation WUIs do include areas of high risk in lower elevations within and adjacent to communities during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and mustards. In some instances the presence of invasive winter annuals and perennial grasses is heavier in the communities than in adjacent lands, creating greater potential risk for wildland fire occurring in the WUIs. Areas of high wildland fire ignition history are found in the vicinity of Sells, and moderate ignition history occurs within the communities of Artesa, Ali Molina, and Haivana Nakya. Public use within the WUIs is considered moderate due to the vastness of the Nation's land and the number of connecting Indian reservation routes that provide access to the Tohono O'odham Nation's communities. The Pima County CWPP analyzed 7,820 acres for the potential risk of wildland fire within and adjacent to the community of Sells and found that 6 percent of the WUI is at high risk and 34 percent of the WUI at moderate risk for wildland fire. The Pima County CWPP analyses determined that the Sells Community WUI includes areas of high community values, has a history of high wildland fire ignitions, areas of high wildfire risk, and areas of limited fire response access. The overall wildland fire risk rating of the Sells community WUI is high. The Pima County CWPP analyzed 69,965 acres within the San Xavier Community WUI for potential risk to wildfire. The Pima County CWPP analyses determined that the San Xavier Community WUI contains areas of high community values due to the number of visitors to the San Xavier del Bac Mission. The San Xavier Community WUI has a low history of wildfire ignitions and includes areas of high wildfire risk. The Pima County CWPP analyses determined that 3 percent of the WUI is at high risk and 75 percent is at moderate risk for wildland fire. Due to the high community values and areas of high wildland fire risk, the overall wildland fire risk rating of the San Xavier Community WUI is moderate.

Tucson–South Tucson Community WUI

The Tucson–South Tucson Community WUI is composed of private and public lands within the Tucson and South Tucson Fire Department boundaries and includes the cities of Tucson and South Tucson and some unincorporated lands. Tucson is the 32nd largest city in the United States, covering an area of 227 square miles. Tucson sits at an elevation of 2,389 feet and is surrounded by five mountain ranges: the Tucson, Santa Catalina, Rincon, Santa Rita, and Tortolita mountains. Fire protection is provided by the Tucson and South Tucson fire departments. The Tucson Fire Department started in 1881 as an all volunteer force and today is Arizona's second largest Fire Department. The Tucson Fire Department is organized into five divisions: Headquarters, Operations, Code Administration, Support Services, and Training. The Tucson Fire Department maintains an ISO rating of 2. The 2010 census estimated population for the city of Tucson is 520,116 residents occupying 231,883 residential units (http://factfinder2.census.gov/ accessed, March 2013). The city of South Tucson covers an area of about 1.2 square miles and is completely surrounded by the city of Tucson. It is located at the junction of I-19 and I-10 about 1 mile south of downtown Tucson and is bounded by I-10, I-19, and the Union Pacific railroad tracks. The city of South Tucson incorporated in 1940; it is referred to as the "Pueblo within a City." The city of South Tucson is located within zones designated by the U.S. Department of Housing and Urban Development—the 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 fire protection service is provided to residents by the City of South Tucson Fire Department. The 2010 census estimated population for the City of South Tucson is

5,652 residents residing in 2,191 residential units (http://factfinder2.census.gov/, accessed March 2013). The Pima County CWPP included the cities of Tucson and South Tucson because they border open lands and are near mountain ranges that are composed of areas of high risk for wildland fire. Additionally, wildfire threats within the municipalities include large riparian corridors such as the Santa Cruz River, Rillito, and Tanque Verde creeks; Pantano Wash; and the Canada del Oro confluence at Rillito Creek. These riparian corridors are heavily vegetated and include areas of infestations of nonnative heavy vegetation fuels such as saltcedar and invasive perennial grasses such as buffelgrass. The potential spread of vegetative-driven fires within the city of Tucson escalates with increasing spread of invasive woody and grass species, particularly within the riparian corridors and neighboring open lands.

Although the major landcover within the cities of Tucson and South Tucson is classified as "impervious," areas of moderate and high wildland fire risk are found in the vicinity of open lands adjacent to the Tucson International Airport, to I-10 in the area of the Houghton Road intersection, and to areas of high risk in and near the Pima County Fairgrounds. The major vegetation associations in these open areas include desert wash/xeroriparian corridors, creosotebush-white bursage desert scrub, and paloverde-mixed cacti desert scrub associations. The cities of Tucson and South Tucson are composed of a complex of interspersed wildland interfaces at their borders; heavily vegetated municipal riparian corridors provide cover and shelter for homeless persons and continued colonization of invasive woody and grass species. The complex of vegetative fuels has created conditions that require Tucson Fire Department to response to an average over 1,200 brush fires annually since 2000. Brush fires that are driven by invasive species such as buffelgrass can spread, under some conditions, at a speed of 770 feet per minute, which equates to over 8 miles per hour (Grissom 2010). Vegetative-driven fires under these conditions have severe risk to public and firefighter safety, property and loss of natural habitats prior to the arrival of firefighters. Although areas of significant threat to public and firefighter safety exist within the cities of Tucson and South Tucson, the overall wildland fire risk rating is low.

Why Community WUI

The Why Community WUI is composed of private and public lands within 1 mile of developed areas of the community of Why. It lies near the western border of the Tohono O'Odham Nation and is due north of Organ Pipe Cactus National Monument in southern Arizona. It is approximately 30 miles north of the Mexican border near Lukeville, Arizona, and Sonoita, Sonora, Mexico, and 10 miles south of Ajo, Arizona. The major transportation corridors in the Why Community WUI are SR 85 south from the community of Ajo and SR 86 from the east from the Tohono O'Odham Nation and the Tucson Basin. The community of Why provides retail services to individuals traveling to Sonora, Mexico—especially to the resort town of Puerto Peñasco—and to the Organ Pipe Cactus National Monument. The Pima County CWPP analyzed 4,619 acres within the Why Community WUI for the potential risk of wildland fire. The Why Fire District provides fire protection services to the community of Why. The Why Community WUI is assigned an ISO rating of 10. The SR 85/SR 86 intersection is the major business corridor in the WUI. The 2010 estimated population of the Why census-designated place is 167 residents occupying 102 housing units (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml/Census tract 46.09.

Major vegetation associations include desert wash/xeroriparian corridors and creosote bush-bursage desert scrub types, with paloverde-mixed cacti desert scrub occurring in higher elevations of the Pozo

Redondo and Gunsight hills. The areas of highest wildfire risk are located along the foothills of the Pozo Redondo and Gunsight hills to the east of the community of Why. This portion of the WUI does include areas of high risk in lower elevations to the north and east of the community during extreme rainfall years from increased light fuels produced from winter annual and perennial invasive grasses such as Mediterranean grass, red brome, and buffelgrass. Wildfire ignitions within the Why Community WUI are low. Public use within the WUI is considered moderate due to the adjacent Organ Pipe Cactus National Monument and holiday traffic to the resort community of Puerto Peñasco. The WUI is mostly composed of mobile home and traditional home lots found in the community center. The combination of high housing density on small private land parcels, intermixed with invaded vegetative associations, and areas with a high ISO rating creates areas of high risk to community values. The Pima County CWPP analyses determined that 91 percent of the Why Community WUI is at moderate risk for wildland fire. Due to areas of moderate wildfire risk, a low ignition history, and a moderate density of community values, the overall wildland fire risk rating of the Why Community WUI is moderate.

F. Cumulative Risk Analysis

The cumulative risk analysis synthesizes the risk associated with fuel hazards, wildfire ignition points, wildfire occurrence, and community values. These different components were analyzed spatially, and an overall cumulative risk for the analysis area was calculated. Table 2.7 displays the results of the cumulative risk analyses, identifying the areas and relative percentages of analysis area areas of high, moderate, and low risk. Visual representations of cumulative wildfire hazard are mapped in Figures 2.9a–2.9c.

Table 2.7. Cumulative Risk Levels, by Percentage of the WUI Area

Pima County CWPP Community Sub-Analysis Area	High Risk (%)	Acres	Moderate Risk (%)	Acres	Low Risk (%)	Acres	Total Acres
Ajo	2	561	55	13,096	43	10,300	23,957
Arivaca-Sasabe	14	7,901	71	38,916	15	8,001	54,818
Avra Valley	4	5,926	74	103,228	22	30,476	139,630
Three Points–Drexel Heights	5	18,421	64	216,106	30	100,728	335,255
Golder Ranch	8	2,561	49	15,355	42	13,171	31,095
Catalina Foothills	22	15,970	47	33,979	31	22,580	72,529
Corona de Tucson	3	2,204	87	69,642	10	8,034	79,880
Mt. Lemmon	99	7,408	1	51	0	0	7,459
Cascabel	2	340	51	6,961	46	6,295	13,599
Lukeville	3	200	11	1,516	0	3	1,741
Green Valley-Elephant Head-Helmet Peak	3	6,525	66	137,134	31	64,765	208,440
Kitt Peak	0	0	63	1,262	37	748	2,009
Mescal-J6	23	6,860	71	21,638	6	1,842	30,378
Pascua Yaqui	0	3	33	463	66	926	1,392
San Xavier	3	1,841	75	52,590	22	15,534	69,965
Picture Rocks	10	3,114	53	15,982	36	10,926	30,022
Rincon Valley	17	16,186	66	63,649	17	16,217	96,052
Tohono O'odham	0	0	10	1,052	90	9,049	10,101
Northwest	10	14,613	44	65,693	46	70,871	151,188
Sells	66	5,178	34	2,643	0	0	7,820
Tucson–South Tucson	1	1,078	23	42,753	76	138,191	182,022
Why	0	0	91	4,209	9	410	4,619
Sonoita-Elgin	18	4,623	75	19,105	7	1,856	25,596
Total WUI Acres	8	121,511	59	926,760	34	531,189	1,579,572

Source: Logan Simpson Design Inc.

*Treatment areas not equal to area risk assessment due to data-rounding errors.

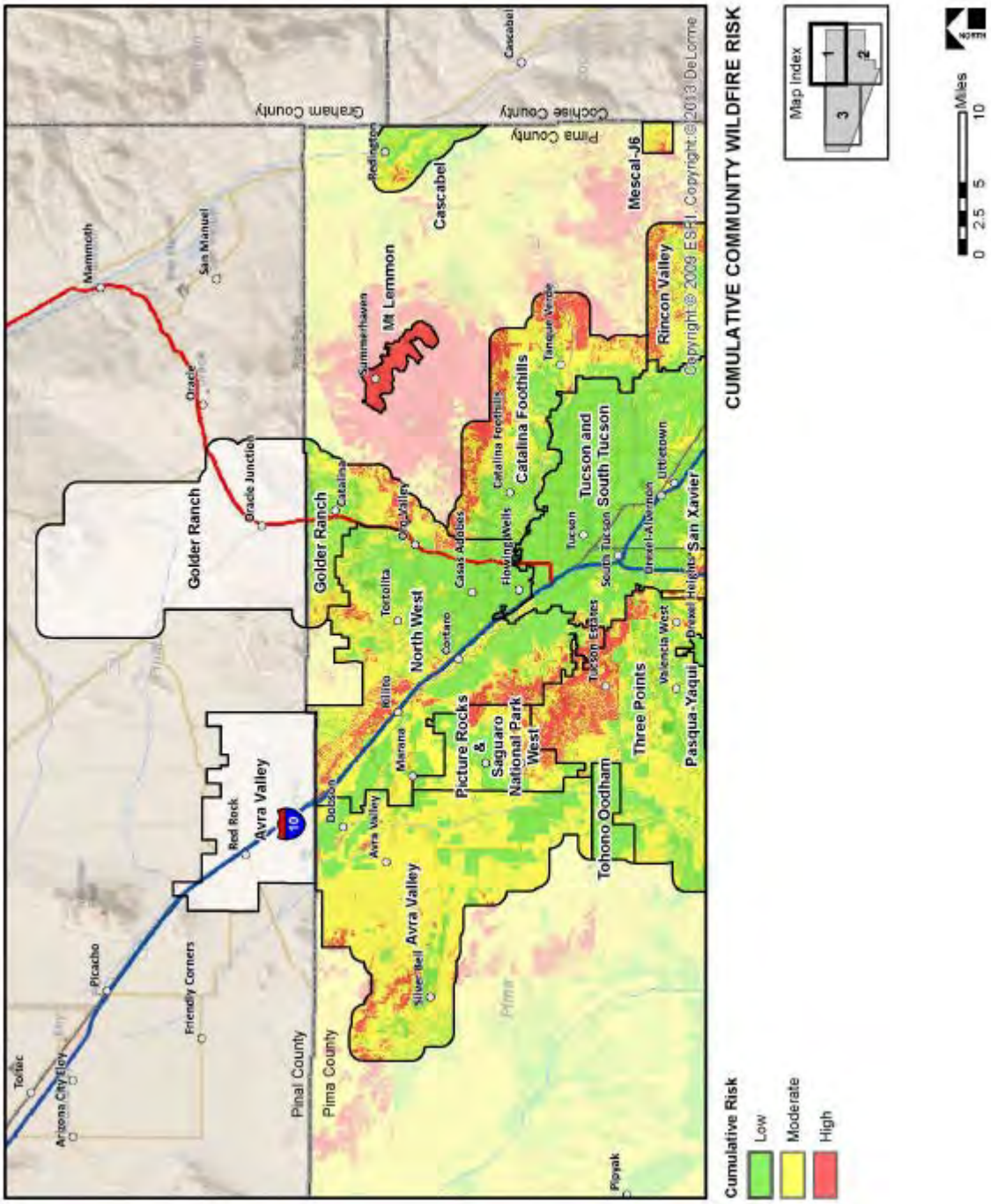

Figure2.9a. Cumulative Community Wildfire Risk, North

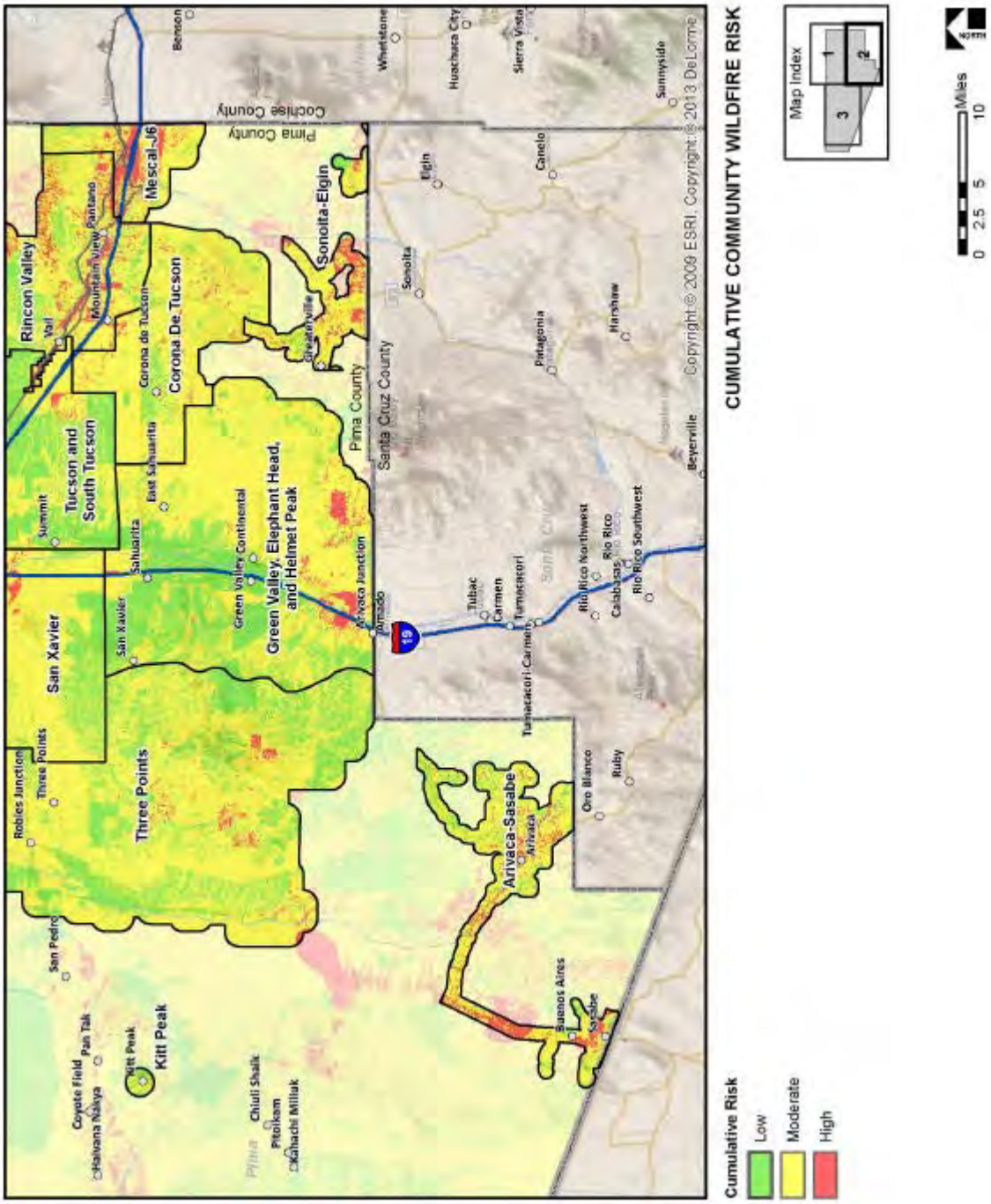

Figure2.9b. Cumulative Community Wildfire Risk, South

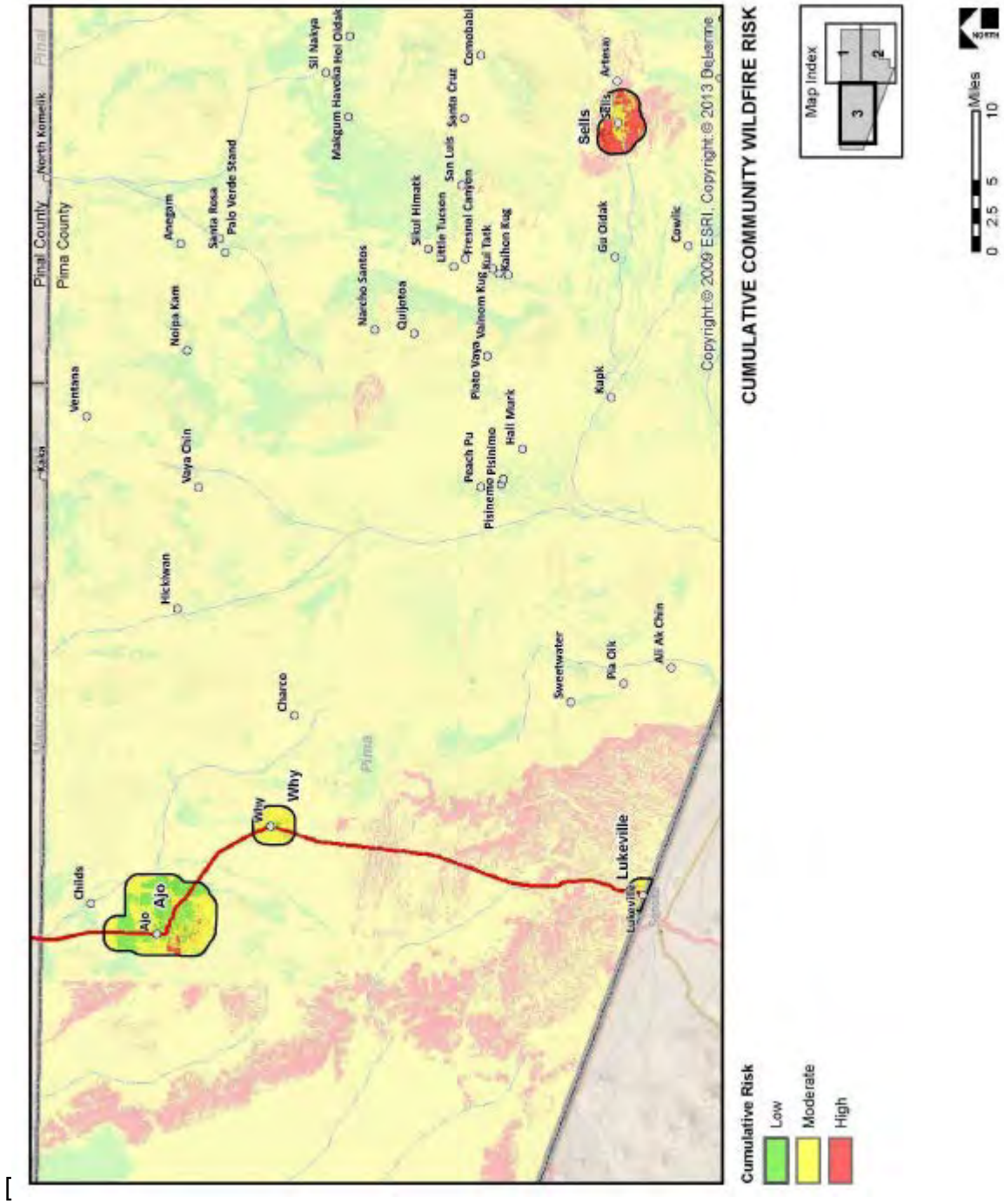

Figure2.9c. Cumulative Community Wildfire Risk, West

III. COMMUNITY MITIGATION PLAN

This section outlines Pima County CWPP priorities for wildland fuels treatments, as well as the recommended methods of treatment and management strategies for mitigating the potential spread of catastrophic wildland fire throughout the community WUIs. This section also presents recommendations for enhanced wildland fire protection capabilities and public education, information, and outreach.

A. Fuel Reduction Priorities

After determining the areas at greatest risk for wildland fire (see Section II of this CWPP), the Core Teams developed a series of proposed actions, including residential treatments; a series of firebreaks appropriate for the wildland fuel types; and fuel mitigation treatments for undeveloped landscape areas (Table 3.1). The Core Teams have proposed wildland fire mitigation projects for at-risk public, tribal trust, and private lands. These proposed actions are recommended to prevent wildfire spread from public lands onto private land and, conversely, to reduce the risk of fires spreading from private land onto public lands by reducing wildland fuels and creating a survivable space around your home to reduce the risk from wildfire (http://www.firewise.org; http://www.fireadapted.org). A primary goal of the Pima County CWPP is for proposed treatments to be continuous across property boundaries, allowing for the most effective protection from wildfires.

Hazardous fuels reduction recommendations on public lands vary by constituting either a single firebreak in appropriate width and length within the WUI or broader land treatment applications of wildland fuel reduction and habitat restorations within or adjacent to the WUI. Additional firebreaks or hazardous fuels reduction projects may be developed over time and will conform to the types of treatment recommendations developed by the Core Teams. The PCOEM, ASFD, CNF, NPS, USFWS, BLM, tribal and local fire departments and districts, and the Core Teams' participating resource specialists developed firebreak recommendations by vegetative fuel types. These recommendations are based on firebrand movement during the peak fire season under normal seasonal weather conditions in relation to slope, aspect, and fuel type. The recommended land treatments and fuelbreaks will enhance public and firefighter safety, provide for community value protection, enhance restoration of native vegetation, and provide for wildlife habitat needs. Designated wilderness areas and special-status lands within or adjacent to the Pima County CWPP WUI include the Rincon Mountain, Pusch Ridge, the Saguaro Wilderness areas, and the Ironwood Forest National Monument. Wildland fuel mitigation treatments within special-status lands will be conducted by BLM, NPS, and CNF under appropriate wilderness regulations. The Core Teams may recommend fuelbreaks along specific identified private in-holdings adjacent to wilderness boundaries to allow BLM, NPS, and CNF to use appropriate response to wildland fire.

The wildland vegetative fuel and firebreak recommended treatments meet the Pima County CWPP goals of enhancing firefighter and public safety, reducing hazardous wildland fuels on public and private lands, improving fire prevention and suppression, restoring riparian, forest and rangeland health, involving the community, and expediting project implementation. To prioritize wildland fuel mitigation projects, the Core Teams analyzed wildland fuel hazards, fire history, and community values. This combined risk assessment was compiled in a single community base map depicting areas of low-, moderate-, and high-risk evaluations (see Figures 2.8.a.–2.8.c). These risk areas were further identified and categorized into a total

of 95 wildland treatment management units (TMUs) within 23 sub-WUI designations of the WUI. These treatment units were analyzed and categorized according to potential risk for wildfire with an overall risk value determined for each management unit (Figures 3.1a–3.1c).

The Core Teams described the location of each treatment management unit in the WUI and then assigned recommended treatments for each unit (Table 3.2).The management units listed in Table 3.2 do not always coincide with fire department or fire district boundaries or lie within established fire departments and districts. For example, the Avra Valley community sub-WUI is much larger than the fire district boundary, and some treatment management units are not in any fire department or district or under federal jurisdiction for fire protection; therefore, no fire departments or districts are responsible for those treatment management units.

Private land treatments in the WUI typically occur on small land parcels near power lines, structures, and other obstacles. In many cases, cut trees and slash cannot be piled and burned on small private land parcels, or it is not the preferred slash treatment by the owner of a small residential lot or by the local fire departments. Therefore, the Core Teams recommend that slash from wildland fuel reduction treatments on small residential parcels be removed, whole or chipped, and transported to a disposal site. The Core Teams do not oppose alternative vegetative treatments to achieve wildland vegetative fuel mitigation objectives, such as an experimental grazing program using primary grazers within the WUI, adjacent to state or federal lands. The Core Teams also recommend that fallow agricultural lands be restored through the planting of native vegetation species in accordance with the *National Conservation Practice Standards, Range Planting*, Code 550 (NRCS 2002). The Core Teams also recommend that firebreaks constructed on public and private lands to restrict wildland fire movement be maintained in accordance with the above-mentioned mitigation measures and stipulations on a rotating 2- or 3-year interval, or as deemed necessary to ensure the integrity of the firebreak through removal of fine and light vegetative fuels.

Treatment of wildland fuels within the WUI is expected to generate considerable slash and vegetative waste material. Private individual use of wood products from fuel reduction treatments within the WUI is primarily for fuelwood. Commercial use of the woody material from fuel reduction treatments is also primarily limited to fuelwood, and any commercial value of treatment by-products will not significantly affect land treatment costs. Recent costs of fuels mitigation treatment on BLM lands within the WUI include mesquite grubbing at $525.00 per acre for stewardship contracting; $400.00 per acre for service contracting; and $250.00 to 350.00 per acre in-house. If wildland fuel modification prescriptions require follow-up pile burning or herbicide application after vegetation treatment, the total cost per acre could include $21.00 for burning and $370.00 for foliar herbicide application (BLM, pers. comm. 2013).

Costs for herbicide applications to buffelgrass-invaded sites varies widely based on distance from roads and trails, amount of buffelgrass and size of patches, method used, and other variables. In 2010–2012, costs for FS, BLM, and NPS have ranged from $30 to $370 per acre, averaging $200–$250 per acre. Small areas treated by private contractors may have a similar range of costs per acre.

Table 3.1. Fuel Modification and Treatment Plans

Treatment No.	1 Developed Private Parcels <2 Acres				2 Undeveloped Private Parcels Or Single-Structure Parcels >2 Acres		3 Grassland Firebreaks		4 Oak/Pinyon/Juniper and Shrublands within the WUI	
Treatment Category	**Zone 1 (0–10 feet from structures)**	**Zone 2 (10–30 feet from structures)**	**Zone 3 (30–100 feet from structures)**	**Zone 4 (100–600 feet around home)**	**Slopes <20%**	**Streambeds, Channels, and Slopes ≥20%**	**Slopes <20%**	**Slopes ≥20%**	**Landscape Treatment Outside Firebreaks**	**Firebreaks**
Vegetation	Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet to reduce flammable vegetation. Remove and destroy insect-infested, diseased, and dead trees and shrubs. Grasses and forbs may be cut with a mower to a 4-inch stubble Remove dead plant material from ground; prune tree limbs overhanging roof; remove branches within 10 feet of chimney; remove flammable debris from gutters and roof surfaces. Remove non-irrigated nonnative grasses (especially buffelgrass).	Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet; remove and destroy insect-infested, diseased, and dead trees. Create separation between trees, tree crowns, and other plants based on fuel type, density, slope, and other topographical features. Reduce continuity of fuels by creating a clear space around brush or planting groups. Grasses and forbs may be cut with a mower to a 4-inch stubble. Remove non-irrigated nonnative grasses (especially buffelgrass). All snags and vegetation that may grow into overhead electrical lines, other ground fuels, ladder fuels, dead trees, and thinning from live trees must be removed.	Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet; remove and destroy insect-infested, diseased, and dead trees. Maximum density of trees (whichever is greater: 60 square feet of basal area at 80–100 trees/acre *or* average density of 100 trees/acre). Grasses and forbs may be cut with a mower to a 4-inch stubble. Remove non-irrigated nonnative grasses (especially buffelgrass).	For natural areas, thin selectively and remove highly flammable vegetation. See fuel modification plan (this section) developed to promote forest health, to prevent spread of fire to adjacent property, and to create defensible space with considerations for wildlife and groundwater protection Carefully space trees; choose Firewise plants.[a] Remove non-irrigated nonnative grasses (especially buffelgrass).	Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 8 feet; remove and destroy insect-infested, diseased, and dead trees. Maximum density of trees (whichever is greater: 60 square feet of basal area at 80–100 trees/acre *or* average density of 100 trees/acre) See fuel modification plan (this section) developed to promote riparian health, to prevent spread of fire to adjacent property, and to create defensible space with considerations for wildlife and groundwater protection. Single structure or structures on parcels exceeding 2 acres should include Treatment 1 in proximity to structures and Treatment 2 for remaining acres. See the fuel modification plan (this section) developed to prevent spread of fire to adjacent property and to create defensible space with considerations for wildlife and groundwater protection.	Remove dead, diseased, and dying trees. Fell dead trees away from stream channels with defined bed and banks. Areas should be hand-thinned and hand-piled; inaccessible areas may be treated with periodic Rx. Develop fuel modification plan (this section) for treatments. Remove nonnative grasses (especially buffelgrass and fountaingrass).	Grassland types may be mechanically treated, including mowing, chopping, or mastication, to reduce or remove vegetation or may be grazed to a stubble height. Ensure that removal of vegetation within a designed firebreak of >1 chain (66 feet) in width and length is sufficient to protect federal, state, or private land values. Fuel reduction treatments within grassland vegetation types may include multiple-entry burns to maintain stand structure and reduce fine fuels. Trees and shrubs >8 inch drc should be thinned to a variable distance of 15–35 feet between trees. Trees and shrubs <8 inches drc should be removed. Mechanical/chemical or grazing treatment may be used to maintain firebreaks on private lands. Remove nonnative grasses (especially buffelgrass, fountaingrass and Lehmann's lovegrass), including winter annual grasses (especially red broom, cheatgrass, and Mediterranean grass).	Same as for slopes <20%. Fuel treatments may require hand-thinning and hand-piling or grazing in steep slopes. Rx may be used to reduce high fire potential (see Treatment 5). Designated firebreaks may be increased to no more than 2 chains in steep slopes where herbaceous (fine fuels) and subshrub species fuel loads increase to pretreatment levels within 3 years. Remove nonnative grasses (especially buffelgrass, fountaingrass and Lehmann's lovegrass), including winter annual grasses (especially red broom, cheatgrass, and Mediterranean grass).	Spacing may be variable with a 20- to 35-foot minimum to promote (1) wildlife habitat while breaking horizontal fuel loading, which allows for patches of closely spaced trees for adequate cover, and (2) other habitat components while incorporating openings to increase herbaceous forage production, to maximize edge effect, and to promote fire-resilient stands. Mechanical thinning and Rx (see Treatment 5) can be used to reduce vegetative fuels and move stands toward potential natural vegetation groups as described in the *FRCC Interagency Handbook* (FRCC Interagency Working Group 2005a) or grazed to like conditions. All trees >10 inches drc will be targeted as "leave trees" unless removal is necessary to achieve the desired spacing.	Woodland and shrub trees <8 inches drc will be thinned to a spacing of 15 feet between trees, or Rx will be applied to achieve like conditions. Shrub and tree trunks will be severed <4 inches from the ground. Mechanical treatments, such as crushing, chipping, mastication, and Rx, may be used to create open stands that produce flame lengths of ≤4 feet to minimize crown-fire potential and to produce vegetative fuel conditions conducive to suppression action. Herbaceous and subshrub understory may be mechanically treated, including mowing, chopping, and masticating, or grazed to limit fine-fuel loading while protecting soil integrity from rainfall runoff.
Slash/litter	Remove or reduce natural flammable material 2–4 feet above the ground around improvements. Remove vegetation that may grow into overhead electrical lines, ladder fuels, and dead trees. Thinning from live trees must be removed (chipped, etc.). Remove all leaf litter to a depth of 1 inch.	Control soil erosion from small waterflow channels by using rock or noncombustible velocity-reducing structures. Remove all leaf litter to a depth of 1 inch.	Same as Zones 1 and 2.	Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, turned, or grazed for like treatment.	All slash, snags, and vegetation that may grow into overhead electrical lines; other ground fuels; ladder fuels; dead trees; and thinning from live trees must be removed, mechanically treated (chipped, etc.), or piled and burned along with existing fuels.	Clean dead and down debris in channels where debris may be mobilized in floods and thus create downstream jams. Some slash and debris can be scattered and retained in small, ephemeral streambeds in which slash can help retain runoff and sediment and provide headcut stabilization.	Slash from grassland treatments may be burned, removed, masticated, or turned (disked).	Same as for slopes <20%; however, slash may be hand-piled and ignited with Rx as the primary slash reduction treatment.	Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, or turned.	Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, or turned.

Continued

Table 3.1. Fuel Modification and Treatment Plans

Treatment No.	5 Forest Types within or adjacent to the WUI		6 Prescribed Fire	7 Escape and Resource Transportation Corridors (federal and nonfederal lands)	8 Riparian Areas (federal, nonfederal, and private lands)		9 Conditional Suppression Areas (federal and nonfederal lands)	10 Saltcedar Removal (federal and nonfederal lands)
Treatment Category	**Thinning**	**Shaded Fuelbreaks**	**Federal, State, or Private Lands**	**Federal, State, or Local Government Where Designated as Escape Route**	**Federal or State Lands**	**Firebreaks on Private Lands**	**Federal, State, or Private Lands**	**Federal, State, or Private Lands**
Vegetation	Lands may be thinned to create vegetation structure, composition, and fuel loadings that support low-intensity surface fire to reduce the impacts of wildfire on communities. Residual stocking levels for private land would be reduced to 20–80 trees per acre (≤60 square feet of basal area/acre). Thinning treatments on Forest Service land will enhance private land treatments, but must comply with the Forest Land Management Plan and other associated rules and regulations. In general, treatments will favor leaving larger trees and removing ladder fuels. Tree spacing should be random with some degree of "clumpiness."Refer to Treatment 1 for additional guidelines in areas close to structures.	A fuel break is a natural or manmade change to native vegetation which affects fire behavior so that fires burning into them can be more readily controlled. The size and type of fuel break will depend on the vegetation and topography. Fuel break construction on Forest Service land will enhance private land treatments, but must comply with the Forest Land Management Plan and other associated rules and regulations.	Rx will be used as a tool to accomplish specific resource management objectives in accordance with ASLD, ASFD, CNF, and/or BLM standards and guides. Rx on federal land is authorized if part of an approved Rx burn plan. As additional areas within the WUI are identified, Rx may be used as a treatment tool provided that a wildland fire implementation plan is in effect and that all conditions set forth have been met. Rx can occur at low, moderate, and high intensity. High-intensity fire will be used to create openings by removing above ground vegetation.	Reduce fuel loading by thinning trees <10 inches drc. Reduce trees to 15-foot spacing. Shrub and tree trunks will be cut no less than 4 inches from the ground. Stands will be variable across the landscape, such as retention of bands of higher-density vegetation with sufficient understory to maintain functionality of important wildlife movement corridors in areas of low structure density. Mechanical treatments may include chipping, piling and burning, or removal and Rx in the project area. Trees may be left in clumps with fuel ladders removed from below. Dead, diseased, and dying trees of all sizes will be emphasized for removal. Some trees >8 inches drc may be cut to reduce safety hazards or when needed to reach desired 15-foot spacing. Escape and resource transportation corridors may serve as firebreaks in all vegetative types. Firebreaks for each vegetative type, as described in this table, would be implemented at appropriate distance from the centerline of the escape and resource transportation corridors to produce fire-resilient stands and to enhance evacuation and response access. Emphasis will be placed on removing nonnative and flammable species. Grasses and forbs may be cut with a mower to 4-inch stubble.	Riparian treatments will be limited in scope. The majority of riparian areas that fall within the WUI boundary will be avoided unless deemed a fuel hazard. Clearing or cutting of any material by mechanized equipment within 10 feet of any stream on federal land may be prohibited to prevent the risk of accelerating erosion. Treatments may include some overstory removal of deciduous riparian trees and shrubs in areas where encroachment has increased heavy woody fuels (emphasizing removal and control of saltcedar and other invasive trees). Treatments will emphasize nonnative species. Snags >8 inches may be retained. All presettlement trees, including snags, will be targeted for retention. Restricting the removal of the vegetative overstory in the riparian areas to the period of October 15–March 31 will prevent the disturbance of any nesting by neotropical migrant bird species, including the southwestern willow flycatcher. Fuels reduction should occur October 15–March 31 in riparian areas, as long as fire danger is not extreme. Herbicides can be used against nonnative grasses, but it takes about 3 years to break fuel continuity. This is not the best method for zones 1 and 2 unless coupled with mowing or as a follow-up to pulling. Emphasis will be placed on removing species listed in Appendix A.	Private land treatment should use hand tools, chain saws, or mowers. Dead vegetation and slash should be removed. Ladder fuels, including limbs and branches, should be removed up to a maximum of 8 feet aboveground. All mechanized equipment must meet state and local fire-department/district standards. Perform treatments October–March annually. Treatment of annuals may be best when annuals are green. Herbicides can be used against nonnative grasses, but it takes about 3 years to break fuel continuity. This is not the best method for Zones 1 and 2 unless coupled with mowing or as a follow-up to pulling.	This prescription includes lands with desert shrub/scrub vegetative types in which no fuel modification treatments have been identified as necessary to provide protection from wildland fire. The threat from catastrophic wildland fire is low or nonexistent. This includes areas in which fire never played a historical role in developing and maintaining ecosystems. Historically, in these areas, fire return intervals were very long. These are areas in the WUI in which fire could have negative effects unless fuel modifications take place. These include areas in which the use of fire may have ecological, social, or political constraints and areas in which mitigation and suppression are required to prevent direct threats to life or property. Wildland fire growth within these areas will be monitored for private-property, ecological, and cultural threats before initiating suppression. Agency and fire-department/district policy provisions will determine suppression response. Response will be full suppression when firefighter and public safety, property, improvements, or natural resources are threatened	Areas of monotypic saltcedar or in mix with mesquite or other riparian tree species may be treated mechanically or chemically or by controlled burning and reburning to reduce stem density, canopy, and excessive fuel loading. Mechanical removal for saltcedar by cutting below the root collar during November–January is preferred. Mechanical whole-tree extraction has achieved as high as 90% mortality on initial treatments and may be considered a preferred treatment. Low-volume oil-based herbicide applications in late spring through early fall would be considered for controlling small plants (<2 inches drc). Low-volume cut-stump herbicide applications will be considered in combination with mechanical treatment. Preferred phenological stage for burning is peak summer months and postavian breeding months. Black lines and appropriate headfires should be initiated depending on site-specific vegetative and burning conditions. Maintenance, revegetation, restoration, and monitoring should follow as needed for each treatment area. Seedlings can effectively be pulled by hand.
Slash/litter	Refer to Treatment 1 for areas close to structures. In areas away from structures, slash may be piled and burned, chipped and removed or lopped and scattered to a noncompacted thickness of no more than 2 feet deep and be treated later as part of a broadcast burn. Fuelwood and timber harvest are also viable means of removal in all areas.	Slash would be piled and burned or chipped and removed. Fuelwood and timber harvest are also viable means of removal.	Slash, jack piles, and down logs may be burned as appropriate in consideration of local conditions and distance from private property. Pile or Rx can be used to remove fuel from private land as designated. Snags and down woody material may be retained in areas where fire resilience is not compromised.	Snags, slash, and down logs will be removed in proximity to private land. Pile burning or broadcast burning can be used to remove fuel. Snags and down woody material may be retained in areas where fire resilience is not compromised. Vehicle pullouts should be planned in appropriate numbers and locations where vegetation, slope, and terrain permit.	After removal of heavy woody fuels, fine fuels may be maintained by cool-season low-intensity Rx that moves slowly downslope or into prevailing winds to midslope. Large down woody material and snags (≥12 inches) may be retained in riparian areas.	Fuel treatments and woody material removal will occur on existing roads. Cool-season low-intensity Rx may be used for maintenance of fine fuels. Pile or jackpot burning will not occur in ephemeral, intermittent, or perennial stream channels.	Fuel treatments and woody material removal could occur on existing roads. Cool-season low-intensity Rx may be used for maintenance of fine fuels. Pile or jackpot burning will not occur in ephemeral, intermittent, or perennial stream channels.	Created slash will be made available for woody biomass use. If not used for wood-related products, slash will be piled with preexisting fuels and burned, or otherwise used for soil stabilization. Disturbed areas should be immediately revegetated with a native plant community that contains no invasive species and meets other land use objectives, such as wildlife habitat enhancements or recreational-use benefits.

Note: R_x = prescribed fire, drc = diameter at root collar.

[a]List of Firewise plants can be found in the Firewise literature listed in Appendix C, Educational Resources.

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
Ajo	AJ1	M	Lands on SR 85 north of Ajo at Ajo airport	1,2,3,7,9	1,233	1,233	NA	1	NA
	AJ2	L	Lands on SR85 north of Ajo south of Ajo airport	1,2,3,7,9	2,560	2,145	NA	415	NA
	AJ3	L	Lands within the town of Ajo	1,2,3,7,9	14,396	7,035	32	7,329	NA
	AJ4	H	Lands on SR 85 immediately south of Ajo	1,2,3,7,9	5,771	3,984	NA	1,787	NA
Arivaca-Sasabe	See the Arivaca-Sasabe CWPP for description of the 29 Arivaca and 9 Sasabe treatment management units								
Avra Valley	AV1	L	Lands immediately west of I-10 west of Santa Cruz River	1,2,3,8,9	4,151	NA	NA	4,151	NA
	AV2	M	Central WUI Pinal County south to AV4 and AV3	1,2,3,8,9	16,232	1,894	5,050	9,288	NA
	AV3	M	Central WUI south of AV2 north of AV9	1,2,3,8,9	13,585	45	1,862	11,677	NA
	AV4	M	Central WUI south of AV2 north of AV8	1,2,3,8,9	10,756	1,888	1,821	7,047	NA
	AV5	M	Central WUI Pinal County south to Tohono O'odham boundary	1,2,3,8,9	16,886	11,161	4,476	1,249	NA
	AV6	H	Northeast WUI bordering Tohono O'odham and Pinal County	1,2,3,8,9	28,854	16,287	4,819	7,748	NA
	AV7	L	Eastern WUI bordering Tohono O'odham	1,2,3,8,9	12,896	3,587	310	5,951	3,048
	AV8	L	Southeast WUI bordering Tohono O'odham	1,2,3,8,9	12,520	4,481	1,718	6,321	NA
	AV9	M	Lands immediately north of Tohono O'odham including Brawley Wash	1,2,3,8,9,10	23,762	4,296	2,001	17,463	2
Cascabel	CB1	M	San Pedro River corridor community of Redington	1,2,3,5,7,8,9,10	13,601	NA	9,759	3,842	NA
Catalina Foothills	CF1	H	Northwest WUI in CNF buffer west of Sabino Canyon	1,2,3,4,5,7,8,10	3,004	2,354	NA	650	NA
	CF2	H	North-central WUI in CNF buffer east of Sabino Canyon	1,2,3,4,5,7,8,10	5,400	4,310	NA	1,090	NA
	CF3	H	Northeast WUI in CNF buffer	1,2,3,4,5,7,8,10	6,065	4,334	NA	1,731	NA
	CF4	L	South of CF1 adjacent to the Rillito River corridor	1,2,7,8,10	12,452	1	3	12,448	NA
	CF5	M	South of CF2 adjacent to Tanque Verde and Pantano creek corridors	1,2,7,8,10	11,521	58	NA	11,463	NA

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
	CF6	M	South of CF3 adjacent to Tanque Verde and Pantano creek corridors	1,2,7,8,10	12,865	NA	4	12,862	NA
	CF7	H	Northeast WUI at Redington Pass adjacent to Saguaro National Park	1,2,3,5,7,8,9,10	11,804	6,076	NA	5,729	NA
	CF8	H	Southeast WUI adjacent to Saguaro National Park	1,2,3,5,7,8,9,10	4,994	4,050	NA	944	NA
	CF9	L	Southwest WUI west of CF8	1,2,7,8,10	4,434	90	NA	4,344	NA
Corona de Tucson	CDT1	M	Northwest WUI south of Sahuarita Road	1,2,3,5,7,8,9	8,795	1,197	2,673	4,925	NA
	CDT2	M	North-central WUI immediately south of I-10	1,2,3,5,7,8,9	12,050	NA	11,251	799	NA
	CDT3	L	Central WUI south of CDT2	1,2,3,5,7,8,9	6,797	NA	3,310	3,487	NA
	CDT4	H	Northeast WUI south of I-10	1,2,3,5,7,8,9	3,116	NA	716	2,400	NA
	CDT5	M	Southern WUI north of Santa Rita Experiment Range	1,2,3,5,7,8,9	19,423	5,674	7,935	5,814	NA
	CDT6	M	Eastern WUI adjacent to CNF Santa Rita Mountains	1,2,3,5,7,8,9	29,708	2,971	18,026	8,712	NA
Golder Ranch			See the Catalina CWPP for description and risk ratings of G1 through G32						
	G33	H	Southeast WUI in the CNF buffer	1,2,3,4,7,8,9,10	2,993	2,993	NA	NA	NA
	G34	M	Northeast WUI in the CNF buffer	1,2,3,4,7,8,9,10	2,467	2,465	1	1	NA
	G35	M	Northwest WUI at Pinal County boundary	1,2,3,4,7,8,9,10	3,232	203	1,250	1,779	NA
Green Valley	GV1	H	South central WUI on I-19 corridor north of Santa Cruz County south of Green Valley	1,2,3,7,9	11,167	NA	1,006	10,161	NA
	GV2	L	Central WUI on I-19 corridor including Green Valley	1,2,3,7,9	11,036	NA	86	10,950	NA
	GV3	H	Southeast WUI north of Santa Cruz County on Santa Rita Mountains foothills	1,2,3,4,5,7,9	16,008	4,900	6,316	4,792	NA
	GV4	L	Eastern WUI on Santa Rita Mountains foothills and Santa Rita Experimental Range	1,2,3,4,5,7,9	31,794	8,818	19,285	2,691	NA
	GV5	L	Central WUI grasslands east of I-19 corridor east of Green Valley	1,2,3,5,7,9	39,614	51	34,574	5,009	NA
	GV6	M	Northeast WUI on City of Tucson border	1,2,3,5,7,9	16,176	NA	14,341	1,835	NA
	GV7	L	North central WUI I-19 corridor at Sahuarita	1,2,3,5,7,9	17,698	NA	3,370	14,328	NA

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
	GV8	M	North WUI immediately south of San Xavier District	1,2,3,5,7,9	3,835	NA	589	3,835	10
	GV9	L	Northwest WUI immediately south of San Xavier District east of ridge line of the Sierrita Mountains	1,2,3,5,7,9	38,295	2,498	4,115	31,619	64
	GV10	L	Southwest WUI east from ridge line of the Sierrita Mountains	1,2,3,5,7,9	22,237	122	14,112	8,003	NA
Kitt Peak	KT1	H	WUI surrounding Kitt Peak Observatory	1,2,3,4,5,7,	2,010	NA	NA	NA	2,010
Lukeville	LV1	M	WUI surrounding the community and Lukeville Port of Entry	1,2,3,9	1,742	1,389	NA	353	NA
Mescal-J6	M1	H	Isolated northern treatment management unit on Cochise County border, in Happy Valley south of Rincon Mountain Wilderness	1,2,3,4,5,7,9	3,017	2,395	NA	622	NA
	M2	M	Northeast WUI on Cochise County border north of I-10	1,2,3,4,5,7,9	5,512	1,324	1,748	2,439	NA
	M3	H	I-10 and Union Pacific Railroad corridor immediately east of Cochise County border	1,2,3,7,8,9	8,223	NA	6,258	1,965	NA
	M4	M	South of I-10 from Cochise County to Cienega Creek Natural Preserve	1,2,3,5,7,8,9	6,853	NA	6,258	1,965	NA
	M5	L	Southeast WUI west of Cochise County boundary north of Las Cienegas National Conservation Area	1,2,3,5,7,8,9	6,777	564	4,407	1,806	NA
Mount Lemmon	MT1	H	Community of Summerhaven and adjacent private and CNF lands	1,2,4,5,6,7	7,459	7,150	NA	309	NA
Northwest	NW1	H	Southeast WUI CNF buffer south of Golder Ranch WUI	1,2,3,4,7,8,9,10	5,524	3,797	1,727	NA	NA
	NW2	L	Central portion of WUI from southeastern fire department boundary including Casa Adobes, Canada del Oro, and portions of the city of Oro Valley	1,2,3,4,7,8,9,10	46,188	27	47	46,115	NA
	NW3	M	North-central WUI east of I-10 to northern fire department boundary	1,2,3,4,7,8,9,10	20,694	NA	3	14,586	NA

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
	NW4	M	I-10 corridor from southern fire department boundary to immediately south of Avra Valley Road, including Santa Cruz River	1,2,3,7,8,10	5,133	NA	196	4,938	NA
	NW5	L	Immediately south of Santa Cruz River from southern fire department boundary to Avra Valley Road	1,2,3,7,9	14,608	19	3	14,586	NA
	NW6	H	Southern WUI boundary in Tucson Mountains at Starr Pass north to immediately north of Gates Pass	1,2,3,7,9	2,654	NA	NA	2,654	NA
	NW7	H	Southwest WUI boundary from Gates Pass to immediately north of Sweetwater Drive foothills of Tucson Mountains	1,2,3,7,9	5,380	240	158	4,981	NA
	NW8	H	Western WUI Tucson Mountains from Wasson Peak north to northern boundary of Saguaro National Park	1,2,3,5,7,9	8,412	4,985	948	2,479	NA
	NW9	M	Central WUI from northern boundary of Saguaro National Park north to immediately above Avra Valley Road	1,2,3,7,9	3,251	42	6	3,203	NA
	NW10	H	I-10 corridor north from Avra Valley Road east to foothills of the Tortolita Mountains	1,2,3,7,9	22,448	882	12,187	9,379	NA
	NW11	L	Northwest WUI Twin Peaks Road north to north of Marana Road, including Marana Regional Airport and portions of the Santa Cruz River corridor	1,2,3,7,8,9,10	16,918	743	8,870	7,304	NA
Pascua Yaqui	PY1	NA	Pascua Yaqui tribal land	See Pascua Yaqui *Fire Management Plan* and *Fuels Management Plan*					
Picture Rocks	PR1	L	Northwest WUI boundary south to Saguaro National Park northern boundary	1,2,3,5,7,8	17,427	3,032	4,691	9,704	NA
	PR2	H	Northeast WUI in northern Saguaro National Park	1,2,3,5,7,8	5,968	3,551	686	1,732	NA
	PR3	H	Southwest WUI west of Saguaro National Park, including portions of Brawley Wash	1,2,3,5,7,8,9,10	6,631	3,788	900	1,943	NA
Rincon Valley	RV1	H	Northwest WUI immediately south of I-10 Davidson Canyon west to Wentworth Road	1,2,3,7,8,9	4,729	NA	3,282	1,447	NA

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
	RV2	L	South of RV1 east to Davidson Canyon	1,2,3,7,8,9	4,031	NA	3,716	316	NA
	RV3	M	Immediately south of I-10 at Davidson Canyon east to Las Cienegas Conservation Area	1,2,3,7,8,9	4,231	NA	4,209	22	NA
	RV4	H	North WUI I-10 Union Pacific corridor from fire department boundary east to eats of Las Cienegas Conservation Area, including the community of Vail	1,2,3,7,8,9	14,007	NA	6,621	7,386	NA
	RV5	H	North of RV5 foothills of the Rincon Mountains	1,2,3,7,8,9	6,653	NA	3,737	2,916	NA
	RV6	M	East-central WUI foothills of Rincon Mountains portion of Agua Verde Creek	1,2,3,7,8,9	5,048	205	2,680	2,164	NA
	RV7	H	Northeast WUI, including southern portion of Rincon Mountain Wilderness	1,2,3,7,8,9	4,963	3,925	62	976	NA
	RV8	L	Central WUI south of Rincon Mountain Wilderness, including portions of Agua Verde Creek	1,2,3,7,8,9	5,465	14	3,403	2,049	NA
	RV9	H	North-central WUI west from city of Tucson boundary east to CNF boundary, including portions of Cienega Creek Natural Preserve	1,2,3,7,8,9	6,384	1,211	281	4,891	NA
	RV10	L	North-central WUI at city of Tucson boundary east along Old Spanish Trail to Colossal Cave Park	1,2,3,7,8,9,10	21,488	11	7,766	13,712	NA
	RV11	H	Northwest WUI at city of Tucson boundary east at south boundary of Saguaro National Park	1,2,3,7,8,9,10	19,072	8,975	1,392	8,705	NA
San Xavier	SX1	M	San Xavier District		69,971	See *Tohono O'odham Nation Fire Management Plan*			69,971
Sells	Sells1	H	Northwest of community		2,180	See *Tohono O'odham Nation Fire Management Plan*			2,180
	Sells2	M	Community center		1,152	See *Tohono O'odham Nation Fire Management Plan*			1,152
	Sells4	H	South and northeast of community		4,489	See *Tohono O'odham Nation Fire Management Plan*			4,489
Sonoita Elgin	See the Sonoita Elgin CWPP for description and risk ratings of the 79 treatment management units								
Three Points	TP1	H	Northeast WUI, including Tucson Mountain Park	1,2,3,7,9	25,706	5,750	929	19,027	NA

Table 3.2. Identified Treatment Management Units

Treatment Management Unit	Map ID	Risk Value	Location and Description	Recommended Treatment[a]	Total Acres	Federal Acres	State Trust Acres	Nonfederal Acres	Tribal Acres
	TP2	H	Northeast WUI Tucson Mountain Park along SR 86 south to San Xavier District on city of Tucson boundary	1,2,3,7,9	7,955	62	58	7,829	6
	TP3	L	Central WUI north of Pascua Yaqui tribal land north to Tucson Mountain Park	1,2,3,7,9	19,412	1,927	2,391	15,087	7
	TP4	M	Central WUI, including Ryan Airfield	1,2,3,7,9	17,632	931	4,027	12,657	17
	TP5	M	West-central WUI Avra Valley south of Tohono O'odham Nation, including portions of Brawley Wash	1,2,3,7,8,9,10	28,821	1,273	13,166	14,372	10
	TP6	M	West-central WUI east of Tohono O'odham Nation, including portions of Brawley Wash, Altar Valley, and the community of Three Points	1,2,3,7,8,9,10	49,690	1,248	28,994	17522	1925
	TP7	M	East-central WUI south of community of Three Points east to Sierrita Mountains and south to McGees Settlement	1,2,3,7,8,9,10	39,625	2,424	23,757	13,411	33
	TP8	M	West central WUI including Brawley Wash, SR286, and Altar Wash	1,2,3,7,8,9,10	47,430	2,650	33,382	11,398	NA
	TP9	M	Southwest WUI south of TP8 on SR286 along Altar Wash to Buenos Aires National Wildlife Refuge	1,2,3,7,8,9,10	46,450	4,750	32,773	8,928	NA
Tohono O'odham	TO1	L	Tohono O'odham Nation in Avra Valley	See *Tohono O'odham Nation Fire Management Plan*	10,108	5	NA	14	10,089
Tucson and South Tucson	TUC1	L	Municipal boundaries of cities of Tucson and South Tucson	1,2,7,8,9,10	172,482	10,769	37,441	124,257	15
	TUC2	M	I-10 corridor from approximately Rita Road interchange to Vail interchange	1,2,3,7,9	6,525	NA	6,160	365	NA
	TUC3	H	Pima County Fairgrounds and Southeast Regional Park	1,2,3,7,9	3,034	NA	19	3,015	NA
Why	W	M	Community of Why	1,2,3,7	4,619	2,402	643	495	1,081

Note: L = low, M = moderate, H = high.

[a]See Table 3.1 for recommended treatments.

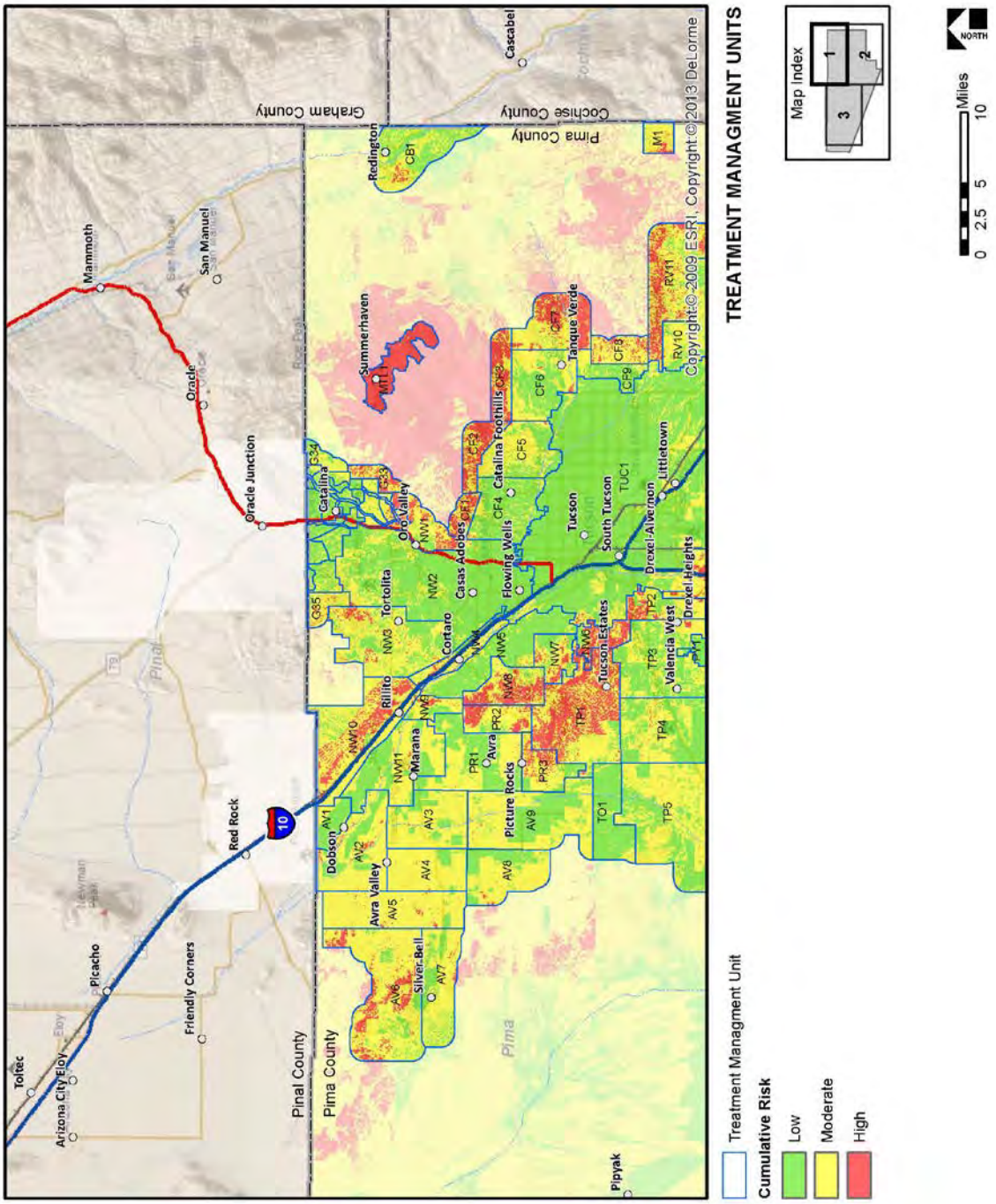

Figure 3.1a. Pima County CWPP Treatment Management Units, North

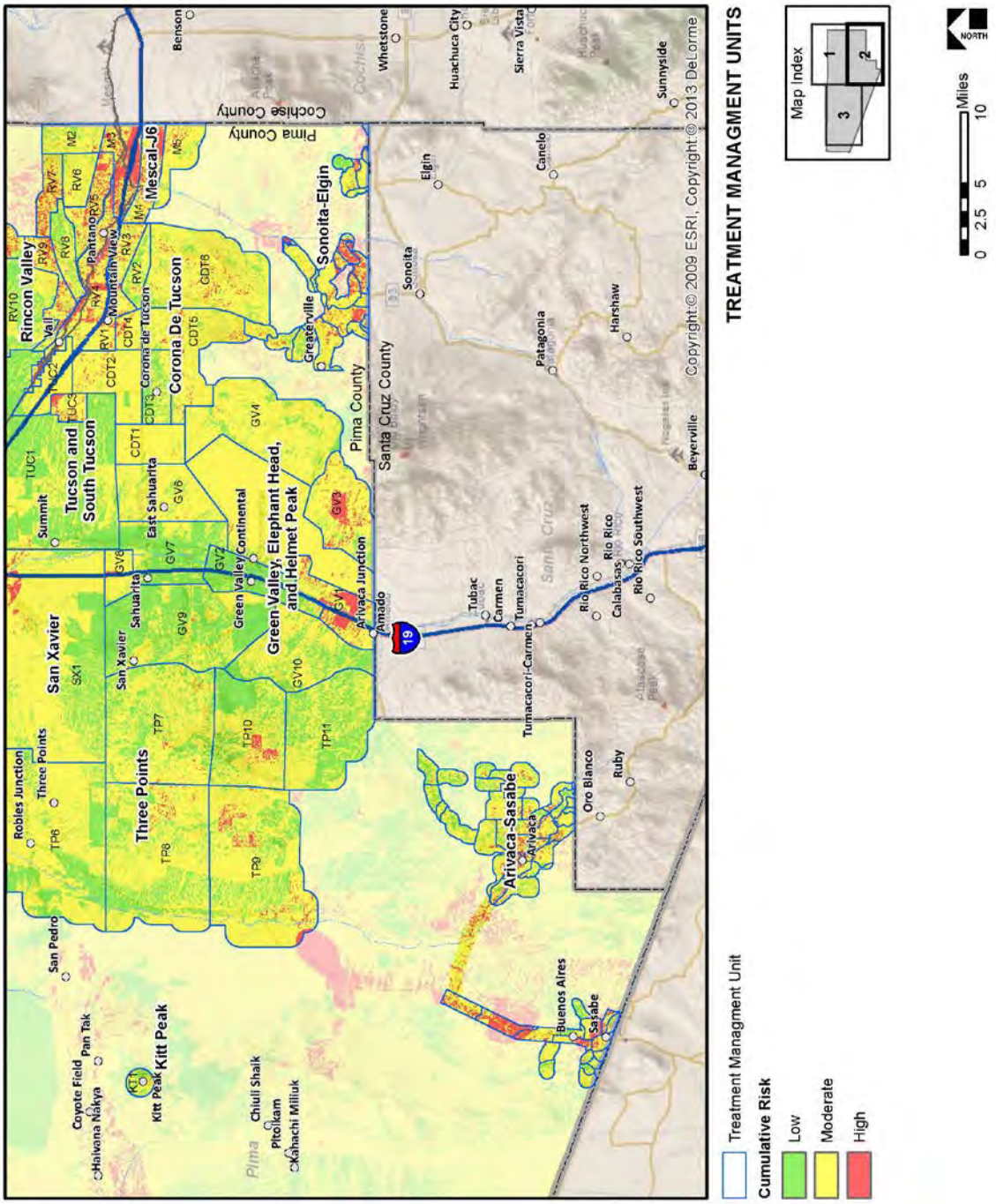

Figure 3.1b. Pima County CWPP Treatment Management Units, South

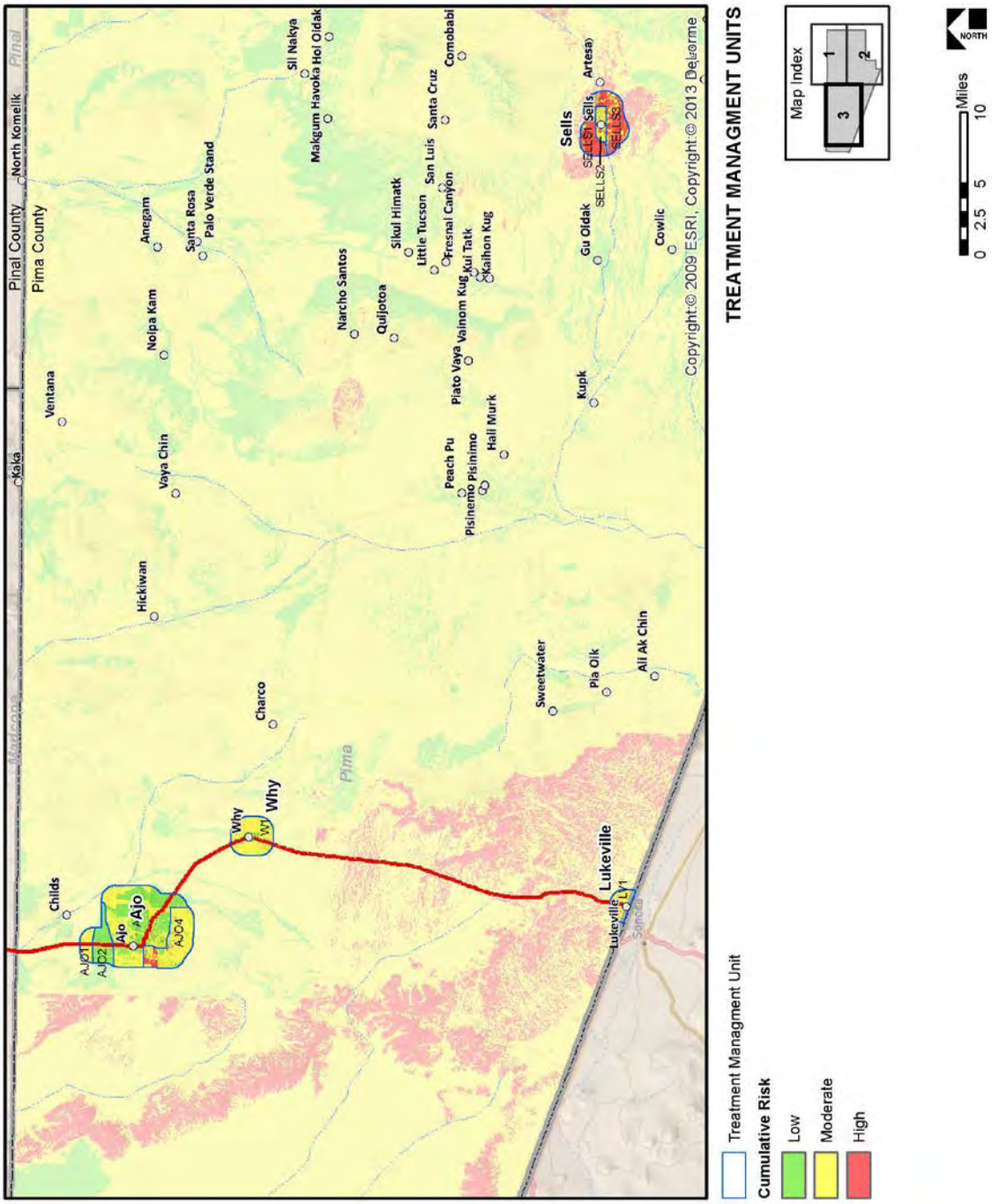

Figure 3.1c. Pima County CWPP Treatment Management Units, West

The Core Teams recommend that when available, wildland fuel modification projects be contracted to ASFD to ensure that treatments are conducted in a timely fashion and at a reasonable cost. The estimates of daily costs, which include a 20-person inmate labor crew and a chipper for a 100-mile roundtrip to the project site by an ASFD crew carrier, are as follows:

- 10-hour day—$1,400.00
- 12-hour day—$1,580.00

Cost estimates for treatments in the WUI are based on the estimates provided by the ASFD for the Fire and Fuels Crew costs for both federal and nonfederal land treatments (see Table 3.3). The ASFD Inmate Fire and Fuels Crews do not remove hazard trees or provide "climbers" for pruning or segmented tree removal that is sometimes required on private lands. The Core Teams do support and encourage local business development that will complement wildland fuel mitigation needs within federal and nonfederal lands of the WUI. Vegetative fuel mitigation costs for this CWPP are estimated to be $350.00 per acre, which is comparable to the estimated cost of the ASFD Inmate Fire and Fuels Crews and to estimated fuel mitigation costs on adjacent federal lands. However, the availability of federal, state, and local funding for mitigation of wildland fire risk, enhanced response, and public education will drive the ability of the Core Teams to meet the goals of the Pima County CWPP.

Table 3.3. Acres of Wildland Fuels Mitigation Treatment Conducted by ASFD Fire and Fuels Crew during a 10-Hour On-Site Workday

Vegetation Association	Average Acres per Day Treated
Ponderosa pine/mixed conifer	0.5 to 1 acre per day
Pinyon/juniper	1 to 2 acres per day
Mesquite woodland	3 to 4 acres per day
Oak woodland	3 to 4 acres per day
Riparian	1 to 2 acres per day (depending on fuel loading)
Grassland	2 to 4 acres per day (depending on grass type and fuel loading)

The Core Teams recommend that private landowners who wish to adopt fuel modification plans other than those described in Table 3.1 have the plan prepared or certified by a professional forester, by a certified arborist, by other qualified individuals, or in conjunction with local fire department or fire districts recommendations that reference Firewise or firesafe guidelines. Fuel modification plans for federal and state lands within 0.5 mile of private land may be prepared for wildlife and watershed benefits—including the retention of large snags or vegetative patches of high wildlife value in areas more than 600 feet from private lands in which desired vegetative objectives are not impaired and will not compromise public or firefighter safety from unwanted wildland fire. A fuel modification plan should identify the actions necessary to promote rangeland, wildlife, or watershed health and to help prevent the spread of fire to adjacent properties by establishing and maintaining survivable space. The action identified by the fuel modification

plan should be completed before development of the property or identified during project initiation on federal and state lands.

Alternate Federal, State, or Private Land Wildland Fuel Modification Plan

A fuel modification plan for federal and state lands will follow agency procedures, standards, and guidelines. Fuel modification treatment plans for private land parcels should at least include the following information:

- A copy of the site plan
- Methods and timetables for controlling, changing, or modifying fuels on the properties in a timely and effective manner
- Elements for removal of slash, snags, and vegetation that may grow into overhead electrical lines; removal of other ground fuels, ladder fuels, and diseased, dying, and dead trees; and thinning of live trees
- Methods and timetables for controlling and eliminating diseased or insect-infested vegetation
- A plan for the ongoing maintenance of the proposed fuel reduction and control measures for disease and insect infestations
- A proposed vegetation management plan for groupings of parcels under multiple ownership that has been accepted by all individual owners (subject to compliance with this section)

The recommended treatments within the Pima County CWPP have been developed to be consistent with federal land-management action alternatives and are intended to be compliant with and facilitate efficient planning and decision making concerning fuels mitigation treatments or habitat rehabilitation of areas so as to reduce risks to communities caused by severe fires and to restore fire-adapted ecosystems (USDA FS 2000).

B. Prevention and Loss Mitigation

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 Pima County CWPP Core Teams established specific goals for wildland fire prevention and loss mitigation as follows:

- Improve fire prevention and suppression for firefighter and public safety and to protect private property
- Promote community collaboration, involvement, and education
- Work with organizations such as SABCC who promote public awareness and activism for management of high risk vegetation such as buffelgrass
- Recommend measures to reduce structural ignitability in the Pima County CWPP WUI
- Preserve the aesthetics and wildlife values within native habitats
- Identify funding needs and opportunities
- Expedite project planning through partnerships with ASFD, BLM, CNF, NPS, and private and public entities in managing wildland fire risk within the WUI

The Pima County CWPP will be reviewed and updated as needed. Successful implementation of this plan will require a collaborative process among multiple layers of government entities and a broad range of community interests. The PCOEM and Core Teams have also discussed the advantage of working cooperatively with Tucson Electric Power (TEP), and Salt River Project (SRP) utility companies to maintain acceptable wildland fuel conditions within TEP and SRP existing utility corridors, rights-of-way, easements and other utility owned lands within high risk areas of the WUI. The Core Teams, TEP, and SRP also recognize the benefits of working cooperatively to achieve acceptable wildland fuel conditions adjacent to the utility companies' easements, rights-of-way and other utility owned lands. The Core Teams recognize existing agreements between TEP, SRP, land-management agencies, and private landowners for vegetative treatments within rights-of-way and easements, and agree that the Pima County CWPP does not bind or obligate TEP or SRP in the maintenance of vegetative fuels outside their rights-of-way or easements. The Core Teams believe that these agreements and resultant vegetative treatments are complementary to the objectives of the Pima County CWPP.

The Core Teams and collaborators have made the following action recommendations to meet the goals of the Pima County CWPP:

1. *Establish Pima County CWPP Administration and Implementation*

- Establish a countywide community CWPP Working Group—composed of Pima County fire chiefs, PCOEM, ASFD, BLM, CNF, NPS, USFWS, SABCC, TEP, and SRP concurring agencies, and members of the Core Teams to coordinate individual agency implementation of the recommendations for fuel modification, public outreach, protection capability, and structural ignitability within the Pima County CWPP WUI, including fuel hazards removal on private lands within the WUI.

2. Improve Protection Capability and Reduce Structural Ignitability

The Pima County CWPP considers the risks of wildland fire igniting and spreading throughout the WUI a serious threat. The Core Teams and collaborators believe that actions to reduce fire risks and promote effective responses to wildland fires must be undertaken. The following are recommendations to enhance protection capabilities for at-risk communities within Pima County:

- Obtain fully functional Type 6 engines and fully functional Type 3 engines for wildland fire response by local fire departments and districts.
- Obtain a medium-size water tender for local use by fire departments and districts.
- Strategically locate additional water-storage tanks, wells, or other water sources for tender filling throughout the fire departments and districts.
- Maintain helicopter landing sites.
- Update mapping capabilities of local fire departments and districts.
- Encourage fire departments and districts to participate in annual multi-agency wildland fire safety training conducted prior to the fire season.

- Encourage fire departments and districts to report responses to brushfires and fuel type to SABCC for incorporation into the SABCC data base.
- Obtain a chipper/shredder, tub grinder, air curtain destructor, and other equipment necessary for treatment and processing of vegetative slash for use by local fire departments and districts for wildland fuel mitigation projects.
- Obtain multi-purpose utility vehicle with attachments for chipping, brush cutting, and mini water tending, such as the Bobcat Toolcat.
- Implement GIS and GPS (Global Positioning System) software and laptops to update mapping capabilities of local fire departments and districts.
- Arrange for the acquisition, operation, and maintenance of a green-waste disposal site within reasonable proximity to the citizens and encourage the use of the disposal site for all vegetative material removed during wildland fuel treatments on private lands within the WUI.
- Provide enhanced and coordinated firefighting training and equipment, such as personal protective equipment and second-generation fire shelters, for newly certified wildland firefighters and volunteer firefighters.
- Develop and maintain mutual-aid agreements with neighboring fire departments or districts for wildland and structural fire response support and other emergency response.
- Meet annually with representatives from SRP and TEP to mutually identify locations of needed vegetative treatments within rights-of-way in high-risk areas of the WUI and support the Core Team in obtaining grants and agreements necessary to implement vegetative fuel reduction projects adjacent to rights-of-way.
- Develop a pre-suppression plan with BLM, NPS, ASFD, CNF, USFWS, PCOEM and local fire departments along the boundary of the WUI.
- Develop additional wildland fire preplans for all high-hazard locations across Pima County where they have not been adopted.
- Develop IGAs with Pima County on nuisance-abatement projects located in high-hazard communities.
- Meet annually before the fire season, to coordinate early suppression deployment and to determine training and equipment needs.

3. Promote Community Involvement and Improve Public Education, Information, and Outreach

Pima County, BLM, CNF, NPS, USFWS, ASFD, SABCC, local fire departments and districts, and the Core Teams will continue developing and implementing public outreach programs to help create an informed citizenry. The Core Team recognizes the significance of partnering with organizations such as SABCC in public involvement, volunteer management and wildland fuel treatment data keeping. The goal is to have residents support concepts of Firewise and fire-safe landscaping and naturally functioning wildland systems through restoration management, invasive species management, and rapid response to wildland fire. There are groups such as SABCC, who are currently promoting wildfire and vegetation management awareness through their programs. Developing working relationships and sharing information would

strengthen the message and benefit all parties involved. The Pima County CWPP is intended to be a long-term strategic plan containing prescriptive recommendations to address hazardous fuels. A grassroots collaborative structure of individual citizens, supported by local governments as full partners, will provide the most effective long-term means to achieve these goals and to maintain community momentum. The components of such a structure include the following recommendations:

- Assist in implementing a Firewise Communities/USA Recognition program in communities where the program is supported by the local fire departments and districts. The Firewise Communities approach emphasizes community and individual responsibility for safer home construction and design, landscaping, and maintenance. The Core Teams will also help identify high-priority communities that would most benefit from a Firewise Communities program.
- Expand the use of current public information tools for fire-safe residential treatments as an immediate action step. This will be accomplished through information mailers to homeowners, presentations by local fire departments and districts, and the development of specific promotional materials by Pima County.
- Coordinate with SABCC in encouraging public reporting of buffelgrass distribution, abundance, and fire response information.
- Collaborate with SABCC to develop duel use outreach/education materials which promote wildfire awareness and the benefits of vegetation management specifically high fire risk buffelgrass.
- Assist with SABCC in developing the Integrated Brushfire Database that will be used to map current and historic brushfires within the WUI to promote awareness of the dangers of brushfires and buffelgrass and for identifying high risk areas.
- Place fire-danger information signs on major access roads throughout the WUI. Community bulletins and other public service announcements concerning wildfire threat and preparedness should be developed with assistance from ASFD, BLM, NPS, CNF, USFWS, and Pima County.
- Place and maintain bilingual wildfire caution signs within camping areas and access routes in some areas of the WUI.
- Complete wildfire home assessments through the use of Redzone software, or an equivalent software system, and submit wildfire hazard mitigation strategies to landowners for each private property assessed within highest risk communities.
- Replace and maintain fencing adjacent to high-use and illegal off-road-vehicle use areas within or adjacent to the WUI.

4. Encourage Use of Woody Material from WUI Fuel Mitigation Programs

The Core Teams and their collaborators will continue to support and promote private contractors who perform Firewise mitigation work. The County will continue to support and promote new businesses involved in the wildland fuel reduction market. Pima County, CNF, NPS, BLM, USFWS, and local fire departments and districts are committed to encouraging, as appropriate, the use of vegetative by-products from the WUI fuel management program for commercial or community-service organization use. Possible

by-product uses encouraged by the Core Teams include the following:

- Bagged mesquite wood for sale to visitors and larger-community markets as “campfire cooking” for commercial or personal culinary uses
- Firewood marketed to local residents, visitors, and adjacent communities
- Mesquite, pinyon pine, and juniper wood marketed for artwork, furniture, and other specialty wood products

IV. PIMA COUNTY CWPP PRIORITIES: ACTION RECOMMENDATIONS AND IMPLEMENTATION

The Core Teams have developed action recommendations (see Section III of this CWPP) necessary to meet the plan's objectives. A series of recommendations for reducing wildland fuels and structural ignitability, improving fire prevention and suppression, and enhancing public outreach have been developed by the Core Teams. A unified effort to implement this collaborative plan requires timely decision making at all levels of government. However, the Core Teams recognize that countywide recommendations do not impinge on or interfere with the fire departments' and districts' rights to independently seek funding for projects within their jurisdictions without CWPP Working Group support.

To meet Pima County CWPP objectives, the Core Teams have developed the following action recommendations. At the end of each year, projects implemented from these action recommendations will be monitored for effectiveness in meeting Pima County CWPP objectives. For the life of the Pima County CWPP, recommendations for additional projects will be made for each future year on the basis of project performance from the previous implemented projects.

A. Administrative Oversight

Generally, the most efficient way to manage the mitigation of wildland fire threat in the WUI is through identifying, delegating, implementing, and monitoring the action recommendations of the Pima County CWPP. Establishing a unified effort to collaboratively implement the Pima County CWPP embraces adaptive management principles that enhance decision making and reduce inconsistency at all levels of government.

The Core Teams recommend the establishment of a countywide community CWPP Working Group (CWPP Working Group)—composed of the fire chiefs from Pima County or their representatives, PCOEM, SABCC, ASFD, CNF, NPS, Pascua Yaqui Tribe, and BLM—to work with the Core Teams and concurring agencies to accomplish the recommendations for outreach and structural ignitability within the Pima County CWPP WUI area, which include fuel hazards removal on private lands within the WUI. The CWPP Working Group should consist of interested community members; local fire departments and districts; and, as needed, additional representatives from the PCOEM, SABCC, ASFD, ASLD, CNF, NPS, BLM, and other concurring agencies. PCOEM will be the lead agency responsible for coordinating the CWPP Working Group and producing the monitoring reports and future updating of the CWPP.

The CWPP Working Group will prioritize wildland fuel modification, structural ignitability, protection capability, and public outreach projects listed in the approved Pima County CWPP on a countywide basis, and will review these priority recommendations for possible reprioritization subsequent to approval of the Pima County CWPP by ASFD. Fuel modification and community planning, outreach, and wildfire threat warning programs will be prioritized by the CWPP Working Group as a whole; other projects involving firefighter training, equipment, communications, facilities, and apparatus will be recommended by the fire chiefs from Pima County or their representatives in the CWPP Working Group.

The CWPP Working Group is expected to be an advocate for and provide support to fire departments and districts or other agencies in the submittal of grant applications and the solicitation of other funding

opportunities to implement wildland fuel modification, structural ignitability, protection capability, and public outreach projects established as priorities by the CWPP Working Group. Additionally, individual agencies will be able to seek letters of support from the CWPP Working Group or partner agencies in applying for funding for projects identified as priorities by the Working Group.

The CWPP Working Group will also compile monitoring and report data from cooperating agencies to provide information on additional measures necessary to meet Pima County CWPP goals, including additional future recommendations from fire departments and districts and other agencies for inclusion in the priority recommendations. The CWPP Working Group may also act as an advisory group to Pima County Planning and Zoning and to developers in outlying areas to ensure adequate fire response access and to provide vegetation mitigation and landscaping recommendations, water supplies for emergency services, and recommendations for establishing and funding fire services and equipment in residential and commercial developments.

The following general criteria will be used for prioritizing proposed projects and action items:

1. Geographic/fuel-load/residential density:
    a. The Mt. Lemmon Community WUI will remain a high priority for wildland fuel modifications, public education and outreach and enhanced wildland fire response due heavy fuel type such as ponderosa pine, mixed conifer, and Madrean pine-oak forest vegetation associations which as evidenced by previous wildfires, can support extreme fire behavior. Wildfire ignitions within the Mt. Lemmon Community WUI and public use within the WUI is considered high.
    b. The Catalina Foothill Community WUI will remain a high priority area for wildland fuel modifications, public education and outreach and enhanced wildland fire response. Specific high risk areas include desert washes originating from the foothills of the Santa Catalina and terminating at Tanque Verde and Rillito creeks, heavy fuel loads associated with the foothills of the Santa Catalina Mountains. High public use within the WUI in Sabino Canyon and other community and CNF trails in the WUI. The WUI is mostly composed of large developed private land parcels of high assessed value and some areas with a high ISO rating.
    c. The San Pedro, Santa Cruz River, and urban riparian corridor including Canada del Oro, Rillito, and Pantano will receive long-term priority due to high vegetative fuel risk, infestations of saltcedar, high ignition history, and threatened structures and infrastructures.
    d. Areas with high infestation of invasive species, especially buffelgrass in proximity to high community values.
    e. Fuel breaks to be established and maintained in the front range of the Catalina and Rincon Mountains bordering the CNF and Saguaro National Park East will receive long-term priority due to high wildland fire threat potential, invasive species, and high community values at risk.
    f. In any given year, the CWPP Working Group will evaluate countywide weather, vegetation, and fuel-load conditions and projections, as well as current residential and commercial densities, to determine short-term priority adjustments for projects in all WUI areas of the county for that year.
    g. In any given year, the CWPP Working Group will evaluate the progress of new developments and increasing residential and commercial densities to determine potential needs and priorities within the WUI for 3 years following that given year.

2. Categorical/functional criteria—priorities will generally be established in the order listed below; these priorities are subject to review and change by the CWPP Working Group on an ongoing basis:
   a. Prioritize fuel modification projects that are within fire-department and fire-district, CNF, NPS, BLM, or ASFD jurisdictions within the Avra Valley and Rincon Valley sub-WUIs
   b. Enhance wildland firefighter training and acquire personal protection equipment
   c. Acquire wildland-fire suppression equipment and tools, including brush engines and water tenders
   d. Develop water-storage sites and supply facilities
   e. Develop community planning and outreach activities, including warning signs/systems and identification and improvement of evacuation routes
   f. Designate and develop helicopter pads for firefighter deployment or evacuation
   g. Construct fire stations in areas with sufficiently high threat and population densities as determined annually by the CWPP Working Group

The agencies involved in the formation of this plan support local community efforts and will work with the communities as needed to accomplish action items. BLM, CNF, NPS, ASFD, Pascua Yaqui Tribe, PCOEM, and fire departments and districts will coordinate fuel mitigation projects on state, public, and National Park and Forest Systems lands, and also within TEP, and SRP utility corridors, within the WUI in coordination with the CWPP Working Group when established. The Core Teams and the proposed CWPP Working Group will be responsible for submitting grants and soliciting other opportunities to implement wildland fuel mitigation projects on private lands and to support public information, education, and outreach within the WUI. Successful award of grant funds will be used to implement the action recommendations for private land treatments, mitigation features for reduced structural ignitability, firefighting response, and public outreach. BLM, CNF, NPS, Pascua Yaqui Tribe, ASFD, PCOEM, fire departments and districts, and the Core Teams will pursue funding to construct and maintain firebreaks as well as broader applications of wildland fuel mitigation projects within the WUI. Monitoring and reporting compiled by the CWPP Working Group will provide information on additional measures necessary to meet Pima County CWPP goals. Some projects may require Endangered Species Act or State Historic Preservation Officer consultations.

B. Priorities for Mitigation of Hazardous Wildland Fuels

Table 4.1 displays the priority for constructing firebreaks and landscape wildland fuel treatments within the WUI as recommended by the Core Teams. These action recommendations will reduce wildfire potential to the community and have high valuations for reducing wildland fire risk. The Core Teams recognize that not all acres within a high-risk landscape can be treated. Site-specific analysis will determine treatment acres and methods that produce a fire-resilient vegetative stand appropriate for the habitat.

C. Identified Action Items for Protection Capability and Reduced Structural Ignitability

The Core Teams and collaborators will evaluate; maintain; and, where necessary, upgrade community wildfire preparation and response facilities, capabilities, and equipment. Table 4.2 lists the identified action items proposed by the Core Teams for consideration by individual fire departments and districts for structural ignitability and public outreach within their respective jurisdictions.

The CWPP Working Group will meet subsequent to the ASFD's final approval of the Pima County CWPP to prioritize projects on a countywide basis for the upcoming year and, thereafter, at least annually to reevaluate projects and reallocate priorities as needed. Such countywide prioritization will not impinge on or interfere with the fire departments' and districts' rights to independently seek funding for projects within their jurisdictions without CWPP Working Group support.

Table 4.1. Action Recommendations for Wildland Fuel Modification

Management Area[a]	Location and Description	Project Partner	Estimated Treatment Cost[b]
NW1	Southeast WUI CNF buffer South of Golder Ranch WUI	PCOEM, ASFD, and Northwest Fire Department	5,524 high-risk acres, 30% of lands to be treated over 3 years estimated to be 550 acres/year in FY 2014–16 = $221,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
G33	Southeast WUI in the CNF buffer	PCOEM, CNF, ASFD, and Golder Ranch Fire Department	2.993 high-risk acres, 30% of lands to be treated over 3 years estimated to be 300 acres/year in FY 2014–16 = $120,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
CF2	North-central WUI in CNF buffer east of Sabino Canyon	PCOEM, CNF, Rural Metro Fire Department, Hidden Valley, and Tanque Verde Fire Department	5,400 high-risk acres, 30% of lands to be treated over 3 years estimated to be 540 acres/year in FY 2014–16 = $216,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
RV11	Northwest area of the WUI adjacent to the City of Tucson boundary along the western and southern boundary of Saguaro National Park	PCOEM, ASFD, CNF, NPS, BLM, and Rincon Valley	19,072 high-risk acres, 30% of lands to be treated over 5 years estimated to be 1,150 acres/year in FY 2013–16 = $458,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
TP1	Northeast WUI including Tucson Mountain Park	PCOEM, NPS, BLM, ASFD, and Three Points Fire Department	25,706 high-risk acres, 30% of lands to be treated over 10 years estimated to be 775 acres/year in FY 2013–16 = $310,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
M3	I-10 and Union Pacific Railroad corridor immediately east of Cochise County border	PCOEM, BLM, ASFD, and Mescal-J6 Fire Department	8,223 high-risk acres, 30% of lands to be treated over 5 years estimated to be 595 acres/year in FY 2013–16 = $198,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
GV1	South central WUI on I-19 corridor north of Santa Cruz County south of Green Valley	PCOEM, ASFD, and Green Valley Fire Department	11,167 high-risk acres, 30% of lands to be treated over 5 years estimated to be 670 acres/year in FY 2014–16 = $268,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands

Table 4.1. Action Recommendations for Wildland Fuel Modification

Management Area[a]	Location and Description	Project Partner	Estimated Treatment Cost[b]
MT1	Mount Lemmon WUI – Areas within and surrounding the Mount Lemmon WUI Boundary which includes the community of Summerhaven to include:	CNF, MLFD, ASFD, Mount Lemmon Water District (MLWD), University of Arizona (UA), organization camps, communications site permit holders, privates land owners, recreational residence permit holders	7,459 high-risk acres, 30% of lands to be treated over 5 years estimated to be 445 acres/year in FY 2014–16 = $178,000.00/year; cost estimated to average $400.00/acre on federal, ASLD, and private lands
	1. Spencer Bigelow Project - Mt. Bigelow to Spencer Peak including Palisades, Lower Soldier's Camp	1. CNF, ASFD, (RRM), communications site permit holders, UA, recreational residence permit holders	1. 843 acres
	2. Loma II -USFS land south of Summerhaven	2. CNF, MLFD, ASFD, private landowners, recreational residence permit holders	2. 135 acres
	3. Turkey Run - Drainage that supports the Mount Lemmon Water District (MLWD) water supply	3. CNF, MLFD, ASFD, MLWD, UA, Ski Valley, private landowners	3. This area has been identified as a priority using fire modeling and local knowledge. Acreage is unknown at this time. Priorities are subject to change as conditions change and site specific information grows through field verification and analysis.
	4. Firebreak - Southwest of Summerhaven	4. CNF, MLFD, ASFD, UA, private landowners, recreational residence permit holders	4. 1 chain fuelbreak
	5, Organization Ridge - Permitted areas for organizations along Organization Ridge Road	5. CNF, MLFD, ASFD, Boy Scouts of America Camp Lawton, Girl Scouts of America Whispering Pines Camp, First Southern Baptist Church, Sycamore Canyon Academy-Rite of Passage, Camp Zion, Amphi Camp, St. Marks Presbyterian Church, Pima County Sheriff's Department, RRM	5. This area has been identified as a priority using fire modeling and local knowledge. Acreage is unknown at this time. Priorities are subject to change as conditions change and site specific information grows through field verification and analysis.
	6. Bear Wallow – Area along Bear Wallow Road west of Mt. Bigelow (Rd 2 and Rd 34)	6. CNF, MLFD, ASFD, UA, recreational residence permit holders	6. This area has been identified as a priority using fire modeling and local knowledge. Acreage is unknown at this time. Priorities are subject to change as conditions change and site specific information grows through field verification and analysis.

Table 4.1. Action Recommendations for Wildland Fuel Modification

Management Area[a]	Location and Description	Project Partner	Estimated Treatment Cost[b]
	7. Southwest of Development – Areas southwest of development includes, but is not limited to Summerhaven, Greater Soldier's Camp, Organization Ridge, and Willow Canyon	7. CNF, MLFD, ASFD, private landowners, recreational residence permit holders	7. This area has been identified as a priority using fire modeling and local knowledge. Acreage is unknown at this time. Priorities are subject to change as conditions change and site specific information grows through field verification and analysis.
	8. Rose Canyon – Near Rose Canyon Campground, adjacent to Catalina Highway	8. CNF, MLFD, ASFD, RRM, recreational residence permit holders	8. This area has been identified as a priority using fire modeling and local knowledge. Acreage is unknown at this time. Priorities are subject to change as conditions change and site specific information grows through field verification and analysis.
Firebreak maintenance	1- to 3-year rotating maintenance of fine and light fuels in firebreaks	ASLD, ASFD, NPS, CNF, PCOEM, and participating fire departments and districts	1,200 acres/year of light understory fuel treatments in excess of 4 acres treated/10-hour day at $1,400.00/day costs = $420,000.00/year

[a] NW = Northwest ; MT = Mount Lemmon; GV = Green Valley; RV = Rincon Valley; M = Mescal-J6; TP = Three Points; CF = Catalina Foothills; G = Golder Ranch.

[b] Total acres to be treated during the life of the plan; one-third of acres estimated to be treated based on site-specific analysis, which will determine actual acres available for treatment in each area.

Table 4.2. Action Recommendations for Structural Ignitability and Public Outreach

Project Partner	Project	Specific Recommendation	Estimated Cost	Timeline
PCOEM and Northwest Fire Department	**E1**—Wildland Fire Protection and Reduced Ignitability	Purchase one Type 3 fire engine for use by Northwest Fire Department	New acquisition with standard equipment $320,000.00	Begin grant applications in 2014; purchase in 2015
PCOEM and Green Valley Fire District	**E1**—Wildland Fire Protection and Reduced Ignitability	Purchase one Type 6 fire engine for use by Green Valley Fire District	New acquisition with standard equipment $131,000.00	Begin grant applications in 2013/2014; purchase in 2014/2015
PCOEM, CNF, NPS, ASFD, ASLD, and associated fire departments and districts	**A1**—Wildland Fire Protection and Reduced Ignitability	Construct a series of 5,000-gallon water-storage facilities located strategically throughout residential areas	Install water-storage facilities/year: $5,000.00/facility	Locate and install one water-storage facility in 2013
PCOEM and Corona de Tucson Fire Department	**A2**—Enhanced Public Education, Information, and Outreach	Develop wildfire public education brochures	Produce and publish community-specific wildfire informational brochures	Begin grant applications in 2013; continue on an ongoing basis in 2014
PCOEM and Rural/Metro and Tucson Fire Departments	**E2**—Wildland Fire Protection and Reduced Ignitability	Obtain one Type 6 brush truck for wildland fire response within the Catalina Foothills community WUI	New acquisition with standard equipment $131,000.00	Begin grant applications in 2014; purchase in 2015

Table 4.2. Action Recommendations for Structural Ignitability and Public Outreach

Project Partner	Project	Specific Recommendation	Estimated Cost	Timeline
PCOEM, CNF, NPS, ASFD, ASLD, and associated fire departments and districts	**A2**—Enhanced Public Education, Information, and Outreach	Work with land agencies for the acquisition, operation, and maintenance of a green-waste disposal site within reasonable proximity to community	Locate and coordinate with land management agency; excavate pit and fence: $20,000.00	Begin planning with agencies in FY 2013/14; implement in FY 2014/15
PCOEM, CNF, NPS, ASFD, ASLD, and associated fire departments and districts	**A3**—Enhanced Public Education, Information, and Outreach	Develop a fire-safety awareness program for community groups	Promote and conduct a community fire-awareness day at local fire departments and districts: $2,000.00	Solicit funds for promotion, brochures, and event materials in 2013; conduct in 2013
PCOEM, CNF, NPS, ASFD, ASLD, and associated fire departments and districts		Create fire-safety and fire-awareness posters for public places	Development, printing, and distribution costs: $5,000.00	Solicit funds for production and printing in 2013; publish and post in 2013
PCOEM and Rincon Valley Fire District	**E4**—Wildland Fire Protection and Reduced Ignitability	Obtain one Type 3 Interface Engine and a tactical water tender for wildland fire response within the Rincon Valley Community WUI	New acquisition with standard equipment $350,000.00; 1,500-gallon tactical water tender, 4-wheel drive: $186,000	Begin grant applications in 2013; purchase in 2014

[a] Projects are designated by project type (E = equipment; A = administrative) but not ranked in order of importance.

D. Priorities for Promoting Community Involvement through Education, Information, and Outreach

The PCOEM and the Core Teams will implement public outreach and education programs for residents to heighten awareness and understanding of the threat that wildland fire poses to the communities.

Table 4.3 displays the Pima County CWPP priority recommendations to promote community involvement. Additional programs that could be used or developed to enhance community outreach and education may be proposed and implemented in the future. The Core Teams will use the resources of the local fire departments, SABCC, ASFD, NPS, CNF, and BLM for additional public education programs and community outreach. Community bulletins and other public service announcements concerning wildfire threat and preparedness should be developed with assistance from local fire departments, SABCC, ASFD, NPS, CNF, and BLM.

Table 4.3. Action Recommendations for Enhanced Public Education, and Information

Project Partner	Project[a]	Equipment/Expense	Timeline
PCOEM, CNF, NPS, BLM, ASFD, SABCC, and associated fire departments and districts	**A7**—Establish and maintain roadside fire-danger warning signs and other informational and directional road signs along major roads as determined by the Pima County Fire Chiefs Association	Construction and placement: $5,000.00	Construct and implement in FY 2013/14
	A8—Create and distribute community bulletins on annual fire season preparedness	Development, printing, and distribution costs: $5,000.00	Develop in FY 2013; distribute continually
	A9— Collaborate in developing Public Education and Outreach materials by providing data, graphics or text that will help promote coinciding goals	Development of data reporting process by SABCC for Integrated bushfire database and public information material	Develop in FY 2013
	I2—Acquire Redzone, or equivalent software, and field data recorders or PDAs (personal digital assistants) to complete home fire assessments and implement fire-safe recommendations	Software and data recorder: $1,300.00 Assessment completion: $2,000.00	Acquire software and complete assessments in FY 2013/14; implement recommendations in FY 2015
	I3—Encourage private businesses that perform Firewise land treatments; encourage market development of WUI by-products from vegetative fuel mitigation programs	Marketing plan to be developed	Initiate community marketing planning meetings in FY 2014
	I4—Replace and maintain fencing adjacent to high OHV (off-highway vehicle) use areas	Assess in 2013, initial plan for 1 mile of new or repaired fencing	Estimate $6,000.00m per mile of standard 4-wire fencing

[a] Projects are designated by project type (A = administrative; I = infrastructure) but not ranked in order of importance.

V. MONITORING PLAN

Monitoring is essential to ensure that Pima County CWPP goals are met. The Pima County CWPP administrators, the local fire departments and districts, PCOEM, ASFD, CNF, NPS, BANWR, Pascua Yaqui Tribe, and BLM will actively monitor the progress of the Pima County CWPP action recommendations to determine the effectiveness of ongoing and completed projects in meeting Pima County CWPP objectives, as well as to recommend future projects necessary to meet Pima County CWPP goals.

In accordance with Section 102.g.5 of HFRA, Pima County CWPP communities will participate in any multiparty monitoring program established by state and federal agencies, or other interested parties, to assess progress toward meeting Pima County CWPP objectives. This authority to participate in multiparty monitoring will be vested in the CWPP Working Group. The Core Teams believe that participation in multiparty monitoring will provide effective and meaningful ecological and socioeconomic feedback on landscape and site-specific fuel reduction projects and watershed enhancements and will also help BLM, NPS, BANWR, CNF, Pascua Yaqui Tribe, ASFD, ASLD, PCOEM, local municipalities, and fire departments and districts with land-management planning.

The CWPP Working Group will request participation in any post-wildfire analysis and burned area emergency response (BAER) planning with lead state or federal agencies. Immediate post-wildfire analysis and planning is essential to Pima County to enhance public safety from possible flood and debris flows, municipal watershed pollution, and other post-wildfire habitat and community impacts.

This section details the performance measures that will be used to assess the effectiveness of implementing the Pima County CWPP action recommendations. Monitoring will include assessing and evaluating the success of individual Pima County CWPP project implementation and a given project's effectiveness in furthering Pima County CWPP objectives.

A. Administrative Oversight, Monitoring, and Pima County CWPP Reporting

The CWPP Working Group, composed of Pima County fire chiefs, PCOEM, SABCC, NPS, CNF, BANWR, Pascua Yaqui Tribe, ASFD, and BLM, will be mutually responsible for implementing and monitoring Pima County CWPP action recommendations in coordination with a future established CWPP Working Group. The CWPP Working Group should identify appropriate grant and other funding mechanisms necessary to implement the action recommendations of the Pima County CWPP. Grant information should be routinely searched to identify updated grant application cycles. Potential grant and funding resources are listed in Appendix C of this CWPP.

As needed, the PCOEM, in coordination with the future-established countywide community CWPP Working Group will produce a report detailing the success of Pima County CWPP project implementation and overall progress toward meeting Pima County CWPP goals. The CWPP Working Group should report successful grant awards received for implementing the Pima County CWPP action recommendations to the Pima County CWPP signatories. The CWPP Working Group's report will also include recommendations to the signatories for updating the Community Mitigation Plan and the Prevention and Loss Mitigation Plan portions of the Pima County CWPP, through the use of the principles of adaptive management. This information will ensure timely decision making for all levels of government and will provide input necessary

for developing future work plans and for prioritizing project recommendations over the life of the Pima County CWPP. Appendix D provides information on the data used in the analysis of the Pima County CWPP and the appropriate contacts for updating the Pima County CWPP. Once the Pima County CWPP is updated, it will be submitted to the PCOEM, the Arizona State Forester, all cooperating fire departments and districts, municipal governments, NPS, CNF, BANWR, and BLM for their concurrence. Once concurrence is achieved, the action recommendations of the updated Pima County CWPP are to be forwarded for funding through HFRA and other appropriate funding sources.

B. Effectiveness Monitoring

Table 5.1 outlines the performance measures that the CWPP Working Group will use to assess status in meeting Pima County CWPP performance goals. In addition to monitoring the listed performance measures, Pima County CWPP administrators should assess the current status of wildland fuel hazards and look for any new or developing issues not covered by the Pima County CWPP. As new issues arise, such as new invasive species infestations, further risks and recommendations for treatment should be identified, and the Pima County CWPP should be updated or amended as necessary to meet the Pima County CWPP goals. To help track fuel treatments being planned and completed through local, state, and federal programs, the Pima County CWPP administrators will cooperate by providing requested detailed mapping information to the Arizona State Forester's office.

Table 5.1. Performance Measures to Assess Pima County CWPP Progress

Goal	Performance Measure
Improve fire prevention and suppression	Reduction of wildland fire occurrence and acres burned (unplanned) in the WUI: • Green-waste disposal sites available in high-risk communities. • Type 3 fire engine acquired by Northwest Fire Department. • Type 6 brush truck acquired for use in Green Valley community WUI. • Type 6 brush truck acquired for use in Catalina Foothills community WUI. • Effectiveness monitoring of fire prevention and suppression will include the following: — Acres burned and degree of severity of wildland fire — Percentage of wildland fire controlled on initial attack — Number of homes and structures lost to wildland fire • Integrated brushfire data base implemented and managed by SABCC • New water sources developed in key areas. • Consistent fire training in use. • Wildland firefighter personal protection equipment acquired as needed.
Reduce hazardous vegetative fuels	Effective treatment of high-risk areas by acre: • Number of treated acres of nonfederal WUI lands that are in Condition Class 2 or 3 are identified as high priorities by the Pima County CWPP and should be moved to Condition Class 1 or another acceptable level of wildland fuel loading and continuity. • Acres treated to acceptable fuel levels within priority treatment management areas. • Total acres treated through any fuel-reduction measures, including prescribed fire, that are conducted in, or adjacent to, the WUI. The change of condition class should be determined for small projects or treatment areas through the use of the LANDFIRE database. • Acres of buffelgrass invaded areas treated by agencies and volunteers.
Restore watershed health	Acres of fuel reduction or watershed enhancement treatments that meet restoration treatment guidelines for riparian habitats: • Coordination with and support of PCOEM, ASFD, ASLD, NPS, CNF, and BLM in implementing and determining social, economic, and environmental effects of riparian restoration treatments (Treatments 7 and 9, see Table 3.1 in mitigation plan). • Acres of saltcedar-invaded riparian areas identified and undergoing restoration treatments.
Promote community involvement and fire prevention	Initiation of public outreach programs: • Countywide community CWPP Working Group initiated. • Public outreach programs and promotions implemented to enhance volunteer efforts to reduce hazardous fuels. • Number and areas (community or dispersed residents) of private landowners supporting and implementing fuel reduction projects. • PCOEM and local fire departments and districts developed and implemented evacuation plans for identified high-risk areas. • Roadside fire-danger warning signs in English and Spanish installed at strategic points within the WUI. • Green-waste disposal and processing site secured and operational. • Fire-awareness articles printed in local newspapers. • Fire-safety awareness program, posters, and information available in public places.
Encourage economic development	Wood-products industry growth and diversification to use all sizes of material removed by fuel-reduction treatments: • Number of value-added wood products developed by the community. • Number of new markets (local firewood sales) for local products created.

VI. Declaration of Agreement and Concurrence

The following partners in the development of the Pima County Community Wildfire Protection Plan have reviewed and do mutually agree or concur with its contents:

Agreement

Pima County Board of Supervisors	Date
City of Oro Valley	Date
City of Sahuarita	Date
Town of Marana	Date
City of South Tucson	Date
City of Tucson	Date
President, Altar Valley Conservation Alliance	Date
Executive Director, Southern Arizona Buffelgrass Coordination Center	Date
Salt River Project	Date
Chief, Avra Valley Fire Department	Date

Chief, Picture Rocks Fire Department	Date
Chief, Northwest Fire Department	Date
Chief, Mountain Vista Fire Department	Date
Chief, Golder Ranch Fire District	Date
Chief, Hidden Valley Fire Department	Date
Chief, Tanque Verde Valley Fire Department	Date
Chief, Sabino Vista Volunteer Fire Department	Date
Chief, Tucson Fire Department	Date
Chief, South Tucson Fire Department	Date
Chief, Rincon Valley Fire Department	Date
Chief, Mescal-J6 Fire Department	Date

Chief, Corona De Tucson Fire Department	Date
Chief, Sonoita-Elgin Fire Department	Date
Chief, Green Valley Fire Department	Date
Chief, Elephant Head Volunteer Fire Department	Date
Chief, Helmet Peak Fire Department	Date
Chief, Three Points Fire Department	Date
Chief, Arivaca Fire Department	Date
Chief, Drexel Heights Fire Department	Date
Chief, Why Fire Department	Date
Chief, Mount Lemmon Fire District	Date
Chief, Pascua Yaqui Fire Department	Date

Concurrence

Arizona State Forester Arizona State Forestry Division	Date
Gila District Manager Bureau of Land Management	Date
Forest Supervisor Coronado National Forest	Date
Chairman Pascua Yaqui Tribe	Date
Superintendent Saguaro National Park	Date
Refuge Manager Buenos Aires National Wildlife Refuge	Date

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VIII. GLOSSARY OF FIRE MANAGEMENT TERMS

A

Aerial Fuels: All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush.

Aerial Ignition: Ignition of fuels by dropping incendiary devices or materials from aircraft.

Air Tanker: A fixed-wing aircraft equipped to drop fire retardants or suppressants.

Agency: Any federal, state, county, or city government organization participating with jurisdictional responsibilities.

Anchor Point: An advantageous location, usually a barrier to fire spread, from which to start building a fire line. An anchor point is used to reduce the chance of firefighters being flanked by fire.

Appropriate Tools: Methods for reducing hazardous fuels including prescribed fire, wildland fire use, and various mechanical methods such as crushing, tractor and hand piling, thinning (to produce commercial or pre-commercial products), and pruning. They are selected on a site-specific case and are ecologically appropriate and cost effective.

Aramid: The generic name for a high-strength, flame-resistant synthetic fabric used in the shirts and jeans of firefighters. Nomex, a brand name for aramid fabric, is the term commonly used by firefighters.

Aspect: Direction toward which a slope faces.

B

Backfire: A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire and/or change the direction of force of the fire's convection column.

Backpack Pump: A portable sprayer with hand-pump, fed from a liquid-filled container fitted with straps, used mainly in fire and pest control. (see Bladder Bag)

Bambi Bucket: A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.

Basal area: The cross-sectional area of all stems of a species or all stems in a stand measured at breast height and expressed per unit of land area. (http://dictionaryofforestry.org/dict/term/basal_area)

Behave: A system of interactive computer programs for modeling fuel and fire behavior that consists of two systems: BURN and FUEL.

Bladder Bag: A collapsible backpack portable sprayer made of neoprene or high-strength nylon fabric fitted with a pump. (see Backpack Pump)

Glossary of Wildland Fire Terminology, at http://www.nwcg.gov/pms/pubs/pubs.htm (National Wildfire Coordinating Group Program Management Unit, 2012).

Blow-up: A sudden increase in fire intensity or rate of spread strong enough to prevent direct control or to upset control plans. Blow-ups are often accompanied by violent convection and may have other characteristics of a fire storm. (see Flare-up)

Brush: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

Brush Fire: A fire burning in vegetation that is predominantly shrubs, brush and scrub growth.

Bucket Drops: The dropping of fire retardants or suppressants from specially designed buckets slung below a helicopter.

Buffer Zones: An area of reduced vegetation that separates wildlands from vulnerable residential or business developments. This barrier is similar to a greenbelt in that it is usually used for another purpose such as agriculture, recreation areas, parks, or golf courses.

Bump-up Method: A progressive method of building a fire line on a wildfire without changing relative positions in the line. Work is begun with a suitable space between workers. Whenever one worker overtakes another, all workers ahead move one space forward and resume work on the uncompleted part of the line. The last worker does not move ahead until completing his or her space.

Burnable Acres: Any vegetative material/type that is susceptible to burning.

Burned Area Rehabilitation: The treatment of an ecosystem following fire disturbance to minimize subsequent effects. (1995 Federal Wildland Fire Policy.)

Burn Out: Setting fire inside a control line to widen it or consume fuel between the edge of the fire and the control line.

Burning Ban: A declared ban on open air burning within a specified area, usually due to sustained high fire danger.

Burning Conditions: The state of the combined factors of the environment that affect fire behavior in a specified fuel type.

Burning Index: An estimate of the potential difficulty of fire containment as it relates to the flame length at the most rapidly spreading portion of a fire's perimeter.

Burning Period: That part of each 24-hour period when fires spread most rapidly, typically from 10:00 a.m. to sundown.

Burn Intensity: The amount and rate of surface fuel consumption. It is not a good indicator of the degree of chemical, physical and biological changes to the soil or other resources. (see Fire Severity)

C

Campfire: As used to classify the cause of a wildland fire, a fire that was started for cooking or warming that spreads sufficiently from its source to require action by a fire control agency.

Candle or Candling: A single tree or a very small clump of trees that is burning from the bottom up.

Catastrophic: Fire that burns more intensely than the natural or historical range or variability, thereby fundamentally changing the ecosystem, destroying communities and/or rare or threatened species/habitats, or causing unacceptable erosion [definition added from the *Proposed Statewide Land Use Plan for Fire, Fuels and Air Quality Management* (USDI Bureau of Land Management 2004)]. (see Severe Wildland Fire)

Chain: A unit of linear measurement equal to 66 horizontal feet.

Closure: Legal restriction, but not necessarily elimination of specified activities such as smoking, camping, or entry that might cause fires in a given area.

Cold Front: The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, the result may be cloudiness, precipitation, and thunderstorms. If both air masses are dry, no clouds may form. Following the passage of a cold front in the Northern Hemisphere, westerly or northwesterly winds of 15 to 30 or more miles per hour often continue for 12 to 24 hours.

Cold Trailing: A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand for heat to detect any fire, digging out every live spot, and trenching any live edge.

Command Staff: The command staff consists of the information officer, safety officer and liaison officer. They report directly to the incident commander and may have assistants.

Community Impact Zone (CIZ): The zone around a community that may be impacted by wildfire. Similar to Defensible Space, but on a community level.

Complex: Two or more individual incidents located in the same general area, which are assigned to a single incident commander or unified command.

Condition Class: Based on coarse scale national data, Fire Condition Classes measure general wildfire risk as follows:

> *Condition Class 1*. For the most part, fire regimes in this Fire Condition Class are within historical ranges. Vegetation composition and structure are intact. Thus, the risk of losing key ecosystem components from the occurrence of fire remains relatively low.
>
> *Condition Class 2*. Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.
>
> *Condition Class 3*. Fire regimes on these lands have been significantly altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure and diversity have been significantly altered. Consequently, these lands verge on the greatest risk of ecological collapse. (Cohesive Strategy 2002, in draft)

Contain a Fire: A fuel break around the fire has been completed. This break may include natural barriers or manually and/or mechanically constructed line.

Control a Fire: The complete extinguishment of a fire, including spot fires. Fireline has been strengthened so that flare-ups from within the perimeter of the fire will not break through this line.

Control Line: All built or natural fire barriers and treated fire edge used to control a fire.

Cooperating Agency: An agency supplying assistance other than direct suppression, rescue, support, or service functions to the incident control effort; e.g., Red Cross, law enforcement agency, telephone company, etc.

Coyote Tactics: A progressive line construction duty involving self-sufficient crews that build fire line until the end of the operational period, remain at or near the point while off duty, and begin building fire line again the next operational period where they left off.

Creeping Fire: Fire burning with a low flame length and spreading slowly.

Crew Boss: A person in supervisory charge of usually 16 to 21 firefighters and responsible for their performance, safety, and welfare.

Critical Ignition Zones: Those areas that are likely to be key in the formation of large wildfires if ignition occurs at that location. These include locations such as at the bottom of a hill, or in fuels that will ignite easily and sustain growth of fire with increasing flame lengths and fire intensity.

Crown Fire (Crowning): The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.

Curing: Drying and browning of herbaceous vegetation or slash.

D

Dead Fuels: Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.

Debris Burning: A fire spreading from any fire originally set for the purpose of clearing land or for rubbish, garbage, range, stubble, or meadow burning.

Defensible Space: An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, “defensible space” is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation. (see Survivable Space)

Deployment: See Fire Shelter Deployment.

Detection: The act or system of discovering and locating fires.

Diameter root collar: The diameter at the location on a plant where the primary vascular anatomy changes from that of a stem to that of a root. (http://dictionaryofforestry.org/dict/term/root_collar)

Diameter breast height: a standard height from ground level, generally 4.5 ft (1.37 m), for recording diameter, circumference (girth), or basal area of a tree. (http://dictionaryofforestry.org/dict/term/breast_height)

Direct Attack: Any treatment of burning fuel, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.

Dispatch: The implementation of a command decision to move a resource or resources from one place to another.

Dispatcher: A person employed who receives reports of discovery and status of fires, confirms their locations, takes action promptly to provide people and equipment likely to be needed for control in first attack, and sends them to the proper place.

Dispatch Center: A facility from which resources are directly assigned to an incident.

Division: Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span-of-control of the operations chief. A division is located with the Incident Command System organization between the branch and the task force/strike team.

Dozer: Any tracked vehicle with a front-mounted blade used for exposing mineral soil.

Dozer Line: Fire line constructed by the front blade of a dozer.

Drip Torch: Hand-held device for igniting fires by dripping flaming liquid fuel on the materials to be burned; consists of a fuel fount, burner arm, and igniter. Fuel used is generally a mixture of diesel and gasoline.

Drop Zone: Target area for air tankers, helitankers, and cargo dropping.

Drought Index: A number representing net effect of evaporation, transpiration, and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers.

Dry Lightning Storm: Thunderstorm in which negligible precipitation reaches the ground. Also called a dry storm.

Duff: The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil.

E

Ecosystem: A spatially explicit, relative homogeneous unit of the Earth that includes all interacting organisms and components of any part of the natural environment within its boundaries. An ecosystem can be of any size, e.g., a log, pond, field, forest, or the Earth's biosphere (Society of American Foresters, 1998).

Ecosystem Integrity: The completeness of an ecosystem that at geographic and temporal scales maintains its characteristics diversity of biological and physical components, composition, structure, and function (Cohesive Strategy, 2000).

Energy Release Component (ERC): The computed total heat released per unit area (British thermal units per square foot) within the fire front at the head of a moving fire.

Engine: Any ground vehicle providing specified levels of pumping, water and hose capacity.

Engine Crew: Firefighters assigned to an engine. The *Fireline Handbook* defines the minimum crew makeup by engine type.

Entrapment: A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."

Environmental Assessment (EA): EAs were authorized by the National Environmental Policy Act (NEPA) of 1969. They are concise, analytical documents prepared with public participation that determine if an

Environmental Impact Statement (EIS) is needed for a particular project or action. If an EA determines an EIS is not needed, the EA becomes the document allowing agency compliance with NEPA requirements.

Environmental Impact Statement (EIS): EISs were authorized by the National Environmental Policy Act (NEPA) of 1969. Prepared with public participation, they assist decision makers by providing information, analysis and an array of action alternatives, allowing managers to see the probable effects of decisions on the environment. Generally, EISs are written for large-scale actions or geographical areas.

Equilibrium Moisture Content: Moisture content that a fuel particle will attain if exposed for an infinite period in an environment of specified constant temperature and humidity. When a fuel particle reaches equilibrium moisture content, net exchange of moisture between it and the environment is zero.

Escape Route: A preplanned and understood route firefighters take to move to a safety zone or other low-risk area, such as an already burned area, previously constructed safety area, a meadow that won't burn, natural rocky area that is large enough to take refuge without being burned. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).

Escaped Fire: A fire that has exceeded or is expected to exceed initial attack capabilities or prescription.

Extended Attack Incident: A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander.

Extreme Fire Behavior: "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One of more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

F

Faller: A person who fells trees. Also called a sawyer or cutter.

Field Observer: Person responsible to the Situation Unit Leader for collecting and reporting information about an incident obtained from personal observations and interviews.

Fine (Light) Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Fingers of a Fire: The long narrow extensions of a fire projecting from the main body.

Fire Behavior: The manner in which a fire reacts to the influences of fuel, weather and topography.

Fire Behavior Forecast: Prediction of probable fire behavior, usually prepared by a Fire Behavior Officer, in support of fire suppression or prescribed burning operations.

Fire Behavior Specialist: A person responsible to the Planning Section Chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather and topography.

Firebreak: A natural or constructed barrier used to stop or check fires that may occur or to provide a control line from which to work.

Fire Cache: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.

Fire Crew: An organized group of firefighters under the leadership of a crew leader or other designated official.

Fire Defense System: The cumulative effect of the fire suppression system of a community, including fuels reduction programs, fire breaks, defensible space, and the response capabilities of emergency personnel.

Fire District: A special taxing district organized for community fire protection under Arizona Revised Statutes Chapter 5 Fire Districts, Article 1 General Provisions, 48-805.

Fire Frequency: The natural return interval for a particular ecosystem.

Fire Front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.

Fire Hazard Reduction Zone: Home ignition zone area, where fuel reduction and home fire resistant projects should take place to reduce the risk of a wildfire damaging a structure.

Fire Intensity: A general term relating to the heat energy released by a fire.

Fire Line: A linear fire barrier that is scraped or dug to mineral soil.

Fire Load: The number and size of fires historically experienced on a specified unit over a specified period (usually one day) at a specified index of fire danger.

Fire Management Plan (FMP): A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

Fire Management Planning: A generic term referring to all levels and categories of fire management planning, including: preparedness, prevention, hazardous risk assessment, and mitigation planning.

Fire Management Unit (FMU): A land management area definable by objectives, management constraints, topographic features, access, values to be protected, political boundaries, fuel types, major fire regime groups, etc. that set it apart from the characteristics of an adjacent FMU. The FMU may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

Fire Perimeter: The entire outer edge or boundary of a fire.

Fire-prone ecosystem: Ecosystems that historically burned intensely at low frequencies (stand replacing fires), those that burned with low intensity at a high frequency (understory fires), and those that burned very infrequently historically, but are not subject to much more frequent fires because of changed conditions. These include fire-influenced and fire-adapted ecosystems (Cohesive Strategy, 2000).

Fire Regime: A generalized description of the role fire plays in an ecosystem. It is characterized by fire frequency, predictability, seasonality, intensity, duration, scale (patch size), as well as regularity or variability. Five combinations of fire frequency, expressed as fire return interval in fire severity, are defined:

> *Groups I and II* include fire return intervals in the 0–35 year range. Group I includes Ponderosa pine, other long needle pine species, and dry site Douglas fir. Group II includes the drier grassland types, tall grass prairie, and some Pacific chaparral ecosystems.
>
> *Groups III and IV* include fire return internals in the 35–100+ year range. Group III includes interior dry site shrub communities such as sagebrush and chaparral ecosystems. Group IV includes lodgepole pine and jack pine.
>
> *Group V* is the long interval (infrequent), stand replacement fire regime and includes temperate rain forest, boreal forest, and high elevation conifer species.

Fire-Return Interval: The number of years between successive fire events at a specific site or an area of a specified size.

Fire Risk Reduction Zone: A zone targeted for risk reduction, including measures such as fuels reduction, access protection, and construction of structures to minimize the risk of ignition from wildfire.

Fire Season: (1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resource values sufficient to warrant organized fire management activities. (2) A legally enacted time during which burning activities are regulated by state or local authority.

Fire Severity: The amount of heat that is released by a fire and how it affects other resources. It is dependent on the type of fuels and the behavior of the fuels when they are burned. (see Burn Intensity)

Fire Shelter: An aluminized tent offering protection by means of reflecting radiant heat and providing a volume of breathable air in a fire entrapment situation. Fire shelters should only be used in life-threatening situations, as a last resort.

Fire Shelter Deployment: The removing of a fire shelter from its case and using it as protection against fire.

Firestorm: A fire of great size and intensity that generates and is fed by strong inrushing winds from all sides; the winds add fresh oxygen to the fire, increasing the intensity.

Fire Triangle: Instructional aid in which the sides of a triangle are used to represent the three factors (oxygen, heat, fuel) necessary for combustion and flame production; removal of any of the three factors causes flame production to cease.

Fire Use Module (Prescribed Fire Module): A team of skilled and mobile personnel dedicated primarily to prescribed fire management. These are national and interagency resources, available throughout the prescribed fire season, that can ignite, hold and monitor prescribed fires.

Fire Use: The combination of wildland fire use and prescribed fire application to meet resource objectives.

Fire Weather: Weather conditions that influence fire ignition, behavior and suppression.

Fire Weather Watch: A term used by fire weather forecasters to notify using agencies, usually 24 to 72 hours ahead of the event, that current and developing meteorological conditions may evolve into dangerous fire weather.

Fire Whirl: Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than one foot to more than 500 feet in diameter. Large fire whirls have the intensity of a small tornado.

Firewise: A public education program developed by the National Wildland Fire Coordinating Group that assists communities located in proximity to fire-prone lands. (For additional information, see http://www.firewise.org)

Firefighting Resources: All people and major items of equipment that can or potentially could be assigned to fires.

Flame Height: The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

Flame Length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

Flaming Front: The zone of a moving fire where the combustion is primarily flaming. Behind this flaming zone, combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front. Also called fire front.

Flanks of a Fire: The parts of a fire's perimeter that are roughly parallel to the main direction of spread.

Flare-up: Any sudden acceleration of fire spread or intensification of a fire. Unlike a blow-up, a flare-up lasts a relatively short time and does not radically change control plans.

Flash Fuels: Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, that ignite readily and are consumed rapidly when dry. Also called fine fuels.

Forb: A plant with a soft, rather than permanent woody stem, that is not a grass or grass-like plant.

Fuel: Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs and trees, that feed a fire. (see Surface Fuels)

Fuel Bed: An array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.

Fuel Loading: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.

Fuel Model: Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

Fuel Moisture (Fuel Moisture Content): The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees Fahrenheit.

Fuel Reduction: Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control. Incorporated within this are treatments to protect, maintain, and restore land health and desired fire cycles.

Fuel Type: An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

Fusee: A colored flare designed as a railway-warning device and widely used to ignite suppression and prescription fires.

G

General Staff: The group of incident management personnel reporting to the incident commander. They may each have a deputy, as needed. Staff consists of operations section chief, planning section chief, logistics section chief, and finance/administration section chief.

Geographic Area: A political boundary designated by the wildland fire protection agencies, where these agencies work together in the coordination and effective utilization of firefighting resources.

Ground Fuel: All combustible materials below the surface litter, including duff, tree or shrub roots, dried out dead wood, peat, and sawdust that normally support a glowing combustion without flame.

H

Haines Index: An atmospheric index used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire.

Hand Line: A fire line built with hand tools.

Hazard Reduction: Any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

Hazardous Fuels Reduction: “Fuel Reduction” is defined as the manipulation or removal of fuels, including combustion, to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control. Incorporated within this are treatments to protect, maintain, and restore land health and desired fire cycles. “Hazard Reduction” is defined as any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

Head of a Fire: The side of the fire having the fastest rate of spread.

Heavy Fuels: Fuels of large diameter such as snags, logs, large limb wood, that ignite and are consumed more slowly than flash fuels.

Helibase: The main location within the general incident area for parking, fueling, maintaining, and loading helicopters. The helibase is usually located at or near the incident base.

Helispot: A temporary landing spot for helicopters.

Helitack: The use of helicopters to transport crews, equipment, and fire retardants or suppressants to the fire line during the initial stages of a fire.

Helitack Crew: A group of firefighters trained in the technical and logistical use of helicopters for fire suppression.

Holding Actions: Planned actions required to achieve wildland prescribed fire management objectives. These actions have specific implementation timeframes for fire use actions but can have less sensitive implementation demands for suppression actions.

Holding Resources: Firefighting personnel and equipment assigned to do all required fire suppression work following fireline construction but generally not including extensive mop-up.

Home Ignitability: The ignition potential within the Home Ignition Zone.

Home Ignition Zone: The home and its immediate surroundings. The home ignition zone extends to a few tens of meters around a home not hundreds of meters or beyond. Home ignitions and, thus, the WUI fire loss problem principally depend on home ignitability.

Hose Lay: Arrangement of connected lengths of fire hose and accessories on the ground, beginning at the first pumping unit and ending at the point of water delivery.

Hotshot Crew: A highly trained fire crew used mainly to build fireline by hand.

Hotspot: A particular active part of a fire.

Hotspotting: Reducing or stopping the spread of fire at points of particularly rapid rate of spread or special threat, generally the first step in prompt control, with emphasis on first priorities.

I

Incendiary: Causing or capable of causing fire.

Incident: A human-caused or natural occurrence, such as wildland fire, that requires emergency service action to prevent or reduce the loss of life or damage to property or natural resources.

Incident Action Plan (IAP): Contains objectives reflecting the overall incident strategy and specific tactical actions and supporting information for the next operational period. The plan may be oral or written. When written, the plan may have a number of attachments, including: incident objectives, organization assignment list, division assignment, incident radio communication plan, medical plan, traffic plan, safety plan, and incident map.

Incident Command Post (ICP): Location at which primary command functions are executed. The ICP may be co-located with the incident base or other incident facilities.

Incident Command System (ICS): The combination of facilities, equipment, personnel, procedure and communications operating within a common organizational structure, with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

Incident Commander: Individual responsible for the management of all incident operations at the incident site.

Incident Management Team: The incident commander and appropriate general or command staff personnel assigned to manage an incident.

Incident Objectives: Statements of guidance and direction necessary for selection of appropriate strategy(ies), and the tactical direction of resources. Incident objectives are based on realistic expectations of what can be accomplished when all allocated resources have been effectively deployed.

Indigenous Knowledge: Knowledge of a particular region or environment from an individual or group that lives in that particular region or environment, e.g., traditional ecological knowledge of American Indians (FS National Resource Book on American Indian and Alaskan Native Relations, 1997).

Infrared Detection: The use of heat sensing equipment, known as Infrared Scanners, for detection of heat sources that are not visually detectable by the normal surveillance methods of either ground or air patrols.

Initial Attack: The actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire.

J

Job Hazard Analysis: This analysis of a project is completed by staff to identify hazards to employees and the public. It identifies hazards, corrective actions and the required safety equipment to ensure public and employee safety.

Jump Spot: Selected landing area for smokejumpers.

Jump Suit: Approved protection suite work by smokejumpers.

K

Keech Byram Drought Index (KBDI): Commonly used drought index adapted for fire management applications, with a numerical range from 0 (no moisture deficiency) to 800 (maximum drought).

Knock Down: To reduce the flame or heat on the more vigorously burning parts of a fire edge.

L

Ladder Fuels: Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

Large Fire: (1) For statistical purposes, a fire burning more than a specified area of land, for example, 300 acres. (2) A fire burning with a size and intensity such that its behavior is determined by interaction between its own convection column and weather conditions above the surface.

Lead Plane: Aircraft with pilot used to make dry runs over the target area to check wing and smoke conditions and topography and to lead air tankers to targets and supervise their drops.

Light (Fine) Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Lightning Activity Level (LAL): A number on a scale of 1 to 6 that reflects frequency and character of cloud-to ground lightning. The scale is exponential, based on powers of 2 (i.e., LAL 3 indicates twice the lightning of LAL 2).

Line Scout: A firefighter who determines the location of a fire line.

Litter: Top layer of the forest, scrubland, or grassland floor, directly above the fermentation layer, composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles, little altered in structure by decomposition.

Live Fuels: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

M

Micro-Remote Environmental Monitoring System (Micro-REMS): Mobile weather monitoring station. A Micro-REMS usually accompanies an incident meteorologist and ATMU to an incident.

Mineral Soil: Soil layers below the predominantly organic horizons; soil with little combustible material.

Mobilization: The process and procedures used by all organizations, federal, state and local for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.

Modular Airborne Firefighting System (MAFFS): A manufactured unit consisting of five interconnecting tanks, a control pallet, and a nozzle pallet, with a capacity of 3,000 gallons, designed to be rapidly mounted inside an unmodified C-130 (Hercules) cargo aircraft for use in dropping retardant on wildland fires.

Mop-up: To make a fire safe or reduce residual smoke after the fire has been controlled by extinguishing or removing burning material along or near the control line, felling snags, or moving logs so they won't roll downhill.

Multiagency Coordination (MAC): A generalized term that describes the functions and activities of representatives of involved agencies and/or jurisdictions who come together to make decisions regarding the prioritizing of incidents and the sharing and use of critical resources. The MAC organization is not a part of the on-scene ICS and is not involved in developing incident strategy or tactics.

Mutual Aid Agreement: Written agreement between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel and equipment.

N

National Environmental Policy Act (NEPA): NEPA is the basic national law for protection of the environment, passed by Congress in 1969. It sets policy and procedures for environmental protection, and authorizes Environmental Impact Statements and Environmental Assessments to be used as analytical tools to help federal managers make decisions.

National Fire Danger Rating System (NFDRS): A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

National Wildfire Coordinating Group (NWCG): A group formed under the direction of the Secretaries of Agriculture and the Interior and comprised of representatives of the US Forest Service, Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service, and Association of State Foresters. The group's purpose is to facilitate coordination and effectiveness of wildland fire activities and provide a forum to discuss, recommend action, or resolve issues and problems of substantive nature. NWCG is the certifying body for all courses in the National Fire Curriculum.

Nomex: Trade name for a fire-resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters. (see Aramid)

Normal Fire Season: (1) A season when weather, fire danger, and number and distribution of fires are about average. (2) Period of the year that normally comprises the fire season.

O

Operations Branch Director: Person under the direction of the operations section chief who is responsible for implementing that portion of the incident action plan appropriate to the branch.

Operational Period: The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational periods can be of various lengths, although usually not more than 24 hours.

Overhead: People assigned to supervisory positions, including incident commanders, command staff, general staff, directors, supervisors, and unit leaders.

P

Pack Test: Used to determine the aerobic capacity of fire suppression and support personnel and assign physical fitness scores. The test consists of walking a specified distance, with or without a weighted pack, in a predetermined period of time, with altitude corrections.

Paracargo: Anything dropped, or intended for dropping, from an aircraft by parachute, by other retarding devices, or by free fall.

Participating Agency: 1) an agency that has an interest in, is consulted about, and has the opportunity to become involved in a project or program; or 2) an agency invited to be included in the production, review, development of plans or process for a project without authority to act or does not intent to act with respect to the project

Peak Fire Season: That period of the fire season during which fires are expected to ignite most readily, to burn with greater than average intensity, and to create damages at an unacceptable level.

Performance Measures: A quantitative or qualitative characterization of performance (Government Performance and Results Act of 1993).

Personal Protective Equipment (PPE): All firefighting personnel must be equipped with proper equipment and clothing in order to mitigate the risk of injury from, or exposure to, hazardous conditions encountered while working. PPE includes, but is not limited to, 8-inch-high laced leather boots with lug soles, fire shelter, hard hat with chin strap, goggles, ear plugs, aramid shirts and trousers, leather gloves, and individual first aid kits.

Preparedness: Condition or degree of being ready to cope with a potential fire situation.

Prescribed Fire: Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

Prescribed Fire Plan (Burn Plan): This document provides the prescribed fire burn boss information needed to implement an individual prescribed fire project.

Prescription: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations.

Prevention: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards.

Project Fire: A fire of such size or complexity that a large organization and prolonged activity is required to suppress it.

Pulaski: A combination chopping and trenching tool, which combines a single-bitted axe-blade with a narrow adze-like trenching blade fitted to a straight handle. Useful for grubbing or trenching in duff and matted roots. Well-balanced for chopping.

R

Radiant Burn: A burn received from a radiant heat source.

Radiant Heat Flux: The amount of heat flowing through a given area in a given time, usually expressed as calories/square centimeter/second.

Rappelling: Technique of landing specifically trained firefighters from hovering helicopters; involves sliding down ropes with the aid of friction-producing devices.

Rate of Spread: The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

Reburn: The burning of an area that has been previously burned but that contains flammable fuel that ignites when burning conditions are more favorable; an area that has reburned.

Red Card: Fire qualification card issued to fire rated persons showing their training needs and their qualifications to fill specified fire suppression and support positions in a large fire suppression or incident organization.

Red Flag Warning: Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern.

Rehabilitation: The activities necessary to repair damage or disturbance caused by wildland fires or the fire suppression activity.

Relative Humidity (Rh): The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

Remote Automatic Weather Station (RAWS): An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is re-transmitted to an earth-receiving station for use in the National Fire Danger Rating System.

Resiliency: The capacity of an ecosystem to maintain or regain normal function and development following disturbance (Society of American Foresters, 1998).

Resources: (1) Personnel, equipment, services and supplies available, or potentially available, for assignment to incidents. (2) The natural resources of an area, such as timber, grass, watershed values, recreation values, and wildlife habitat.

Resource Management Plan (RMP): A document prepared by field office staff with public participation and approved by field office managers that provides general guidance and direction for land management activities at a field office. The RMP identifies the need for fire in a particular area and for a specific benefit.

Resource Order: An order placed for firefighting or support resources.

Response Time: The amount of time it takes from when a request for help is received by the emergency dispatch system until emergency personnel arrive at the scene.

Retardant: A substance or chemical agent that reduces the flammability of combustibles.

Restoration: The active or passive management of an ecosystem or habitat toward its original structure, natural compliment of species, and natural functions or ecological processes (Cohesive Strategy, 2000).

Run (of a fire): The rapid advance of the head of a fire with a marked change in fire line intensity and rate of spread from that noted before and after the advance.

Running: A rapidly spreading surface fire with a well-defined head.

Rural Fire Assistance: The Department of the Interior Rural Fire Assistance program is a multi-million dollar program to enhance the fire protection capabilities of rural fire districts. The program will assist with training, equipment purchase, and prevention activities, on a cost-share basis.

S

Safety Zone: An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuel breaks; they are greatly enlarged areas, which can be used with relative safety by firefighters and their equipment in the event of a blow-up in the vicinity.

Scratch Line: An unfinished preliminary fire line hastily established or built as an emergency measure to check the spread of fire.

Severe Wildland Fire (catastrophic wildfire): Fire that burns more intensely than the natural or historical range of variability, thereby fundamentally changing the ecosystem, destroying communities and / or rate or threatened species /habitat, or causing unacceptable erosion (GAO / T-RCED-99-79) (Society of American Foresters, 1998).

Severity Funding: Funds provided to increase wildland fire suppression response capability necessitated by abnormal weather patterns, extended drought, or other events causing abnormal increase in the fire potential and/or danger.

Single Resource: An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.

Size-up: To evaluate a fire to determine a course of action for fire suppression.

Slash: Debris left after logging, pruning, thinning or brush cutting; includes logs, chips, bark, branches, stumps and broken understory trees or brush.

Sling Load: Any cargo carried beneath a helicopter and attached by a lead line and swivel.

Slop-over: A fire edge that crosses a control line or natural barrier intended to contain the fire.

Slurry: A mixture typically of water, red clay, and fertilizer dropped from air tankers for fire suppression.

Smokejumper: A firefighter who travels to fires by aircraft and parachute.

Smoke Management: Application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.

Smoldering Fire: A fire burning without flame and barely spreading.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Spark Arrester: A device installed in a chimney, flue, or exhaust pipe to stop the emission of sparks and burning fragments.

Spot Fire: A fire ignited outside the perimeter of the main fire by flying sparks or embers.

Spot Weather Forecast: A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.

Spotter: In smokejumping, the person responsible for selecting drop targets and supervising all aspects of dropping smokejumpers.

Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Staging Area: Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three-minute available basis. Staging areas are managed by the operations section.

Strategy: The science and art of command as applied to the overall planning and conduct of an incident.

Strike Team: Specified combinations of the same kind and type of resources, with common communications, and a leader.

Strike Team Leader: Person responsible to a division/group supervisor for performing tactical assignments given to the strike team.

Structure Fire: Fire originating in and burning any part or all of any building, shelter, or other structure.

Suppressant: An agent, such as water or foam, used to extinguish the flaming and glowing phases of combustion when direction applied to burning fuels.

Suppression: All the work of extinguishing or containing a fire, beginning with its discovery.

Surface Fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.

Survivable Space: The distance between vegetational fuels and a structure necessary to protect the building from radiant heat and its ignition mechanics. The separation distance was formerly called “defensible space” due to the implication that the fire department could intervene. The term “survivable space” eliminates the dependence on manual suppression and implies that the distance alone provides the protection. (see Defensible Space)

Swamper: (1) A worker who assists fallers and/or sawyers by clearing away brush, limbs and small trees. Carries fuel, oil and tools and watches for dangerous situations. (2) A worker on a dozer crew who pulls winch line, helps maintain equipment, etc., to speed suppression work on a fire.

T

Tactics: Deploying and directing resources on an incident to accomplish the objectives designated by strategy.

Tanker: Either a tank truck used to deliver water from a water source to the scene of a fire, or a fixed wing aircraft used for fire suppression by dropping slurry on the flank or head of a fire.

Temporary Flight Restrictions (TFR): A restriction requested by an agency and put into effect by the Federal Aviation Administration in the vicinity of an incident that restricts the operation of nonessential aircraft in the airspace around that incident.

Terra Torch: Device for throwing a stream of flaming liquid, used to facilitate rapid ignition during burn out operations on a wildland fire or during a prescribed fire operation.

Test Fire: A small fire ignited within the planned burn unit to determine the characteristic of the prescribed fire, such as fire behavior, detection performance and control measures.

Timelag: Time needed under specified conditions for a fuel particle to lose about 63 percent of the difference between its initial moisture content and its equilibrium moisture content. If conditions remain unchanged, a fuel will reach 95 percent of its equilibrium moisture content after four timelag periods.

Torching: The ignition and flare-up of a tree or small group of trees, usually from bottom to top.

Two-way Radio: Radio equipment with transmitters in mobile units on the same frequency as the base station, permitting conversation in two directions using the same frequency in turn.

Type: The capability of a firefighting resource in comparison to another type. Type 1 usually means a greater capability due to power, size, or capacity.

U

Uncontrolled Fire: Any fire that threatens to destroy life, property, or natural resources and (a) is not burning within the confines of firebreaks or (b) is burning with such intensity that it could not be readily extinguished with ordinary tools commonly available [Parts a and b of definition added from the National Wildfire Coordinating Group’s *Glossary of Wildland Fire Terminology*, http://www.nwcg.gov/pms/pubs/glossary]. (see Wildfire)

Underburn: A fire that consumes surface fuels but not trees or shrubs. (see Surface Fuels)

Unplanned and Unwanted Wildland Fires: An unplanned and unwanted fire is one burning outside the parameters as defined in land use plans and fire management plans for that location (including areas where the fire can be expected to spread) under current and expected conditions. Unplanned and unwanted fires include fires burning in areas where fire is specifically excluded; fires that exhibit burning characteristics (intensity, frequency, and seasonality) that are outside prescribed ranges, specifically including fires expected to produce severe fire effects; unauthorized human caused fires (arson, escaped camp fires, equipment fires, etc.); and fires that occur during high fire dangers, or resource shortage, where the resources needed to manage the fire are needed for more critical fire management needs. Unplanned is not the same as unscheduled. The time of a lightning fire ignition is not known; however, a lightning-caused fire could still be used to meet fuels and ecosystem management objectives if that type of fire is expected to burn within the parameters of an approved plan; the fire is burning within the parameters for the area; is not causing, or has the potential to cause, unacceptable effects; and funding and resources to manage the fire are available.

V

Vectors: Directions of fire spread as related to rate of spread calculations (in degrees from upslope).

Volunteer Fire Department (VFD): A fire department of which some or all members are unpaid.

W

Water Tender: A ground vehicle capable of transporting specified quantities of water.

Weather Information and Management System (WIMS): An interactive computer system designed to accommodate the weather information needs of all federal and state natural resource management agencies. Provides timely access to weather forecasts, current and historical weather data, the National Fire Danger Rating System (NFDRS), and the National Interagency Fire Management Integrated Database (NIFMID).

Wet Line: A line of water, or water and chemical retardant, sprayed along the ground, that serves as a temporary control line from which to ignite or stop a low-intensity fire.

Wildfire: An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fire where the objective is to put the fire out [definition added from the National Wildfire Coordinating Group's *Glossary of Wildland Fire Terminology*, http://www.nwcg.gov/pms/pubs/glossary]. (see Uncontrolled Fire; Wildland Fire)

Wildland: Wildland is an area of land where plants and animals exist free of human interference. Ecologists assert that wildlands promote biodiversity, that they preserve historic genetic traits and that they provide habitat for wild flora and fauna [definition added from Wikipedia, http://en.wikipedia.org/wiki/Wildland].

Wildland Fire: Any nonstructure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Implementation Plan (WFIP): A progressively developed assessment and operational management plan that documents the analysis and selection of strategies and describes the appropriate management response for a wildland fire being managed for resource benefits.

Wildland Fire Situation Analysis (WFSA): A decision-making process that evaluates alternative suppression strategies against selected environmental, social, political, and economic criteria. Provides a record of decisions.

Wildland Fire Use: The management of naturally ignited wildland fires to accomplish specific, planned resource management objectives in predefined geographic areas outlined in Fire Management Plans. Wildland fire use is not to be confused with “fire use,” which includes prescribed fire.

Wildland Urban Interface (WUI): The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels (Glossary of Wildland Fire Terminology, 1996).

Wind Vectors: Wind directions used to calculate fire behavior.

APPENDIX A. DESCRIPTIONS OF VEGETATION ASSOCIATIONS

The following vegetation information was adapted from the *Southwest Regional GAP Analysis Project—Land Cover Data Legend Descriptions* (USGS 2005) and was used to analyze vegetation associations composing the WUI of the Pima County CWPP. The following descriptions are for a broad-scale mapping effort, and refer to areas within the WUI as well as areas outside of Pima County. For additional information, see the Southwest Regional Landcover Data Web site (http://ftp.nr.usu.edu/swgap/landcover.html).

DESERT SHRUB-SCRUB ASSOCIATIONS

S070 Sonora-Mohave Mixed Salt Desert Scrub

Concept Summary: This system includes extensive open-canopied shrublands of typically saline basins in the Mojave and Sonoran deserts. Stands often occur around playas. Substrates are generally fine-textured saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens* or *Atriplex polycarpa* along with other species of *Atriplex*. Species of *Allenrolfea, Salicornia, Suaeda*, or other halophytic plants are often present to codominant. Graminoid species may include *Sporobolus airoides* or *Distichlis spicata* at varying densities.

S129 Sonoran Mid-Elevation Desert Scrub

Concept Summary: This transitional desert scrub system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750–1,300 m. Stands occur in the Bradshaw, Hualapai, and Superstition mountains among other desert ranges and are found above Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761) and below Mogollon Chaparral (CES302.741). Sites range from a narrow strip on steep slopes to very broad areas such as the Verde Valley. Climate is too dry for chaparral species to be abundant, and freezing temperatures during winter are too frequent and prolonged for many of the frost-sensitive species that are characteristic of the Paloverde Mixed-Cacti Desert Scrub such as *Carnegiea gigantea, Parkinsonia microphylla, Prosopis* spp., *Olneya tesota*, *Ferocactus* sp., and *Opuntia bigelovii*. Substrates are generally rocky soils derived from parent materials such as limestone, granitic rocks, or rhyolite. The vegetation is typically composed of an open shrub layer of *Larrea tridentata, Ericameria linearifolia*, or *Eriogonum fasciculatum* with taller shrubs such as *Fourqueria splendens*, *Canotia holacantha* (limestone or granite), or *Simmondsia chinensis* (rhyolite). The herbaceous layer is generally sparse.

S063 Sonoran Paloverde-Mixed Cacti Desert Scrub

Concept Summary: This ecological system occurs on hillsides, mesas, and upper bajadas in southern Arizona and extreme southeastern California. The vegetation is characterized by a diagnostic sparse, emergent tree layer of *Carnegiea gigantea* (3–16 m tall) and/or a sparse to moderately dense canopy codominated by xeromorphic deciduous and evergreen tall shrubs *Parkinsonia microphylla* and *Larrea tridentata* with *Prosopis* sp., *Olneya tesota*, and *Fouquieria splendens* less prominent. Other common shrubs and dwarf-shrubs include *Acacia greggii*, *Ambrosia deltoidea*, *Ambrosia dumosa* (in drier sites), *Calliandra eriophylla, Jatropha cardiophylla, Krameria erecta, Lycium* spp., *Menodora scabra,* and *Simmondsia chinensis* and many cacti including *Ferocactus* spp., *Echinocereus* spp., and *Opuntia* spp. (both cholla and prickly pear). The sparse herbaceous layer is composed of perennial grasses and forbs

with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present.

S062 Chihuahuan Creosotebush, Mixed Desert, and Thorn Scrub

Concept Summary: This widespread Chihuahuan Desert land cover type is composed of two ecological systems the Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731) and the Chihuahuan Mixed Desert and Thorn Scrub (CES302.734). This cover type includes xeric creosotebush basins and plains and the mixed desert scrub in the foothill transition zone above, sometimes extending up to the lower montane woodlands. Vegetation is characterized by *Larrea tridentata* alone or mixed with thorn scrub and other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Fouquieria splendens, Dasylirion leiophyllum, Flourensia cernua, Leucophyllum minus, Mimosa aculeaticarpa* var. *biuncifera, Mortonia scabrella (= Mortonia sempervirens* ssp. *scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa*, and *Tiquilia greggii*. Stands of thornscrub dominated by *Acacia constricta, Acacia neovernicosa,* or *Acacia greggii* are included in this system, and limestone substrates appear important for at least these species. Grasses such as *Dasyochloa pulchella, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua ramosa*, *Muhlenbergia porter,* and *Pleuraphis mutica* may be common but generally have lower cover than shrubs.

S069 Sonoran Mohave Creosotebush-White Bursage Desert Scrub

Concept Summary: This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains, and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2%–50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens, Atriplex hymenelytra, Encelia farinosa, Ephedra nevadensis, Fouquieria splendens, Lycium andersonii*, and *Opuntia basilaris*. The herbaceous layer is typically sparse but may be seasonally abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum, Dasyochloa pulchella, Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common.

SHRUBLANDS ASSOCIATIONS

S058 Apacherian-Chihuahuan Mesquite Upland Scrub

Concept Summary: This ecological system occurs as upland shrublands that are concentrated in the extensive grassland-shrubland transition in foothills and piedmont in the Chihuahuan Desert. It extends into the Sky Island region to the west and the Edwards Plateau to the east. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub that may codominate or dominate includes *Acacia neovernicosa, Acacia constricta, Juniperus monosperma*, or *Juniperus coahuilensis*. Grass cover is typically low. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thorn Scrub (CES302.734) but is generally found at higher elevations where *Larrea tridentata* and other desert scrub

are not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737) but does not occur on eolian-deposited substrates.

GRASSLANDS ASSOCIATIONS

S077 Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe

Concept Summary: This ecological system is a broadly defined desert grassland, mixed shrub-succulent, or xeromorphic tree savanna that is typical of the borderlands of Arizona, New Mexico, and northern Mexico [Apacherian region] but that extends west to the Sonoran Desert, north into the Mogollon Rim, and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by typically diverse perennial grasses. Common grass species include *Bouteloua eriopoda, B. hirsuta,B. rothrockii, B. curtipendula, B. gracilis, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis jamesii, Pleuraphis mutica*, and *Sporobolus airoides*; succulent species of *Agave, Dasylirion*, and *Yucca*; and tall shrub/short tree species of *Prosopis* and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica*). Many of the historical desert grassland and savanna areas have been converted, some to Chihuahuan Mesquite Woodlands Vegetation Associations.

WOODLANDS ASSOCIATIONS

S057 Mogollon Chaparral

Concept Summary: This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico, southwestern Utah, and southeast Nevada. It often dominates along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1,000–2,200 m). It occurs on foothills, mountain slopes, and canyons in drier habitats below the encinal and *Pinus ponderosa* woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt, or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii, Forestiera pubescens (= Forestiera neomexicana), Garrya wrightii, Juniperus deppeana, Purshia stansburiana, Rhus ovata, Rhus trilobata*, and *Arctostaphylos pungens,* and *Arctostaphylos pringlei* at higher elevations. Most chaparral species are fire adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

S051 Madrean Encinal

Concept Summary: Madrean Encinal occurs on foothills, canyons, bajadas, and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, extending north into Trans-Pecos Texas, southern New Mexico, and sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition below Madrean Pine-Oak Forest and Woodland (CES305.796) and Madrean Pinyon-Juniper Woodland (CES305.797). Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral, or, sometimes, desert scrub. Common evergreen oak species include *Quercus arizonica, Quercus emoryi, Quercus intricata, Quercus grisea, Quercus oblongifolia*, *Quercus toumeyi,* and, in Mexico, *Quercus chihuahuaensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon, and juniper trees may be present but do not codominate.

Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp.*, Garrya wrightii, Quercus turbinella, Frangula betulifolia (= Syn Rhamnus betulifolia),* or *Rhus* spp. may be present but do not dominate. The graminoid layer usually prominent between trees is grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Schizachyrium cirratum;* these species are typical of Chihuahuan Piedmont Semi-Desert Grassland (CES302.735). This system includes seral stands dominated by shrubby Madrean oaks typically with strong graminoid layer. In transition areas with drier chaparral systems, stands of chaparral are not dominated by Madrean oaks; however, Madrean encinal may extend down along drainages.

S112 Madrean Pinyon-Juniper Woodland

Concept Summary: This system occurs on foothills, mountains, and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, in Trans-Pecos Texas, in southern New Mexico, and in southern and central Arizona from the Mogollon Rim south to the Sky Islands. Substrates are variable, but soils are generally dry and rocky. The presence of *Pinus cembroides, Pinus discolor*, or other Madrean trees and shrubs is diagnostic of this woodland system. *Juniperus coahuilensis, Juniperus deppeana, Juniperus pinchotii, Juniperus monosperma*, and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica, Quercus emoryi*, *Quercus grisea,* or Quercus mohriana may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids

S115 Madrean Juniper Savanna

Concept Summary: This Madrean ecological system occurs in lower foothills and plains of southeastern Arizona, southern New Mexico, and extending into west Texas and Mexico. These savannas have widely spaced mature juniper trees and moderate to high cover of graminoids (>25% cover). The presence of *Madrean Juniperus* spp. such as *Juniperus coahuilensis, Juniperus pinchotii*, and/or *Juniperus deppeana* is diagnostic. *Juniperus monosperma* may be present in some stands, and *Juniperus deppeana* has a range that extends beyond this Madrean system into southern stands of the Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834). Stands of *Juniperus pinchotii* may be short and resemble a shrubland. Graminoid species are a mix of those found in the Western Great Plains Shortgrass Prairie (CES303.672) and the Apachierian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe (CES302.735), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, these areas include succulents such as species of *Yucca, Opuntia*, and *Agave*. Juniper savanna expansion into grasslands has been documented in the last century.

EVERGREEN FOREST TYPES

S036 Rocky Mountain Ponderosa Pine Woodland

Concept Summary: This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin, and north into southern British Columbia. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 500 m in British Columbia to 2,800 m in the New Mexico

Mountains. Occurrences are found on all slopes and aspects, however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Cercocarpus ledifolius, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus, Prunus virginiana, Amelanchier alnifolia*, and *Rosa* spp. common species. *Pseudoroegneria spicata* and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia*, and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return interval maintain these woodlands, depending on climate, degree of soil development, and understory density.

S032 Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland

Concept Summary: This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming and Idaho. These are mixed-conifer forests occurring on all aspects at elevations ranging from 1,200 to 3,300 m. Rainfall averages less than 75 cm per year (40–60 cm) with summer “monsoons” during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. Forests dominated *by Abies concolor* occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii*, and *Festuca arizonica*. This system was undoubtedly characterized by a mixed severity fire regime in its “natural condition,” characterized by a high degree of variability in lethality and return interval.

S038 Southern Rocky Mountain Pinyon-Juniper Woodland

Concept Summary: This southern Rocky Mountain ecological system occurs on dry mountains and foothills in southern Colorado east of the Continental Divide, in mountains and plateaus of northern New Mexico, and extends out onto limestone breaks in the Great Plains. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus monosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus monosperma* at higher elevations. In transitional areas along the Mogollon Rim and in northern New Mexico, *Juniperus deppeana* becomes common. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Artemisia tridentata,*

Cercocarpus montanus, Quercus gambelii, Achnatherum scribneri, Bouteloua gracilis, Festuca arizonica, or *Pleuraphis jamesii.*

S035 Madrean Pine-Oak Forest and Woodland

Concept Summary: This system occurs on mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, in Trans-Pecos Texas, in southern New Mexico, and in southern and central Arizona from the Mogollon Rim southeastward to the Sky Islands. These forests and woodlands are composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla* or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi,* or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1,500–2,300 m elevation). Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembriodes, Pinus discolor, Pinus ponderosa* (with Madrean pines or oaks), and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp., *Arbutus arizonica, Arctostaphylos pringlei, Arctostaphylos pungens, Garrya wrightii, Nolina* spp., *Quercus hypoleucoides, Quercus rugosa*, and *Quercus turbinella*. Some stands have moderate cover of perennial graminoids such as *Muhlenbergia emersleyi, Muhlenbergia longiligula, Muhlenbergia virescens*, and *Schizachyrium cirratum*. Fires are frequent, with perhaps more crown fires than ponderosa pine woodlands, which tend to have more frequent ground fires on gentle slopes.

DECIDUOUS SOUTHWEST RIPARIAN ASSOCIATIONS

S098 North American Warm Desert Riparian Mesquite Bosque

Concept Summary: This ecological system consists of low-elevation (<1,100 m) riparian corridors along intermittent streams in the valleys of southern Arizona and New Mexico and adjacent Mexico. Dominant trees include *Prosopis glandulosa* and *Prosopis velutina*. Shrub dominants include *Baccharis salicifolia, Pluchea sericea*, and *Salix exigua*. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation depends on annual rise in the water table for growth and reproduction.

S097 North American Warm Desert Riparian Woodland and Shrubland

Concept Summary: This ecological system consists of low-elevation (<1,200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata* var. *reticulata*, and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea*, and *Salix exigua*. Vegetation depends on annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

D04 Invasive Southwest Riparian Woodland and Shrubland

Description: *Tamarix* spp. Semi-Natural Temporarily Flooded Shrubland Alliance (A842), or *Elaegnus angustifolus* Semi-Natural Woodland Alliance (A3566).

***Tamarix* spp. Semi-Natural Temporarily Flooded Shrubland Alliance**
Translated Name: Saltcedar species, Semi-natural Temporarily Flooded Shrubland Alliance
Unique Identifier: A.842

Classification Approach: International Vegetation Classification
Concept Summary: This alliance is composed of shrublands that form moderately dense to dense thickets on banks of larger streams, rivers, and playas across the western Great Plains, interior and southwestern United States, and northern Mexico. Stands are dominated by introduced species of *Tamarix*, including *Tamarix ramosissima, Tamarix chinensis, Tamarix gallica*, and *Tamarix parviflora*. Introduced from the Mediterranean, *Tamarix* spp. have become naturalized in various sites, including salt flats, springs, and especially along streams and regulated rivers, often replacing *Salix* or *Prosopis* spp. shrublands or other native vegetation. A remnant herbaceous layer may be present, depending on the age and density of the shrub layer. These species have become a critical nuisance along most large rivers in the semi-arid western United States. Because of the difficulty to remove, *Tamarix* spp. may have irreversibly changed the vegetation along many rivers.

Classification Comments: This broadly defined alliance is composed of vegetation communities from a wide variety of environments that are dominated by diverse *Tamarix* spp. Common species of *Tamarix* include *Tamarix ramosissima, Tamarix chinensis*, and *Tamarix parviflora*, but other species are reported from the western United States, such as *Tamarix africana, Tamarix aphylla, Tamarix aralensis, Tamarix canariensis, Tamarix gallica*, and *Tamarix tetragyna*.

OTHER COVER TYPES AND NONVEGETATED ASSOCIATIONS: ALTERED, DISTURBED, AND DEVELOPED

N21 Developed, Open Space–Low Intensity

Concept Summary: *Developed Open Space* includes areas with a mixture of some construction materials but mostly includes vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. *Developed, Low Intensity* includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49 percent of total cover. These areas most commonly include single-family housing units.

N22 Developed, Medium–High Intensity

Concept Summary: *Developed, Medium Intensity* includes ncludes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50–79 percent of the total cover. These areas most commonly include single-family housing units. *Developed, High Intensity* includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80–100 percent of the total cover (National Land Cover Data, draft legend, July 25, 2003).

N31 Barren Land Types, Non-Specific

Concept Summary: (Rock/Sand/Clay) Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulation of earthen material. Generally, vegetation accounts for less than 15 percent of total cover.

N80 Agriculture

Concept Summary: Agriculture—unable to make distinction between N81 and N82.

S013 Inter-Mountain Basins Volcanic Rock and Cinderland

Concept Summary: This ecological system occurs in the Intermountain western United States and is limited to barren and sparsely vegetated volcanic substrates (generally <10% plant cover) such as basalt lava (malpais), basalt dikes with associated colluvium, basalt cliff faces and uplifted "backbones," tuff, cinder cones, or cinder fields. It may occur as large-patch, small-patch, and linear (dikes) spatial patterns. Vegetation is variable and includes a variety of species depending on local environmental conditions, for example, elevation, age, and type of substrate. At montane and foothill elevations scattered *Pinus ponderosa, Pinus flexilis*, or *Juniperus* spp. trees may be present. Shrubs such as *Ephedra* spp., *Atriplex canescens, Eriogonum corymbosum, Eriogonum ovalifolium*, and *Fallugia paradoxa* are often present on some lava flows and cinder fields. Species typical of sand dunes such as *Andropogon hallii* and *Artemisia filifolia* may be present on cinder substrates.

D03 Recently Mined or Quarried

Concept Summary: 2 hectare or greater; open-pit mining or quarries visible on imagery.

APPENDIX B. NATIONAL FIRE DANGER RATING SYSTEM FUEL MODEL SELECTION KEY

I. Mosses, lichens, and low shrubs predominate ground fuels

A. Overstory of conifers occupies more than one-third of the site

Model Q

B. No overstory, or it occupies less than one-third of the site

Model S

II. Marsh grasses and/or reeds predominate

Model N

III. Grasses and/or forbs predominate

A. Open overstory of conifer and/or hardwoods

Model C

B. No overstory

1. Woody shrubs occupy more than one-third but less than two-thirds of the site

Model T

2. Woody shrubs occupy less than two-thirds of the site

a. Grasses and forbs are primarily annuals

Model A

b. Grasses and forbs are primarily perennials

Model L

IV. Brush, shrubs, tree reproduction, or dwarf tree species predominate

A. Average height of woody plants is 6 feet or greater

1. Woody plants occupy two-thirds or more of the site

a. One-fourth or more of the woody foliage is dead

(1) Mixed California chaparral

Model B

(2) Other types of brush

Model F

b. Up to one-fourth of the woody foliage is dead

Model Q

c. Little dead foliage

Model O

2. Woody plants occupy less than two-thirds of the site

Model F

B. Average height of woody plants is less than 6 feet
   1. Woody plants occupy two-thirds or more of the site
      a. Western United States

         Model F

      b. Eastern United States

         Model O

   2. Woody plants occupy less than two-thirds but greater than one-third of the site
      a. Western United States

         Model T

      b. Eastern United States

         Model D

   3. Woody plants occupy less than one-third of the site
      a. Grasses and forbs are primarily annuals

         Model A

      b. Grasses and forbs are primarily perennials

         Model L

V. Trees predominate

A. Deciduous broadleaf species predominate
   1. Area has been thinned or partially cut, leaving slash as the major fuel component

      Model K

   2. Area has not been thinned or partially cut
      a. Overstory is dormant; leaves have fallen

         Model E

      b. Overstory is in full leaf

         Model R

B. Conifer species predominate
   1. Lichens, mosses, and low shrubs dominate as understory fuels

      Model Q

   2. Grasses and forbs are the primary ground fuel

      Model C

   3. Woody shrubs and/or reproduction dominate as understory fuels
      a. Understory burns readily
         (1) Western United States

            Model T

         (2) Eastern United States

(a) Understory is more than 6 feet tall

Model O

(b) Understory is less than 6 feet tall

Model D

b. Understory seldom burns

Model H

4. Duff and litter, branch wood, and tree boles are the primary ground fuel
   a. Overstory is over mature and decadent; heavy accumulation of dead debris

   Model G

   b. Overstory is not decadent; only a nominal accumulation of debris
      (1) Needles are 2 or more inches long (most pines)
         (a) Eastern United States

         Model P

         (b) Western United States

         Model U

      (2) Needles are less than 2 inches long

      Model H

VI. Slash predominates

A. Foliage is still attached; little settling
   1. Loading is 25 tons/acre or greater

   Model I

   2. Loading is less than 25 tons/acre but greater than 15 tons/acre

   Model J

   3. Loading is less than 15 tons/acre

   Model K

B. Settling is evident; foliage is falling off; grasses, forbs and shrubs are invading
   1. Loading is 25 tons/acre or greater

   Model J

   2. Loading is less than 25 tons/acre

   Model K

APPENDIX C. EDUCATIONAL RESOURCES

Firewise Information and Web Sites

Firewise Communities/USA National Recognition Program. http://www/Firewise.org/USA.

University of Arizona Cooperative Extension Arizona Firewise Resources http://cals.arizona.edu/firewise/

Arizona State Forestry Division Firewise Information
http://www.azsf.az.gov/fire_managment/firewise_communities/

MyFireCommunity Arizona Firewise Resources
http://www.myfirecommunity.net/Neighborhood.aspx?ID=367

Arizona Interagency Fire Prevention and Information Resources http://wildlandfire.az.gov/ &
http://wildlandfire.az.gov/links.asp#Firewise

Ready-Set-Go Personal wildfire Action Plan. Describes defensible space, pre-fire preparation planning, approaching fire and evacuation planning.
http://www.iafc.org/associations/4685/files/wild_readySetGoWildfireActionPlan.pdf

Best-Management Practices and Tools for Collaboration

The Collaboration Handbook, Red Lodge Clearinghouse. http://www.rlch.org/content/view/261/49.

Ecosystem management Initiative at the University of Michigan.
http://wwwsnre.umich.edu/ecomgt.collaboration.htm.

Western Collaborative Assistance Network. http://www.westcanhelp.org.

BLM Partnership. http://www.blm.gov/partnerships/tools.htm.

Forest Service Partnership Resource Center. http://www.partnershipresourcescenter, org/index.shtml.

International Association of Fire Chief's Leader's guide for Developing a Community Wildfire Protection Plan. http://wwwcsfs.colostate.edu/librar/.pdfs/cwpp/CWPP_LG.pdf.

Joint Fire Sciences Collaboration and CWPP Presentation. http://www.jfsp.fortlewis.edu/KTWorkshops.asp.

Fire Adapted Communities. http://www.fireadapted.org/

Grant Web Sites

Southwest Area Forest, Fire, and Community Assistance Grants. This Web site lists grants that are available to communities to reduce the risk of wildfires in the urban interface. http://www.SouthwestAreaGrants.org.

Department of Homeland Security. This Web site lists granting opportunities for Staffing for Adequate Fire and Emergency Services (SAFER) grants and provides other useful information. http://www.firegrantsupport.com.

ESRI Grant Assistance program for GIS users. http://www.esri.com/grants.

US Fire Administration—Assistance to Firefighters Grant Program. http://www.usfa.fema.gove/dhtml/inside-usfa/grants.cfm.

National Association of State Foresters Listing of Grant Sources and Appropriations. http://www/stateforesters.org/S&PF/FY_2002.html.

Stewardship and Landowner Assistance—Financial Assistance Programs. http://www.na.fs.fed.us/spfo/stewardship/financial.htm.

The Fire Safe Council. http://www.FireSafeCouncil.org.

Pre-disaster Mitigation Program. http://www/cfda/gov/public/viewprog.asp?progid=1606.

Firewise. http://www.firewise.org/usa/funding.htm.

Environmental Protection Agency. http://cfpub.epa.gov/fedfund.

Rural Fire Assistance and other State Forestry Grants. http://www.azsf.az.gov/grant_information.

Grant opportunities. http://www.grants.gov.

Arizona Wildfire and the Environment Series

Firewise publications from the University of Arizona: *Forest Home Fire Safety*; *Fire-Resistant Landscaping*; *Creating Wildfire-Defensible Spaces for Your Home and Property*; *Homeowners' "Inside and Out" Wildfire Checklist*; *Firewise Plant Materials for 3000 Feet and Higher Elevations*; *Soil Erosion Control After a Wildfire*; *Recovering from Wildfire*; *A Guide for Arizona's Forest Owners*; *Wildfire Hazard Severity Rating Checklist for Arizona Homes and Communities*. http://cals.arizona.edu; http://cals.arizona.edu/pubs.

Southern Arizona Buffelgrass Coordination Center. http://www.buffelgrass.org/ The Center's mission is to provide a regional information center that emphasizes an integrated management approach to control buffelgrass *(Pennisetum ciliare)* in Southern Arizona.

Monitoring and Evaluation Resources

US Forest Service Collaborative Restoration Program—Multiparty Monitoring Guidelines. http://www.fs.fed.us/r3/spf/cfrp/monitoring/index.shtml.

Rural Voices for Conservation Coalition – Multiparty Monitoring Issue Paper. http://www.ri.uoregon.edu/programs/CCE/communityfireplanning.html.

Other

Federal Emergency Management Agency (FEMA) State Hazard Mitigation Offices. http://www.floods.org/shmos.htm.

National Fire Protection Association (NFPA) standards: NFPA 299 (*Standard for Protection of Life and Property from Wildfire*); NFPA 295 (*Standard for Wildfire Control*); NFPA 291 (*Recommended Practice for Fire Flow Testing and Marking of Hydrants*); NFPA 703 (*Standard for Fire Retardant Impregnated Coatings for Building Materials*); NFPA 909 (*Protection of Cultural Resources*); NFPA 1051 (*Standard for Wildland Fire Fighter Professional Qualifications*); NFPA 1144 (*Standard for Protection of Life and Property from*

Wildfire); NFPA 1977 (*Standard on Protective Clothing and Equipment for Wildland Fire Fighting*). http://www.nfpa.org; http://www.nfpa.org/Catalog.

National Fire Lab. http://www.firelab.org/fbp/fbresearch/WUI/home.htm.

Protect Your Home from Wildfire, Colorado State Forest Service. Publications to help assist you with wildfire prevention. http://www.colostate.edu/Depts/CSFS/homefire.html.

US Fire Administration, FEMA, US Department of Homeland Security. http://www.usfa.fema.gov; http://www.fema.gov/regions/viii/fires/shtm; http://www.fema.gov/kidswldfire.

Fire Education Materials. http://www.symbols.gov.

National Interagency Fire Center, National Park Service fire Web site. http://www.nifc.nps.gov/fire.

"Fire Wars," PBS NOVA. http://www.pbs.org/wgbh/nova/fire.

D'Goat Ranch, LLC. Jason Garn. (801) 440-2149. Leasing and goat herding for vegetative mitigation projects.

Woody Biomass Utilization Desk Guide.
http://www.forestsandrangelands.gov/woody_biomass/documents/biomass_deskguide.pdf.

Pamphlets

Saving Homes from Wildfires: Regulating the Home Ignition Zone, American Planning Association, May 2001. This issue of the American Planning Association's Zoning News examines the wildfire threat to the wildland-urban interface zone and shows how development codes can be used to save residential areas.

Books

Everyone's Responsibility: Fire Protection in the Wildland Urban Interface, NFPA, 1994. This National Fire Protection Association book shows how three communities dealt with interface problems.

Firewise Construction Design and Materials Publication, sponsored by the Colorado State Forest Service and FEMA. This 38-page booklet details home construction ideas to make a home Firewise. Various other publications are available from the Colorado State Forest Service on wildland-urban interface issues.

Is Your Home Protected from Wildfire Disaster? A Homeowner's Guide to Wildfire Retrofit, Institute for Business and Home Safety, 2001. This book provides homeowners with guidance on ways to retrofit and build homes to reduce losses from wildfire damage.

Stephen Bridge, *Road Fire Case Study*, NFPA, 1991. Provides information to assist planners, local officials, fire service personnel, and homeowners.

Wildland Fire—Communicator's Guide. This is a guide for fire personnel, teachers, community leaders, and media representatives.

CD ROMs

Arizona Firewise Communities Educator's Workshop, Payson, AZ, February 18–19, 2003.

Burning Issues, Florida State University and the US Bureau of Land Management. 2000. Interactive multimedia program for middle and high school students to learn about the role of fire in the ecosystems and the use of fire managing rural areas.

Wildland Fire Communicator's Guide. This interactive CD-ROM compliments the book. . http://www.nifc.gov/prevEdu/prevEdu_communicatorGuide.html

Other Publications

It Can't Happen to My Home! Are You Sure? A publication by the US Forest Service, Southwestern Region, 12 page document.

Wildfire Strikes Home! (Publication no. NFES 92075); *It Could Happen to You, How to Protect Your Home!* (Publication no. NFES 92074). Homeowners' handbooks from the US Bureau of Land Management, the US Forest Service, and state foresters.

APPENDIX D. INFORMATION DATA SHEET AND CONTACTS

D.1. CWPP Base Information Data Source

Name	Type	Source	Contact / Web address
Wildland Fuel Hazards	Shapefile	Logan Simpson Design Inc.	Roy Baker (480) 967-1343; rbaker@logansimpson.com
Wildland-Urban Interface (WUI)	Shapefile	Logan Simpson Design Inc.	Roy Baker (480) 967-1343; rbaker@ logansimpson.com
Vegetation Zones	Raster	Southwest Regional Gap Analysis Project (USGS 2005)	http://earth.gis.usu.edu/swgap/
Land Ownership	Shapefile	Arizona State Land Department	Land Resources Information System Published October 29, 2007 Gary Irish, (602) 542-2605
Land Parcel Data	Shapefile	Pima County Assessor's	(602) 506-3406 http://www.pimacounty.gov/Assessor
Ignition History	Shapefile	Bureau of Land Management	http://wildfire.cr.usgs.gov/firehistory/

All final-analysis GIS data—including flammability analysis, fuel hazards analysis, ignition history and density, community values analysis, cumulative risk analysis, and treatment management units—are located at the Pima County Department of Emergency Management and at Logan Simpson Design Inc.

D.2. Pima County CWPP Contacts

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APPENDIX E. INVASIVE SPECIES

The following information is presented by the Core Teams to assist municipal, state, and federal land managers with basic recommendations for the management of invading saltcedar, red brome, cheatgrass, buffelgrass, and Mediterranean grass within Pima County. Information about invading saltcedar tree species is excerpted from the USDA's online Fire Effects Information System (Zouhar 2003 and Hauser 2008), the *Strategy for Long-Term Management of Exotic Trees in Riparian Areas for New Mexico's Five River Systems, 2005–2014* (USDA FS and New Mexico Energy, Minerals and Natural Resources Department, Forestry Division 2005), and the *San Juan Basin Watershed Management Plan* (San Juan County Watershed Group 2005). Information for red brome, cheatgrass, and buffelgrass is excerpted from the USDA's online Fire Effects Information System (Hauser 2008). Additional information is available from *Invasive Non-Native Plants that Threaten Wildlands in Arizona: A Categorized List Developed by the Arizona Wildlands Invasive Plant Working Group* (AZ-WIPWG 2005) and from the *Southern Arizona Buffelgrass Strategic Plan* (Buffelgrass Working Group 2008).

Saltcedar

The continued degradation of native riparian plant communities from invading tree species is a significant concern to the citizens of Pima County.

Saltcedar is one of the most widely distributed and troublesome nonnative invasive plants along watercourses in the southwestern United Sates. Saltcedar reduces recreational usage of parks and riparian areas for camping, hunting, fishing, and agriculture. Since its escape from cultivation, saltcedar has spread primarily in the southwestern United States and northern Mexico, although its distribution extends into many parts of North America. It is especially pervasive in, and has dominated, many low areas bordering the channel of the Southwest river systems since the 1940s. More than 50 percent of the area covered by floodplain plant communities was dominated by saltcedar by 1970 (www.fs.fed.us/database/feis/plants). Saltcedar-dominated communities are often monotypic, though cottonwood and willow are common associates. Several studies in Arizona and New Mexico suggest that saltcedar communities do not support as high a density of native bird species as do native plant communities; however, saltcedar provides habitat for a number of bird species including white-winged and mourning doves, summer tanager, yellow-billed cuckoo, and the endangered southwestern willow flycatcher. Saltcedar communities can trap and stabilize alluvial sediments, reducing the width, depth, and water-holding capacity of river channels. This can subsequently increase the frequency and severity of overbank flooding. These stands can have extremely high evapotranspiration rates when water tables are high but not necessarily when water tables are low or under drought conditions. Because saltcedar stands tend to extend beyond the boundaries of native phreatophytes and to develop higher leaf area index, water use by saltcedar on a regional scale might be substantially higher than for other riparian species. While the natural flood disturbance regime seems to promote native species and discourage saltcedar, consistent natural river-flow conditions through riparian areas is rarely sustained in the Pima County CWPP.

There is little quantitative information on prehistoric frequency, seasonality, severity, and spatial extent of fire in North American riparian ecosystems. Fires in low- to mid-elevation southwestern riparian plant communities dominated by cottonwood, willow, and/or mesquite are thought to have been infrequent.

Increases in fire size or frequency have been reported for river systems in recent decades. Fire appears to be less common in riparian ecosystems where saltcedar has not invaded. Increases in fire size and frequency are attributed to a number of factors including an increase in ignition sources, increased fire frequency in surrounding uplands, and increased abundance of fuels. The structure of saltcedar stands may be more conducive to repeated fire than that of native vegetation. Saltcedar can contribute to increased vertical canopy density that creates volatile fuel ladders, thereby increasing the likelihood of negative impacts of wildfire. Saltcedar plants can have many stems and high rates of stem mortality, resulting in a dense accumulation of dead, dry branches vertically within the canopy as well as within the fuel bed. Large quantities of dead branches and leaf litter are caught in saltcedar branches above the ground surface, enhancing the crowns' flammability. In summary, the likelihood of fire in southwestern riparian ecosystems is greatest with the combination of flood suppression, water stress, and saltcedar presence. The presence of saltcedar in southwestern riparian ecosystems may favor its own propagation by further altering the natural disturbance regime, thereby further decreasing the already limited extent of native cottonwood and willow communities. Additionally, in the absence of flooding, regeneration of native trees is impeded and organic matter accumulates, thus increasing chances for future fires that may further alter the species composition and structure of southwestern riparian systems and promote the spread of saltcedar and other fire-tolerant species (www.fs.fed.us/database/fesi/plants/tree/tamspp/fire_ecology).

Once established in large stands, saltcedar can rarely be controlled or eradicated with a single method, and many researchers and managers recommend combining physical, biological, chemical, and cultural control methods. Removing saltcedar must also be accompanied by an ecologically healthy plant community that is weed resistant and that meets other land use objectives such as wildlife habitat or recreational use benefits. The best phenological stage to burn and reburn saltcedar to reduce density, canopy, and hazardous fuel loads is during the peak of summer, presumably due to ensuing water stress. Use of fire alone to control saltcedar, however, is generally ineffective, only killing aboveground portions of the plant and leaving the root crown intact and able to produce vigorous sprouts. Saltcedar stands can burn hot with erratic fire behavior with numerous firebrands transported downwind from the headfire. Prescribe fire setup requires poorly receptive fuels downwind from the headfire. Saltcedar in dense stands that have not burned in 25–30 years exhibit extreme fire behavior and crowning due to closed canopy at any time of the year. They can have flame lengths exceeding 140 feet, resulting in near-complete fuel consumption. Stands reburned after 5 to 6 years show vastly different fire behavior, carrying fire only if there is adequate fine-fuel load and continuity. Due to the ability to transport fire brands at least 500 feet downwind, blacklines should be at least 700 feet wide, and headfires should be installed with temperatures of 65°F–95°F, relative humidity of 25–40 percent, and wind speeds less than 15 miles per hour.

Managers must be prepared for extreme fire behavior in old decadent stands. Where high-intensity fire is not preferred due to the presence of less fire-resistant vegetative species, fuel reductions through mechanical and chemical controls are recommended. Ignited prescribed fire can be used to thin dense saltcedar stands to follow-up applications of mechanical and chemical controls (www.fs.fed.us/database/feis/plants/tree/tamspp/fire_effects). Mechanical and chemical methods are commonly employed for saltcedar control (*Low-Impact, Selective Herbicide Application for Control of Exotic Trees: Saltcedar, Russian Olive and Siberian Elm A preliminary Field Guide by Doug Parker and Max Williamson*, USDA May 2003). November through January is the most effective time to achieve first time

kills of saltcedar by cutting below the root collar, probably because the plants are entering dormancy at that time and translocating resources into their roots. Whole tree extraction through use of equipment such as the patented Boss Tree Extractor (www.bossreclamation.com) has achieved 90 percent mortality subsequent to initial treatment. In areas where native riparian vegetation species or other habitat issues create a need for agile specific treatment designs, whole tree removal may be considered as the preferred treatment. Herbicide application is most effective when applied immediately after cutting. Full-strength application of Garlon painted on cut stumps within 15 minutes of cutting or applied with a backpack sprayer using 20–30 percent mix of Garlon with Ag. Oil has been successful with the exception of spring months when sap is moving up from the root mass (Parker and Williamson 2003). Extraction and mulching of saltcedar will require treatments of resprouts by mechanical or chemical control methods. Changes in nature of disturbance from fire (frequency, intensity, and severity) have been affected by both saltcedar invasion and by other changes in the invaded communities. Fire frequency and fire behavior in saltcedar-invaded communities are thought to be different than in native plant communities. In the absence of flooding to remove debris, accumulation of woody material can increase to levels that may have a profound effect on the ecology of the system.

Red Brome

In general, red brome initiation and establishment is a direct response to fall rains. Initial growth is relatively slow, followed by a rapid increase in vegetative growth coinciding with warming spring temperatures. Flowering and fruiting generally occur in April and May. Seeds are disseminated in summer.

Red brome is commonly an early to mid-seral species in California chaparral. It is usually sparse in early succession chaparral systems of northern California but may increase rapidly in areas of low soil fertility and moisture. Peak population numbers require several years for seed dispersal into burns or buildup from on-site producers. Continued disturbance such as grazing and repeated low-severity fires favor red brome over native early-seral chaparral species.

Red brome generally shortens fire return intervals. The increased presence of red brome has promoted fires in areas where fire was previously infrequent due to insufficient fuels. Once established, red brome may increase fire frequency by enhancing potential for start and spread. In general, red brome produces an abundant and continuous cover of persistent fine fuels, promoting fast and “hot” fires. Desert scrub-shrub and grasslands dominated by red brome are more susceptible to fire than areas dominated by native forbs. Dead red brome culms and blades are persistent (commonly 2 years); herbage of most desert annual species usually lasts 1 year or less. Red brome produces high amounts of persistent flammable fuels in perennial plant interspaces, promoting ignition and spread.

Heat generated by burning red brome is sufficient to ignite and consume dead stems of native desert forbs. Flames may also consume small shrubs such as white bursage (*Ambrosia dumosa*), winterfat (*Krascheninnikovia lanata*), white burrobush, and Anderson wolfberry (*Lycium andersonii*). However, flames fueled by red brome are generally insufficient to ignite large shrubs such as creosotebush. See Cheatgrass section below for additional information.

Within the Sonoran Desert, dead and dry red brome is easily ignited, supporting fast-moving surface fires. Fire return intervals are also shortened, changing the vegetal composition through increase of nonnative

components and loss of native plant species. Arizona interior chaparral communities are composed of varying plant species compositions, enhanced by the predominant bimodal rainfall patterns of Pima County. Soils in this type are mostly shallow decomposed granite complexes that may hinder establishment of annual grasses. Red Brome can become a wildlife fire enhancing component in down slope desert scrub/shrub types in years of extraordinary rainfall.

Cheatgrass

Cheatgrass is most widespread in sagebrush-steppe communities of the Intermountain West. Many of the ecosystems that cheatgrass has invaded are seriously altered, and no longer support the vegetation of the potential natural community. Cheatgrass can maintain dominance for many years on sites where native vegetation has been eliminated or severely reduced by grazing, cultivation, or fire. The concept of potential natural communities based only on native species is seriously challenged by cheatgrass. Where cheatgrass is highly adapted, it might have to be recognized as a component of the potential plant community. In these situations, cheatgrass may remain the de facto climax dominant, regardless of site potential. The following discussion focuses primarily on component species of potential natural communities that cheatgrass has invaded, from low-elevation salt-desert shrub communities in the southern Great Basin into higher-elevation juniper (*Juniperus* spp.), pinyon-juniper (*Pinus-Juniperus* spp.), pine woodlands, and the coniferous forest zone of the Rocky Mountains.

According to Stewart and Hull in 1949 and Beatley in 1966, (Hauser 2008) only a few cheatgrass plants were found in black greasewood-shadscale (*Sarcobatus vermiculatus-Atriplex confertifolia*) and salt-desert shrub associations. Today, cheatgrass is common in these communities, especially in wet years. Associated species may include budsage (*Artemisia spinescens*), bottlebrush squirreltail (*Elymus elymoides*), Sandberg bluegrass (*Poa secunda*), and Indian ricegrass (*Achnatherum hymenoides*). Cheatgrass also occurs with blackbrush (*Coleogyne ramosissima*), galleta (*Pleuraphis jamesii*), and many other salt-desert species.

In the Intermountain West, and most specifically the sagebrush-steppe and bunchgrass zones, cheatgrass occurs in and often dominates large acreages of rangeland where native dominants include big sagebrush (*Artemisia tridentata*), bluebunch wheatgrass (*Pseudoroegneria spicata*), Thurber needlegrass (*Achnatherum thurberianum*), needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), basin wildrye (*Elymus cinereus*, Idaho fescue (*Festuca idahoensis*), rough fescue (*F. altaica*), bottlebrush squirreltail, low sagebrush (*Artemisia arbuscula*), spiny hopsage (*Grayia spinosa*), and rabbitbrush (*Chrysothamnus* spp.). Cheatgrass often co-occurs with Sandberg bluegrass and/or bottlebrush squirreltail and, on some Nevada sites, has replaced Indian ricegrass or blue grama (*Bouteloua gracilis*). By 1932 cheatgrass had replaced big sagebrush on burned-over areas in the Great Salt Lake region of Utah, and occupied these sites in dense stands associated with cutleaf filaree (*Erodium cicutarium*), rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), and several other relatively unpalatable species and annual weeds. Cheatgrass invades sites dominated by silver sagebrush (*A. cana*) and blue grama in Wyoming.

In pinyon-juniper and mountain brush lands, cheatgrass can be found growing among Rocky Mountain juniper (*J. scopulorum*), western juniper (*J. occidentalis*), singleleaf pinyon (*Pinus monophylla*), Utah juniper (*J. osteosperma*), Colorado pinyon (*P. edulis*), Gambel oak (*Quercus gambelii*), Emory oak (*Q.*

emoryi), antelope bitterbrush (*Purshia tridentata*), curlleaf mountain-mahogany (*Cercocarpus ledifolius*), skunkbush sumac (*Rhus trilobata*), snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier pallida*), and mountain big sagebrush.

Disturbance

Often the critical factor opening niches for cheatgrass invasion is a heightened disturbance regime. Cultivation and subsequent land abandonment, excessive livestock grazing, overstory removal, and repeated fires can interact, or act singly, to proliferate cheatgrass. Excessive grazing and frequent fires can damage biological soil crusts and many perennial plants, thus encouraging cheatgrass establishment, survival, persistence, and dominance. Where fires have occurred at higher elevations, bunchgrasses have recovered vigorously with little cheatgrass invasion. Cheatgrass is less invasive in mesic environments, where it does not compete as effectively with established perennial grasses.

Fire Adaptations

Cheatgrass establishes from soil-stored and transported seed after fire. It has long been known that cheatgrass is highly adapted to a regime of frequent fires. Cheatgrass has a very fine structure, tends to accumulate litter, and dries completely in early summer, thus becoming a highly flammable and often continuous fuel. By the time of burning most cheatgrass seeds are already on the ground, and those not near the heat of burning shrubs can survive and allow cheatgrass to pioneer in the newly burned area. Even if fire comes when cheatgrass plants are still green and kills them before they can set seed, there may be enough viable cheatgrass seed in litter and upper layers of soil for plants to reestablish.

Cheatgrass is a strong competitor in the postfire environment, where it takes advantage of increased resource availability and produces an abundant seed crop. A cheatgrass population may average around 1,000 plants per square foot (10,750 per m^2) prior to burning. During a wildfire, most of the cheatgrass seeds beneath a shrub canopy may be killed by the heat associated with the burning of the shrub. Some cheatgrass seeds located in the interspaces among shrubs are also consumed, while those that are buried or lying in cracks in the soil will likely survive. The next season, surviving seeds germinate and establish at a density of about 1 plant per square foot (11/m^2). These plants are released from competition, and have more water and nutrients available to them. The cheatgrass plants in this sparse population can produce abundant tillers, each supporting many flowers, thus producing a large seed crop.

Fire facilitates cheatgrass dominance on some sites by interrupting successional trajectories of postfire plant communities, and cheatgrass facilitates fire and can thus shorten the interval between fires. This grass/fire cycle is a serious ecological threat on sites where most native plant species are poorly adapted to fire and is recognized in many ecosystems worldwide. This cycle has been documented in the Great Basin since the 1930s, and has been reported in the Mojave and Sonoran deserts beginning in the early 1980s. The result is a type conversion from native shrub and perennial grasslands to annual grasslands adapted to frequent fires.

Fire Regimes

Cheatgrass expansion has dramatically changed fire regimes and plant communities over vast areas of western rangelands by creating an environment where fires are easily ignited, spread rapidly, cover large

areas, and occur frequently. Cheatgrass promotes more frequent fires by increasing the biomass and horizontal continuity of fine fuels that persist during the summer lightning season and by allowing fire to spread across landscapes where fire was previously restricted to isolated patches. Fire in these habitats can have severe effects on native species of plants and animals, although the impact of fire regime changes may differ by region and ecosystem type due to differences in the composition and structure of the invaded plant communities and to climatic differences such as occurrence of summer thunderstorms.

Postfire desert scrub-shrub plant communities are typically dominated by nonnative annual grasses, so burned areas are likely to be more susceptible to fire than unburned areas. Repeated fires stress and kill native perennials. Eventually wind and water erosion may occur, removing and diluting soil organic matter and attendant nutrient concentrations and safe sites around shrubs. After fire has eliminated native perennials, essential mycorrhizae may also be eliminated. Biological soil crusts are also killed by severe fire, and the unusually large, frequent fires associated with cheatgrass dominance can preclude crust species recolonization and succession.

Cheatgrass Fire Regime

Cheatgrass often dominates postfire plant communities, and once established, cheatgrass-dominated grasslands greatly increase the potential and recurrence of wildfires. Cheatgrass fires tend to burn fast and cover large areas, with a fire season from 1 to 3 months longer than that of native rangeland. The average fire-return interval for cheatgrass-dominated stands is less than 10 years. This adaptation to and promotion of frequent fires is what gives cheatgrass its greatest competitive advantage in ecosystems that evolved with less frequent fires. The cheatgrass-fire cycle is self-promoting, as it reduces the ability of many perennial grasses and shrubs to reestablish and furthers the dominance of cheatgrass. Moisture availability can affect cheatgrass productivity and thus affect fuel loads on a site. Drought years may reduce the dominance of cheatgrass in both recently burned and unburned areas, thus decreasing fuel loads and the chance of fire.

Immediate Fire Effect on Cheatgrass

Live cheatgrass plants are susceptible to heat kill, as with a flame thrower or handheld propane torch, though they are difficult to burn when green. When cheatgrass plants are dry enough to burn, they are already dead and have already set seed. Fire will then reduce cheatgrass plants to ash.

Cheatgrass seeds are also susceptible to heat kill, but can survive fires of low severity if the entire litter layer is not consumed or if seeds are buried deeply enough to be insulated from the heat. The amount of litter or ash left on a site is a good indicator of the amount of cheatgrass seed surviving on that site. Low density of cheatgrass immediately following fire indicates either low numbers of cheatgrass seed in the seed bank, or poor survival of seeds during fire.

Discussion and Qualification of Fire Effect

The effects of fire on cheatgrass plants and seeds vary with timing and severity of fire and the composition and density of the prefire plant community. If fire occurs when seed remains in panicles aboveground, most seeds will be killed and cheatgrass density will decline immediately following fire. The chances of seed surviving fire are enhanced once they have dispersed onto or beneath the soil surface. The woody biomass

of some desert shrub, plus litter accumulations, provide sufficient fuel to elevate temperatures high enough for a long enough period to consume cheatgrass seeds on these microsites. Some cheatgrass seeds in the interspace zones are also consumed by fire, but many survive even though the cheatgrass herbage is completely consumed. Fire from herbaceous fuel alone is not usually hot enough to consume cheatgrass seeds. Although fires in pure cheatgrass stands, without woody fuel, are less severe, cheatgrass seed banks can be substantially reduced after fire.

Discussion and Qualification of Plant Response

Cheatgrass response to fire depends on plant community and seed bank composition, density, and spatial distribution; season of burning; fire severity, frequency and patchiness; scale of consideration; postfire management; and climatic conditions. Generalizations are difficult because each combination of climate, vegetation, and soil must be considered separately, as well as considerations of environmental differences both at the time of burning and during subsequent plant reestablishment.

Timing of Fire

If burned during a crucial time during seed ripening, fire can greatly reduce the density of the succeeding cheatgrass stand; however, postfire seed production may equal or exceed that of the prefire population, resulting in increased density the following year. Timing of fire is important also because of variable damage to potential competitors in the native community. For example, cool-season perennial grasses such as bluebunch wheatgrass and western wheatgrass may be less damaged by late-summer wildfires than by fires earlier in the growing season.

Fire Size and Frequency

Nonnative invasive grasses generally benefit from fire and promote recurrent fire. Fire kills biologic soil crusts, thereby allowing more germination sites for cheatgrass for several years or even decades, as crusts are slow to recover. Recurrent fires also tend to enhance cheatgrass dominance because native species cannot usually persist under a regime of frequent fires. Native plant assemblages are thus converted to nonnative annual grasslands. Frequency and size of fires is then further increased.

Fire-Management Considerations

As a management tool, fire can be used to either kill unwanted species or to simulate historical fire regimes and promote desired species. Historical fire regimes did not occur in the presence of many invasive plants that are currently widespread, and the use of fire may not be a feasible or appropriate management action if fire-tolerant invasive plants are present. For example, while fire may be an important natural component of the Great Basin ecosystem, its reintroduction by land mangers is complicated by the presence of invasive plants such as cheatgrass. Fire management should be conducted in ways that prevent establishment of invasive species, and the management of fire and invasive plants must be closely integrated for each to be managed effectively.

Rasmussen presents considerations (e.g., species composition, fuel load, fuel continuity, and weather) to be addressed when using prescribed fire in sagebrush steppes, and general prescriptions that could be used. When precipitation is below 12 inches (300 mm), caution should be used to ensure desired plant

response. If the objective is to maintain the perennial herbaceous vegetation, prescribed burning is most effective when used before sagebrush dominates the site and effectively excludes perennial herbaceous plants. Such timing reduces the need for seeding following a burn. If the objective is to maintain the sagebrush, prescribed burning has very limited applicability.

Cheatgrass Fuels

In the absence of grazing, grass biomass during the fire season may represent 2 years of fuel accumulation, which appears to be optimal for grassland fires. Abundant, continuous cover of cheatgrass can lead to rapid spread of wildfires so that under conditions of high temperatures, low humidity, and wind, the fires are very difficult to suppress.

Brooks compared the roles of nonnative annual grasses and other annual plants in facilitating the spread of fires in the Mojave Desert. Landscapes dominated by nonnative annual grasses, especially annual bromes (*Bromus* spp.), are more flammable than those dominated by native forbs. Possible explanations for this include higher surface-to-volume ratio of grasses compared to forbs; more continuous vegetative cover; and the ability of alien annual grasses to remain rooted and upright longer than native forbs, allowing them to persist as flammable fuels into the summer when the threat of fire is highest. Thick layers of annual plant litter accumulate, and litter decomposes especially slowly in desert regions. Accumulations of litter led to particularly hot temperatures, long flame-residence times, and continuous burn patterns in experimental fires in the Mojave Desert.

Cheatgrass provides a flammable link between open grasslands and forests. It cures early in the fire season and ignites readily during dry periods because of its finely divided stems and pedicels, and it responds readily to changes in atmospheric moisture because of its fine structure. Moisture content is the single most important factor influencing cheatgrass flammability, and it varies with plant phenology and color change as follows:

Plant color	Moisture content (%)
Green	>100
Purple	30–100
Straw	<30

Since there is considerable variation in plant coloration in a stand, close inspection is necessary to determine the predominant coloration. Cheatgrass is not readily ignitable until it reaches the straw-colored stage. The time required for the moisture content to drop from 100 to 30 percent ranged from 8 days on a northern exposure in western Montana to 23 days on a southern exposure in different years, with an average of 14 days. The onset of purple coloring forewarns of hazardous fire conditions within about 2 weeks.

Cheatgrass ignites and burns easily when dry, regardless of quantity, and can support rapid rate of fire spread. Flammability of cheatgrass fuels depends primarily on moisture content, weight, and porosity.

Fuel Management/Fire Prevention

On areas where cheatgrass is abundant, special measures may be necessary to prevent recurrent fires, and thus prevent the elimination of fire-sensitive perennial grasses and forbs and other potential adverse impacts. Fire suppression can discourage invasion and spread of cheatgrass. Grazing management to reduce fuel loads and greenstripping are 2 methods employed to prevent large recurrent fires in areas dominated by cheatgrass. Additionally, herbicides are being tested for effectiveness in creating fuelbreaks in cheatgrass-dominated range.

Cattle grazing can reduce the accumulation of cheatgrass litter and thus lessen the fire hazard on a site. Grazing cheatgrass in winter can reduce cheatgrass herbage and seeds while protecting the dormant perennial grasses.

Greenstripping is a method of establishing fuel breaks to impede the flow of wildfires and thereby increase the fire-free interval on a site dominated by cheatgrass. These fuel breaks are 30 to 400 feet (10–120 m) wide and are seeded with fire-resistant vegetation. As of 1994, 451 miles (16,280 acres) of experimental and operational greenstrips had been established in Idaho. The effectiveness of greenstrips, or any fuels modification project, in reducing wildfire spread is enhanced by 3 factors: (1) disrupting fuel continuity (e.g., by replacing cheatgrass with caespitose grasses such as crested wheatgrass, which have large spaces between individual shrubs); (2) reducing fuel accumulations and volatility (e.g., shrub stands are thinned to maintain a minimum distance of 10 feet [3 m] between plants); and (3) increasing the density of plants with high moisture and low volatile oil content, thus reducing both the potential for ignition and rate of fire spread. Plants used in greenstrips remain green and moist into late summer, making the greenstrip area less flammable for a longer time. Wildfire speed may slow when entering a greenstrip, thus allowing fire-suppression crews to extinguish the fire. Some wildfires burn into greenstrips and extinguish. Native plants in the Great Basin generally do not meet firebreak criteria. Crested wheatgrass and forage kochia are effective in retarding wildfire spread, compete well in a weedy environment, and have been the most successful species in greenstrips. Both plants can, however, be invasive and spread into areas where cheatgrass is being managed with prescribed fire.

Revegetation after Cheatgrass Fires

After wildfires or when planning prescribed burning in areas where cheatgrass is present, managers must decide whether the burned area should be seeded or whether sufficient perennial grasses are present to revegetate a site and successfully compete with cheatgrass. Seeding may not be necessary or desirable if native plant species are able to recover after fire. Cheatgrass-dominated communities tend to have extremely sparse perennial seed banks, however, and the cheatgrass seed bank generally recovers by the second post-fire year. In Utah, natural revegetation (no seeding) is most effective at higher elevations where sufficient moisture and a diverse population of perennial vegetation exist, especially on north- and east-facing slopes. Below 6,000 feet (1,820 m) and in much of Utah's arid environment, cheatgrass and other weedy species readily invade and dominate burned areas. Seeding following fire may be needed to prevent cheatgrass dominance in Wyoming big sagebrush and pinyon-juniper communities but not in mountain big sagebrush communities.

Revegetation of burned areas is desirable to ensure forage for livestock and wildlife and to minimize the potential for erosion and/or invasion by nonnative species. Ideally, wildfire rehabilitation should enhance the recovery of native vegetation through the seeding of native plants adapted to local environmental conditions. Early seral species may provide managers with native plant materials that can successfully germinate and establish in the presence of invasive annuals and do well after subsequent fire. Bottlebrush squirreltail deserves consideration as a post-wildfire revegetation species because in greenhouse experiments, it has substantially greater growth in post-wildfire soil compared with unburned soil, and exhibits relatively higher growth rates in post-wildfire soil compared to cheatgrass. Restoration projects using native species mixes to provide a variety of above- and belowground growth forms, and sowing at high densities, may increase establishment of desirable plants while providing adequate competition against invasive plants. Federal policy currently encourages the use of native plant materials on public lands; but because the primary objective of wildfire rehabilitation on public lands is not ecological restoration but rather prevention of erosion and invasion by undesirable nonnative species, and because of the limited availability of native seeds, the use of native species is not mandatory for revegetation. Because of difficulties related to cost, handling, and reliability of native seed supplies in wildfire rehabilitation situations, many managers prefer nonnative plant materials and traditional seeding methods.

Many large areas have been seeded with nonnative, herbaceous forage species including crested wheatgrass, intermediate wheatgrass, tall wheatgrass (*Thinopyrum ponticum*), Russian wildrye (*Psathyrostachys juncea*), smooth brome, alfalfa, and yellow sweetclover (*Melilotus officinalis*). Seeds for these species are readily available and responsive to standard seeding methods; plants establish and grow rapidly, and have wide environmental tolerances. Many cultivars are also drought tolerant, grazing tolerant, and competitive against other, less desirable nonnative species. The most reliable and persistent grass for low-elevation, drought-prone areas of the Intermountain West is crested wheatgrass. It establishes rapidly even under relatively dry conditions and tends to persist for many years, although some sites seeded to crested wheatgrass return to cheatgrass dominance over time. Grasses that are most competitive against cheatgrass include ‘Hycrest’ crested wheatgrass, ‘Luna’ intermediate wheatgrass, ‘Bozoisky’ Russian wildrye, and smooth brome. The competitive advantage for establishment of crested wheatgrass seedlings is lost if burned areas are not seeded the year of the fire. Forbs such as alfalfa tend to have low persistence in rehabilitation seedings. Current goals of making wildfire rehabilitation objectives compatible with other management objectives on public lands may require careful planning of treatments and some modifications of standard practices, such as greater use of native plants. The identification and use of competitive native perennial plants for arid-land rehabilitation has become a priority for managers and researchers. In big fire years—such as 1996, when millions of acres burned—the scale of the demand for seed greatly exceeds the supply of native plant seed, especially of local genotypes. The competitive ability of nonnative species and the relatively low cost and high availability of their seed will continue to appeal to those faced with large-scale burns in cheatgrass-prone areas. If managers are able to predict large fires in advance, perhaps more efforts could be made to have more native seed available for specific sites.

Buffelgrass

Buffelgrass is native to Africa, India, and western Asia. It was introduced into Texas in the 1940s to stabilize overgrazed rangelands and provide livestock forage. It was introduced into Arizona in the 1930s

and 1940s to control erosion. Buffelgrass also established in Arizona from seed dispersed from Sonora, Mexico, where over 1,000,000 acres (400,000 hectares) of native desert and thornscrub vegetation was converted to buffelgrass pasture. Buffelgrass was first collected on the island of Hawaii in 1932. It was intentionally planted on Kaho'olawe Island, Hawaii in 1988 and 1990. The literature does not describe how buffelgrass arrived in other areas of the United States. Buffelgrass has also been introduced into Australia, where it is considered highly invasive.

Buffelgrass occurs in the southern United States from California to Florida (with the exception of Alabama, Georgia, and the panhandle of Florida), with outlying populations in Oklahoma, Missouri, and New York. It also occurs in Puerto Rico and Hawaii. In North America, buffelgrass is most prominent in the Sonoran Desert of southern Arizona and northern Mexico and in the Chihuahuan Desert of southwestern Texas. Buffelgrass occurs in desert and thornscrub communities in southern Arizona and northern Mexico. It occurs in communities dominated by brittlebush (*Encelia farinosa*), acacia (*Acacia* spp.), Arizona mimosa (*Mimosa distachya* var. *laxiflora*), honey mesquite (*Prosopis glandulosa* var. *glandulosa*) creosotebush (*Larrea tridentata*), saltbush (*Atriplex* spp.), bursage (*Ambrosia* spp.), desert ironwood (*Olneya tesota*), yellow paloverde (*Parkinsonia microphylla*), and/or saguaro (*Carnegiea gigantea*).

The two greatest impacts of buffelgrass in the United States are the alteration of plant communities and fire regimes in the Sonoran Desert. In a news article, United States Geological Survey researcher Julio Betancourt describes the establishment and spread of buffelgrass in the Sonoran Desert of Arizona as "one of the most impressive ecosystem conversions happening in North America." Williams and Baruch describe buffelgrass as "one of the world's most notorious invaders." Buffelgrass was introduced into Arizona by the Natural Resources Conservation Service in the late 1930s and early 1940s. On the plains of Sonora, buffelgrass distribution has expanded from 19,000 acres (7,700 ha) in 1973 to over 350,000 acres (140,000 ha) in 2000. As of 2006, as much as 4 million acres (1.6 million ha) has been seeded to buffelgrass in Sonora. Between 1990 and 1998, the Mexican government subsidized cattle ranchers to convert native desert and thornscrub to buffelgrass pastures. The vast conversion of native communities to buffelgrass pasture may facilitate the spread of buffelgrass not just into native communities in the Sonoran Desert of Mexico and Arizona, but also into the Mojave and Sonoran Desert of California and Baja California. Buffelgrass persistence and spread can lead to reduced richness and diversity in invaded communities in the Sonoran Desert. When native trees are replaced by buffelgrass, a large guild of associated plants and animals also disappears from the area. Unpublished data cited by Burquez and others indicate severe reductions of native plant richness and diversity and less vertical complexity in buffelgrass grasslands compared to native desert scrub. Large reductions in standing crop biomass were also calculated: from 5 to 20 Mg/ha in native vegetation, to 1 to 4 Mg/ha in buffelgrass. Most native vegetation that is removed for the establishment of buffelgrass pastures is burned, resulting in substantial losses of carbon from these ecosystems as carbon dioxide. Thus, the widespread conversion (both active and passive) of native desert scrub to buffelgrass grasslands may have implications for climate change.

Buffelgrass establishment and spread are associated with a reduction or loss of native plant species in the Sonoran Desert, the Lower Rio Grande Valley, Hawaii, and Australia. In areas where buffelgrass occurs, it often outcompetes native species for limited water and nutrient resources by germinating earlier, growing faster, and creating denser stands than native plants. Buffelgrass can negatively affect native plant species richness in areas where it is dominant.

According to the Buffelgrass Working Group (2008), buffelgrass impacts on native plant communities are greatest in the Sonoran Desert. In the Sonoran Desert of northwest Mexico, buffelgrass invasions in columnar cactus (*Pachycereus pecten-aboriginum*) stands severely affect cactus reproduction. While buffelgrass does not affect cactus seed production, seedlings fail to establish in buffelgrass stands. Buffelgrass established in the Organ Pipe Cactus National Monument, Arizona, during the 1970s and 1980s. By 1994, it occupied 20 to 25 square miles (50–65 km²) of the monument and was spreading rapidly. At Organ Pipe Cactus National Monument, buffelgrass reduces abundance of native shrubs such as creosotebush, saltbush, and bursage, as well as abundance of associated native grasses and forbs.

Buffelgrass is described as a fire-adapted species. Fire adaptations vary with reproductive morphology, which varies among forms. Buffelgrass may establish, persist, and spread following fire. Buffelgrass may establish from on-site seed sources after fire. However, in Botswana, no buffelgrass seeds survived prescribed burning when harvested from a savanna and sown on the soil surface in a curlyleaf (*Eragrostis rigidior*) plant community before burning. It is possible that buried or protected buffelgrass seed may survive and germinate following fire. Buffelgrass seed is dispersed by multiple sources, so it may establish on burned sites via offsite seed sources. More information is needed on seed banking and heat tolerance of buffelgrass seeds.

Buffelgrass can persist after fire by sprouting from rhizomes, tillers, or buds that survive fire. Sources describe buffelgrass as simply “sprouting” or “rapidly resprouting” after fire, without indicating the source of sprouts. Esque and others state that buffelgrass resprouts rapidly from the root crown after fire. New buffelgrass growth can appear as soon as 5–10 days following complete top-kill by summer fires; however, postfire response of buffelgrass may depend on season of burning and postfire weather conditions. Buffelgrass fine fuel loads are generally much higher than fine fuel loads from native plants in desert environments. Thus, fires in buffelgrass stands may have longer flame lengths, greater rates of spread, and higher temperatures than fires in native desert vegetation, and cause high mortality in native flora and fauna. Buffelgrass stands burn “very hot” and can burn when green. In the Sonoran Desert, buffelgrass-fueled fires can reach temperatures so hot that the soil is scorched and the bedrock cracked. Headfires in buffelgrass stands can reach temperatures of 1,090 to 1,300°F (585°C–700°C). Esque and others state that buffelgrass grows into an “almost-woody subshrub,” accumulating flammable material over several years, “in effect unlinking fire frequency from annual climatic variability and increasing the fire intensity.”

Buffelgrass fuel loads in Saguaro National Park are large enough to carry fire and were found to be high in comparison to fine fuels from annuals in warm desert biomes of North America. Fine fuels from annuals (natives and nonnatives combined) typically range from 0 to greater than 625 lb/acre in warm deserts. In June 2003, buffelgrass fuel loads on 14 plots in 2 areas of Saguaro National Park (4 at Javelina Picnic Area and 10 at Panther Peak) were measured. During the year of the study, sites received less than 10.5 inches (267 mm) of rain and buffelgrass moisture content was very low (3.6%). Nevertheless, buffelgrass dry, aboveground biomass averaged 2,523 lb/acre and 2,213 lb/acre on the 2 sites.

Buffelgrass growth and spread are greatest in wet years. In northwestern Sonora, Mexico, buffelgrass production was measured in summers of below- and above-average precipitation. On northwestern Mexican rangelands, peak growth is in August. Production ranges from 1,000 lbs/acre in dry years to 6,000 lbs/acre in wet years. Average summer (July-September) precipitation in Sonora is 7.56 inches (192 mm).

During the summer of 1987, precipitation was 5.75 inches (146 mm) below average and buffelgrass biomass production was 465 kg/ha. During the summer of 1986, precipitation was above average by 14.1 inches (358 mm), and buffelgrass biomass production was 3,025 kg/ha. On the Desert Laboratory grounds of Tucson, Arizona, buffelgrass "greatly" expanded its range following 2 unusually wet summers. Buffelgrass had been on the site since 1968.

Although buffelgrass has been in North America for many decades, in the last couple of decades it has spread to the point of altering fuel characteristics and impacting fire regimes of native desert communities. Research regarding its impacts on native fire regimes is limited at the time of this writing (2008), although abundant anecdotal evidence is available. A 2001 review article by Brooks and Pyke describes how buffelgrass and other nonnative plants are beginning to alter fire regimes in the Sonoran Desert. Brooks and Esque warn that shortened fire-return intervals caused by invasive grasses, including buffelgrass, pose a serious threat to plants and animals in the Sonoran Desert.

While buffelgrass occurs in many of the southern States, the majority of buffelgrass fire ecology information comes from areas in the Sonoran Desert, including central and northern Sonora, Mexico, and southern Arizona. In these areas, buffelgrass invasion can increase the biomass and continuity of fine fuels, resulting in large and frequent fires. Buffelgrass also fuels frequent fires in Hawaii and Australia. In central Australia, buffelgrass produces 2 to 3 times as much flammable material as native grasses on some sites. Historically, watercourses were natural firebreaks, but the expansion of buffelgrass in watercourses from water-dispersed seed have turned these areas into "wicks" for fire.

Historically, fires were rare in the Sonoran Desert because fine fuels were sparse and discontinuous and rarely carried fire. The primary carriers of contemporary fires in the Sonoran Desert are introduced perennial plants. In contrast to native species, buffelgrass produces a large amount of continuous, fine fuel, thereby increasing the potential for frequent, intense, and large fires. The buffelgrass fire season in the Sonoran Desert begins at the end of the summer rainy season in late September and continues until the following July when the summer rains return. During winter rains and the cool-season growth period, however, buffelgrass-fueled fires are fewer than in the warm, dry months.

The fire hazard caused by buffelgrass in the Sonoran Desert of Arizona and northern Mexico is increasing. In a news article, a fire inspector in Tucson, Arizona, said, "buffelgrass is like taking a kiddie pool, filling it with gas, and putting it in your front yard." He claimed that buffelgrass fires can go from 4-foot (1 m) flames to 30-foot (10 m) flames in 20 seconds. He described the desert surrounding Tucson as formerly "fire resistant", but 15 to 20 buffelgrass-fueled fires occurred within a 6-week period during the summer of 2007. Similarly, in Hermosillo, Sonora, Mexico, fires were virtually unknown prior to the establishment of buffelgrass in the 1940s. By the 1960s, sporadic buffelgrass-fueled fires were reported. By the late 1990s, buffelgrass-fueled fires had increased to 1 fire every 2 days during the dry summer months.

If buffelgrass continues to spread in the Sonoran Desert, it is likely to lead to a grass/fire cycle, negatively impacting the persistence of native vegetation. While some Sonoran Desert plants can establish or sprout following fire, many cannot. Native plant establishment via seed may take 20 or more years after fire to return to prefire vegetative cover. Buffelgrass can sprout quickly after fire and "outcompete" or even replace native plants. Cacti in the Sonoran Desert may be able to survive a single fire; however, a second fire within 10 years may be "catastrophic" to cacti. Buffelgrass-fueled fires may lead to decline of saguaro,

yellow paloverde, and other native Sonoran Desert plants. In a review, West and Nabhan reported that buffelgrass burns so hot in the Sonoran Desert Biological Reserve that desert ironwood (*Olneya tesota)* trees are completely consumed, and the native desert vegetation is replaced by a dry grassland with no recruitment of native perennials. Esque and others also describe buffelgrass-fueled fires near El Batamote, Mexico completely incinerating desert ironwood and fragrant bursera (*Bursera fagaroides*) trees.

Fire in the Sonoran Desert negatively affects bird habitat quality. Buffelgrass fuels frequent and intense fires that remove native vegetation crucial for some bird species. Buffelgrass fires in national parks and national wildlife refuges in Texas and Arizona threaten desert tortoises, jaguarondis, and ocelots, and other animals that depend upon woody plants or dense litter. Clearing native vegetation and replacing it with buffelgrass in southern Sonora, Mexico, has caused a decline in the Tarahumara frog. The conversion of desert scrub and foothill thornscrub to buffelgrass pastures in the Sonoran Desert is “devastating” to the Sonoran Desert tortoise. Fires that generally follow the transformation of native vegetation to buffelgrass are converting vast areas of tortoise habitat into tracts of nonnative grasslands. In Australia, the expansion of buffelgrass is associated with a decrease in vertebrate and invertebrate diversity.

Control

Given that buffelgrass has only become a problematic species in the United States within the last 10 to 20 years, research on its control is limited. At the time of this writing (2008), physical removal of buffelgrass seems to be the best control method available. Some research suggests that buffelgrass can be controlled by herbicide applications. Physical removal may be the best method of controlling buffelgrass. Based on research by Ward and others, manual removal of buffelgrass should take place at least 4 days after periods of precipitation that exceed roughly 0.67 inch (17 mm).

Physical removal of buffelgrass can be successful if sites are treated for at least 2 years. In year 2, seedlings need to be removed prior to maturity. In 1994, physical removal (hand pulling and digging with a shovel) of buffelgrass at Organ Pipe Cactus National Monument was initiated in a test plot. The following winter, many buffelgrass seedlings were removed from the site. By 1996, seedlings were not found at the site. At west Quitobaquito Springs, physical removal of buffelgrass resulted in almost no reestablishment. Large-scale physical removal of buffelgrass in the monument has proven successful. Sites where buffelgrass is most likely to reestablish following physical removal include burned sites, buffelgrass stands at least several years old, areas near a seed source, areas where vehicles or humans move through a site, areas with white-throated woodrat middens, or areas with topsoil loss due to erosion or bulldozing.

There is very little information on the prevention of buffelgrass establishment and spread. Further information on this topic is needed. On Tumamoc Hill, Arizona, a group known as the “Weedwackers” has initiated a program of revegetating disturbed areas with native species to prevent buffelgrass establishment. The program has been successful at eliminating buffelgrass stands in washes; leading to the reestablishment of native vegetation.

An integrated management program at two sites on the island of Hawaii successfully removed buffelgrass, allowing the establishment of native pili grass. Burns were conducted in February 1998, then reburned once or twice in the next 4 years. On some plots, burning was combined with hand pulling or glyphosate treatment. All sites were seeded with pili grass 3 weeks after the first burn, and watered to counteract

effects of drought. In 2002, 4 years after the initial treatments, pili grass cover was less than 10% on unburned and burn-only plots, but was approximately 34 percent on plots from which buffelgrass had been removed.

Beginning around 2000, the group "Weedwackers" physically removed 4,600 tons (4,200 t) of buffelgrass and other exotic species from roadsides, vehicle pullouts, and washes in Tucson Mountain Park, Arizona. Using National Park Service funding, volunteers removed over 40 tons (40 t) of buffelgrass from Organ Pipe Cactus National Monument between 1994 and 2004.

Buffelgrass has been found to range from less than one ton per acre to over 5 tons per acre in undisturbed desert that has been invaded by buffelgrass. Fire behavior in these infested areas would be similar to a tall grass prairie where flame lengths can reach over 18 feet, in buffelgrass at an experimental burn in Avra Valley in 2008, and fire rate of spread exceeded 155 feet/minute in relatively mild conditions (SABCC 2008).

Mediterranean Grass

Two similar species are known as Mediterranean grass, *Schismus barbatus* and *Schismus arabicus*. Mediterranean grass is a low growing tufted grass (under 20 cm tall) that is abundant in many areas of the desert southwest. According to *Invasive Non-Native Plants that Threaten Wildlands in Arizona* (AZ-WIPWG 2005), both species of *Schismus* are ranked as a medium threat level for Arizona's wildlands. A medium ranking means that these species have a substantial impact on Arizona's ecosystems; have invasive attributes that are conducive to moderate to high rates of dispersal, often enhanced by ground disturbance; and are found with a diversity of ecosystems and the distribution with those ecosystem can range from limited to widespread. *Schismus* has been noted, along with red brome, in the conversion of the Sonoran and Mojave Deserts to flammable grassland (Brown and Minnich 1986, Brooks and Matchett 2006).

Other Species

Additional non-native species are causing fire problems in localized areas and have the potential to spread to other areas. Some recent invaders show rapid expansion rates and can form thick growth that indicates potential fire problems in the future. They are mainly grasses and winter-annual mustard species. Bermudagrass (*Cynodon dactylon*) and Johnson grass (*Sorghum halepense*) are already present along roads and in some washes. Lehmann lovegrass (*Eragrostis lehmanniana*) is present in some pant associations and can form dense monocultures with heavy fuel loads in the desert grassland association. The new, potential problem species include tickgrass (*Eragrostis enchinochloidea*), soft-feather pappusgrass (*Enneapogon cenchroides*), Malta star-thistle (*Centaurea melitensis*), Sahara mustard (*Brassica tourniforti*), and stock (*Matthiola parviflora*). Cooperators must monitor conditions in their jurisdiction and be ready to take action on emerging fire problems.

APPENDIX F. GUIDANCE FOR IMPLEMENTATION OF FEDERAL WILDLAND FIRE MANAGEMENT POLICY

Guidance for Implementation of Federal Wildland Fire Management Policy

February 13, 2009

Foreword

The *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001)* is the primary interagency wildland fire policy document. The *Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (June 20, 2003)* was developed and approved under the authority of the Wildland Fire Leadership Council (WFLC) to set forth direction for consistent implementation of the federal fire policy. It has been used since that time.

On May 2, 2008, the WFLC issued a memorandum entitled *Modification of Federal Wildland Fire Policy Guidance*. This memorandum directed federal agencies to test and implement new guidelines for wildland fire management. The modifications were tested in a number of field units in the 2008 fire season.

In 2009 the National Wildfire Coordinating Group (NWCG) issued a memorandum to the NWCG executive board (NWCG#001-2009, January 7, 2009) that 1) affirms the soundness of the *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001)*, 2) reiterates the policy changes stated in the May 2, 2008 WFLC memorandum entitled *Modification of Federal Wildland Fire Policy Guidance*, 3) states that the Wildland Fire Decision Support System (WFDSS) will replace existing analysis and decision processes, and 4) confirms that the *Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (June 20, 2003)* will be replaced in 2009.

This document, *Guidance for Implementation of Federal Wildland Fire Management Policy (February, 2009)*, is that replacement.

Fire Executive Council

February 13, 2009

Memorandum

To: Chief, USDA Forest Service
Director, Bureau of Indian Affairs
Director, Bureau of Land Management
Director, Fish and Wildlife Service
Director, National Park Service

From: Chair, Fire Executive Council

Subject: Guidance for Implementation of Federal Wildland Fire Policy

On February 13, 2009, the Fire Executive Council (FEC) approved Guidance for the Implementation of Federal Wildland Fire Management Policy. This Guidance provides for consistent implementation of the 1995/2001 Federal Fire Policy, as directed by the Wildland Fire Leadership Council.

Successful implementation of the Guidance requires that each of the federal wildland fire agencies work together through development of unified direction and guidance for agency/bureau manuals, directives, handbooks, guidebooks, plans agreements and other pertinent documents to complete final implementation of this guidance.

In approving the Guidance the FEC:

- directs the National Wildfire Coordinating Group to adopt the guidance and review and revise, as appropriate, all interagency training courses, operational guides, standards, terminology, reporting requirements, skill/competency/qualification/certification requirements and other pertinent documents.
- directs the federal fire directors to work collaboratively with state, local and tribal fire managers and public and nongovernment organizations to communicate direction stated in the guidance with internal and external audiences to foster understanding and support for the complexity of wildland fire management.
- directs the federal fire directors to revise or develop accountability standards, performance measures and tracking systems to assess if resource and protection objectives are met during the course of management on all wildland fires.

We thank the interagency team that produced this implementation guidance and extend special appreciation to the National Association of State Forest, International Association of Fire Chiefs, National Association of Counties, The Wilderness Society, and The Nature Conservancy for the support and commitment in completing the document.

APPROVAL

The *Guidance for Implementation of the Federal Wildland Fire Policy (February, 2009)* is hereby approved by the Fire Executive Council. Implementation actions are to begin immediately.

22FEB09

U.S. Department of Agriculture Date
Forest Service, Fire & Aviation Management
Tom Harbour, Director

2/18/09

Department of the Interior Date
Office of Wildland Fire Coordination
Kirk Rowdabaugh, Director

FEB. 13, 2009

Bureau of Land Management Date
Fire and Aviation Management Directorate
Jim Douglas, Assistant Director

2/19/09

National Park Service Date
Visitor and Resource Protection
Karen Taylor-Goodrich, Associate Director

2/20/09

Fish and Wildlife Service Date
National Wildlife Refuge System
Division Natural Resource and Conservation Planning
Andy Loranger, Chief

2/24/09

Bureau of Indian Affairs Date
Trust Services
Vicki Forrest, Deputy Director

2-17-09

Department of the Interior Date
National Business Center –
Aviation Management Directorate
Mark Bathrick, Associate Director

2/20/09

National Wildfire Coordinating Group Date
Ex officio
Brian McManus, Chair

Table of Contents

Introduction

The *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001)* remains sound and presents a single cohesive federal fire policy for the Departments of the Interior and Agriculture. However, some issues associated with implementation of this policy need closer attention and clarification to fully achieve the intent of the policy.

One such policy area is the Wildland Urban Interface (WUI). WUI is more complex and extensive than previously considered in the 1995 and 2001 Federal Fire Policy reviews. Fire management activities affecting WUI areas require closer coordination and more engagement between with federal, state, local and tribal land and fire managers to ensure firefighter and public safety and mitigate property loss from wildland fire.

A key finding of the 2001 review of the 1995 policy was that "multiple terms for various management options to respond to wildland fire have confused agency managers and employees, operators, partners, and the public, and have perpetuated multiple fire management program elements". This important communications issue will be resolved only through federal, state, local and tribal engagement in building a foundation for common terms (see Appendix A) with understanding and support by all.

The current policy clearly states that wildland fire analysis will carefully consider the long-term benefits in relation to risks both in the short and long term:

> "Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social, and legal consequences of fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected dictate the appropriate management response to fire."
>
> *1995/2001 Federal Wildland Fire Management Policy*

The intent of this framework is to solidify that the full range of strategic and tactical options are available and considered in the response to every wildland fire. These options are to be used to achieve objectives as described in Land and Resource Management Plans and/or Fire Management Plans, subject to clear processes defined to manage fire that crosses jurisdictional boundaries. Mutually developed objectives with adjoining jurisdictions for managing fires that crosses jurisdictional boundaries will also be recognized.

This guidance also calls for increased dialogue and collaboration between federal agencies and tribal, local, and state agencies as plans are updated and implemented to manage wildfires in order to accomplish resource and protection objectives.

This document, *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)*, replaces the *Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (June 20, 2003).* This updated guidance consolidates and clarifies

changes that have occurred since the 2003 strategy document was issued, and provides revised direction for consistent implementation of the *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001)*

Guidance for Implementation

The following guidelines should be used to provide consistent implementation of federal wildland fire policy. Further guidance is provided in the Federal Wildland Fire Management Policy section Table 1.

1. Wildland fire management agencies will use common standards for all aspects of their fire management programs to facilitate effective collaboration among cooperating agencies.
2. Agencies and bureaus will review, update, and develop agreements that clarify the jurisdictional inter-relationships and define the roles and responsibilities among local, state, tribal and federal fire protection entities.
3. Responses to wildland fire will be coordinated across levels of government regardless of the jurisdiction at the ignition source.
4. Fire management planning will be intergovernmental in scope and developed on a landscape scale.
5. Wildland fire is a general term describing any non-structure fire that occurs in the wildland. Wildland fires are categorized into two distinct types:
    a. Wildfires – Unplanned ignitions or prescribed fires that are declared wildfires
    b. Prescribed Fires - Planned ignitions.
6. A wildland fire may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives.
7. Management response to a wildland fire on federal land is based on objectives established in the applicable Land/ Resource Management Plan and/or the Fire Management Plan.
8. Initial action on human-caused wildfire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.
9. Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions.

Implementation

Each of the departments or agencies participating in the review will adopt the *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)* and review and revise, as appropriate, all manuals, handbooks, guidebooks, plans, agreements and other pertinent documents.

The National Wildfire Coordinating Group (NWCG) will adopt the *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)* and review and revise, as appropriate, all interagency training courses, operational guides, standards, terminology, reporting requirements, skill/competency/qualification/certification requirements and other pertinent documents.

The federal fire directors, in collaboration with state, local and tribal fire managers and public and nongovernment organizations, will communicate direction stated in the *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)* with internal and external audiences to foster understanding and support for the complexity of wildland fire management.

The federal fire directors will revise or develop accountability standards, performance measures and tracking systems to assess if resource and protection objectives are met during the course of management on all wildland fires.

Federal Wildland Fire Policy - Guiding Principles and Policy Statements

The following guiding principles and policy statements are excerpted from the *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001).* These remain the foundational principles for Federal Wildland Fire Management Policy.

Guiding Principles

1. Firefighter and public safety is the first priority in every fire management activity.

2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process. Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.

3. Fire Management Plans, programs, and activities support land and resource management plans and their implementation.

4. Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity. Net gains to the public benefit will be an important component of decisions.

5. Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives. Federal agency administrators are adjusting and reorganizing programs to reduce costs and increase efficiencies. As part of this process, investments in fire management activities must be evaluated against other agency programs in order to effectively accomplish the overall mission, set short- and long-term priorities, and clarify management accountability.

6. Fire Management Plans and activities are based upon the best available science. Knowledge and experience are developed among all federal wildland fire management agencies. An active fire research program combined with interagency collaboration provides the means to make these tools available to all fire managers.

7. Fire Management Plans and activities incorporate public health and environmental quality considerations.

8. Federal, State, tribal, local, interagency, and international coordination and cooperation are essential. Increasing costs and smaller work forces require that public agencies pool their human resources to successfully deal with the ever-increasing and more complex fire management tasks. Full collaboration among federal wildland fire management agencies and between the federal wildland fire management agencies and international, State, tribal, and local governments and private entities result in a mobile fire management work force available for the full range of public needs.

9. Standardization of policies and procedures among federal wildland fire management agencies is an ongoing objective. Consistency of plans and operations provides the fundamental platform upon which federal wildland fire management agencies can cooperate, integrate fire activities across agency boundaries, and provide leadership for cooperation with State, tribal, and local fire management organizations.

Federal Wildland Fire Management Policy

Each of the seventeen policy areas are assessed in depth in the following table (Table 1). The policy area's guiding principle is restated first. The left column provides statements to help clarify the Management Intent of the policy statement. The right column specifies actions needed to implement the policy statement.

Table 1 – Policy Clarification of Management Intent and Implementation Actions

Policy Statement	
Management Intent	**Implementation Actions**
1. Safety Firefighter and public safety is the first priority. All Fire Management Plans and activities must reflect this commitment.	
No natural or cultural resource, home, or item of property is worth a human life. All strategies and tactics should seek to mitigate the risk to firefighters and the public.	Agency administrators will develop and establish process, procedures and objectives that ensure firefighter and public safety. Incident Commanders will develop and establish incident objectives, strategies and operational tactics that ensure firefighter and public safety.
2. Fire Management and Ecosystem Sustainability The full range of fire management activities will be used to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social components.	
"Full range of fire management activities" may include any vegetative management treatment tool. Ecosystem sustainability provides a supply of goods, services, social values, and natural processes in perpetuity. Economic intent is to provide for sustainable supplies of goods, services, and social values through implementation of appropriate fire management activities.	Land/Resource Management Plan's (L/RMP) will be developed consistent with both ecological conditions, and fire regime dynamics, and consider the short and long term effects of both action and no action alternatives for planned vegetation management activities as well as responses to wildfire. Agencies will exploit the full range of fire management options to sustain healthy ecosystems within acceptable risk levels as identified in the L/RMP, or Fire Management Plan (FMP). Fire management activities will be based on planning and decision analysis processes that address current and anticipated situational conditions.
3. Response to Wildland Fire Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fires is based on ecological, social and legal consequences of the fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and, values to be protected, dictate the appropriate response to the fire.	
The L/RMP will define and identify fire's role in the ecosystem. The response to an ignition is guided by the strategies and objectives outlined in the L/RMP and/or the Fire Management Plan. Values to be protected from and/or enhanced by wildland fire are defined in the L/RMP and/or the Fire Management Plan. L/RMP and fire management planning is coordinated across jurisdictional boundaries.	FMP's assist in developing the management response to meet L/RMP objectives in designated Fire Management Units (FMU). Fire management strategies will consider current landscape conditions and spatial and temporal components of the fire regime. Responses to wildland fires will be coordinated across jurisdictional boundaries.

Policy Statement	
Management Intent	**Implementation Actions**
4. Use of Wildland Fire Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role. Use of fire will be based on L/RMP and associated Fire Management Plans and will follow specific prescriptions contained in operational plans.	
Use planned and unplanned ignitions to achieve land and resource management goals. Fire management is one tool in the restoration process and should be integrated with other land management activities. Preference will be given for natural ignitions to be managed in meeting the role of fire as an ecological process. Decision support process encourages strategies to manage fire to restore and maintain the natural fire regime where safe and possible.	Incident objectives will identify resource objectives for wildfires managed to achieve resource objectives. Beneficial accomplishments will be measured through specific quantified objectives.
5. Rehabilitation and Restoration Rehabilitation and restoration efforts will be undertaken to protect and sustain ecosystems, public health and safety, and to help communities protect infrastructure.	
Conduct emergency stabilization of burned areas such that no further harm is done. Probability of success will be evaluated for rehabilitation and restoration efforts.	Burned areas will be assessed to determine suitable and effective emergency stabilization and rehabilitation needs to meet current and anticipated environmental conditions. Rehabilitation and restoration activities will be evaluated to assess effectiveness of treatments.
6. Protection Priorities The protection of human life is the single, overriding priority. Setting priorities among protecting human communities and community infrastructure, other property and improvements, and natural and cultural resources will be done based on the values to be protected, human health and safety, and the costs of protection. Once people have been committed to an incident, these human resources become the highest value to be protected.	
Resources are allocated nationally, geographically, and locally based on protection priorities. Protection of human life overrides all other priorities should response capability limits be reached. Local protection priorities are established in the L/RMP and/or FMP.	NMAC establishes national protection priorities considering maintenance of initial attack capability; protection of communities, infrastructure, property, cultural and natural resources; costs; local agency objectives; and national response framework and tasking. Geographic and local area coordination groups will establish a process to set protection priorities. The Agency Administrator will convey protection priorities, based on the L/RMP and FMP, to the geographic and national groups through an incident status report and ensure that protection priorities are known and carried out by the incident commander(s).

Policy Statement	
Management Intent	**Implementation Actions**
7. Wildland Urban Interface The operational roles of federal agencies as partners in the Wildland Urban Interface are wildland firefighting, hazard fuels reduction, cooperative prevention and education, and technical assistance. Structural fire suppression is the responsibility of tribal, state, or local governments. Federal agencies may assist with exterior structural protection activities under formal Fire Protection Agreements that specify the mutual responsibilities of the partners, including funding. (Some federal agencies have structural protection authority for their facilities on lands they administer and may also enter into formal agreements to assist state and local governments with structural protection).	
Prevent the movement of wildfires from the wildlands into the WUI area, out of the WUI area into the wildlands, and improve efficiency of wildfire suppression in WUI situations. The primary responsibility for protecting private property and rural communities lies with individual property owners and local governments. Recognize that many states have wildland fire responsibility while rural fire districts have structural responsibility.	Agreements will be developed to clarify jurisdictional inter-relationships and define roles and responsibilities among local, state, tribal, and federal fire protection entities, based on each organization's enabling protection authorities and assistance/mutual aid responsibilities. Agencies will support the development and implementation of Community Wildfire Protection Plans (CWPP). The Federal wildland agencies will collaborate with tribal, state and local fire management organizations to identify and reconcile gaps in protection responsibility.
8. Planning Every area with burnable vegetation must have an approved Fire Management Plan. Fire Management Plans are strategic plans that define a program to manage wildland fires based on the area's approved land management plan. Fire Management Plans must provide for firefighter and public safety; include fire management strategies, tactics, and alternatives; address values to be protected and public health issues; and be consistent with resource management objectives, activities of the area, and environmental laws and regulations.	
Promote interagency and inter-governmental planning. Encourage landscape scale planning across jurisdictional boundaries.	The FMP should be interagency or intergovernmental in scope and developed on a landscape scale, where practical to take advantage of efficiency, reduce conflict and provide understanding and cooperation. L/RMP and/or FMPs will address the location and conditions under which resource benefits and protection objectives can be met.

Policy Statement	
Management Intent	**Implementation Actions**
9. Science Fire Management Plans and programs will be based on a foundation of sound science. Research will support ongoing efforts to increase our scientific knowledge of biological, physical, and sociological factors. Information needed to support fire management will be developed through an integrated interagency fire science program. Scientific results must be made available to managers in a timely manner and must be used in the development of land management plans, Fire Management Plans, and implementation plans.	
Increase the body of scientific knowledge and understanding about fire management programs through the development of management tools and transfer of knowledge to practitioners and decision makers. Social sciences are a part of the research need.	Agencies will integrate science in planning and monitoring processes. Agencies will coordinate fire-related research to improve fire management program capability. Agencies will emphasize applied science including fire and fuels, physics, social science, and operations research areas. Agencies will seek to improve decision support tools through updated data sets and advances in technology.
10. Preparedness Agencies will ensure their capability to provide safe, cost-effective fire management programs in support of land and resource management plans through appropriate planning, staffing, training, equipment, and management oversight.	
Recognize that particular budget processes and external influences will affect capability and capacity. Size the organization to meet realistic and sustainable management objectives by effective preparedness planning on an interagency basis. Realize efficiencies by incorporating other federal, tribal, state, and local agencies and nongovernmental organizations to meet peak demands for resources. Preseason agreements are an integral part of preparedness.	Agencies will identify and realign organizational staffing and equipment mixes to implement a safe and cost effective fire management program that meets the fire management guidance identified in the L/RMP. Agencies will develop a common process for determining budget needs and cost sharing for all aspects of fire management operations. Implement training program to meet staffing levels (qualification requirements) with the emphasis on managing fires for both protection and resource management objectives. Agencies will develop agreements to efficiently utilize other federal, state, local, and non governmental resources.

Policy Statement	
Management Intent	**Implementation Actions**
11. Suppression Wildland fires are suppressed at minimum cost, considering firefighter and public safety, benefits, and values to be protected, consistent with resource objectives.	
Suppression considerations will be addressed in L/RMP and FMP's. Notwithstanding protection of life, the cost of suppression, emergency stabilization and rehabilitation must be commensurate with values to be protected.	Use a decision support process to assess conditions, analyze risk and document decisions. Predictive services products will be used to support pre-positioning resources. Agencies will coordinate staffing levels through common trend analysis of environmental indicators
12. Prevention Agencies will work together and with their partners and other affected groups and individuals to prevent unauthorized ignition of wildfires.	
Prevention focuses on the activities needed to reduce human-caused ignitions. Prevention includes mitigating risks and loss to ecosystems and communities.	Agencies will work with all partners to develop and implement risk assessment, prevention, and mitigation plans to reduce the frequency of wildfires due to human–caused ignitions..
13. Standardization Agencies will use compatible planning processes, funding mechanisms, training and qualification requirements, operational procedures, values-to-be- protected methodologies, and public education programs for all fire management activities.	
All processes are compatible and transparent so that individuals from cooperating agencies (federal, tribal, state, and local) can more effectively work together. Enhance public and cooperator understanding of wildland fire management processes.	To the extent possible, agencies will use common standards in all aspects of fire management programs so that planning and budgeting methodologies applied in one situation will provide the same results in similar circumstances. Agencies will develop and implement common operational field guidance and operational procedures to deal with all aspects of fire management operations. Agencies will streamline interagency transfer of funds to reduce fiscal inconsistencies.
14. Interagency Cooperation and Coordination Fire management planning, preparedness, prevention, suppression, fire use, restoration and rehabilitation, monitoring, research, and education will be conducted on an interagency basis with the involvement of cooperators and partners.	
Involve all participating agencies, federal, tribal, state, local, and non-governmental organizations in fire management activities. Get everyone working in concert, rather than in opposition to each other.	Ensure that fire management program actions are implemented in collaboration with cooperators and affected partners with due consideration of all management objectives. Agencies will engage cooperators and affected partners at the strategic, and program planning levels, as well as the tactical, program implementation level.

Policy Statement	
Management Intent	**Implementation Actions**
15. Communication and Education Agencies will enhance knowledge and understanding of wildland fire management policies and practices through internal and external communication and education programs. These programs will be continuously improved through the timely and effective exchange of information among all affected agencies and organizations.	
Knowledge and understanding reach all personnel in the field, across agencies. Develop and provide consistent communication, education and outreach with shared messages for the public and internal staff. Have a public that understands the risk, benefits and complexity of wildland fire management.	Develop a consistent and uniform message using common terminology on importance and role of wildland fire in natural resource management. Develop understanding with the public on what we're trying accomplish with fire management. Build understanding with the public on their role when living and recreating in fire prone ecosystems.
16. Agency Administrator and Employee Roles Agency administrators will ensure that their employees are trained, certified, and made available to participate in the wildland fire program locally, regionally, and nationally as the situation demands. Employees with operational, administrative, or other skills will support the wildland fire program as necessary. Agency administrators are responsible and will be held accountable for making employees available.	
Employees participate in wildland fire operations to obtain understanding, expand capabilities, and increase organizational capacity. Assure that we maximize use of the local workforce for efficiencies of knowledge, cost and involvement. Maintain a competent and capable workforce to implement the wildland fire management program to include fuels, aviation, suppression, planning, monitoring, research, communication, finance, etc.	Agency administrators will train, qualify, and certify available personnel for local fire needs and interagency fire management priorities. Agencies will consider adjustment of annual performance expectations based on employee and program contribution to the fire effort.
17. Evaluation Agencies will develop and implement a systematic method of evaluation to determine effectiveness of projects through implementation of the 2001 Federal Fire Policy. The evaluation will assure accountability, facilitate resolution of areas of conflict, and identify resource shortages and agency priorities.	
Use adaptive management process to evaluate and improve the fire management program at all levels. Provide a formal review process to monitor and evaluate performance, suggest revisions, and make necessary adaptations to the implementation guidance at all organizational levels on a regular basis.	Conduct interagency, internal and periodic reviews of the fire management program (all agencies) to determine: 1) consistency of policy implementation; 2) effectiveness of interagency coordination; 3) progress towards ecosystem sustainability; 4) cost management; 5) safety.

Appendices

Appendix A: Glossary

The hierarchy of terminology will be those defined in law, those defined in policy, those defined in this guidance and then all other agency and interagency documentation. The NWCG Glossary of Wildland Fire Terminology will be maintained as the source of record.

Controlled burn – synonymous with Prescribed Fire.

Escaped Prescribed Fire – a prescribed fire that has exceeded or is expected to exceed prescription parameters or otherwise meets the criteria for conversion to wildfire. Criteria is specified in "Interagency Prescribed Fire – Planning and Implementation Procedures Reference Guide".

Fire Management Plan (**FMP**) – a plan that identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. It defines a program to manage wildland fires (wildfire and prescribed fire). The plan is supplemented by operational plans, including but not limited to preparedness plans, preplanned dispatch plans, prescribed fire burn plans and prevention plans. Fire Management Plan's assure that wildland fire management goals and components are coordinated.

Initial Action – the actions taken by the first resources to arrive at a wildfire.

Land/Resource Management Plan (L/RMP) – a document prepared with public participation and approved by an agency administrator that provides general guidance and direction for land and resource management activities for an administrative area. The L/RMP identifies the need for fire's role in a particular area and for a specific benefit. The objectives in the L/RMP provide the basis for the development of fire management objectives and the fire management program in the designated area.

Planned Ignition –the intentional initiation of a wildland fire by hand-held, mechanical or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects (see prescribed fire).

Prescribed Fire—is a wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition (see planned ignition).

Protection - the actions taken to limit the adverse environmental, social, political, and economical effects of fire (FEC Briefing Paper, 3/14/2008).

Response to wildland fire - the mobilization of the necessary services and responders to a fire based on ecological, social, and legal consequences, the circumstances under which a fire occurs,

and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected.

Suppression - all the work of extinguishing a fire or confining fire spread.

Unplanned Ignition – the initiation of a wildland fire by lightning, volcanoes, unauthorized and accidental human-caused fires (see wildfire).

Use of Wildland Fire - management of either wildfire or prescribed fire to meet resource objectives specified in Land/Resource Management Plans.

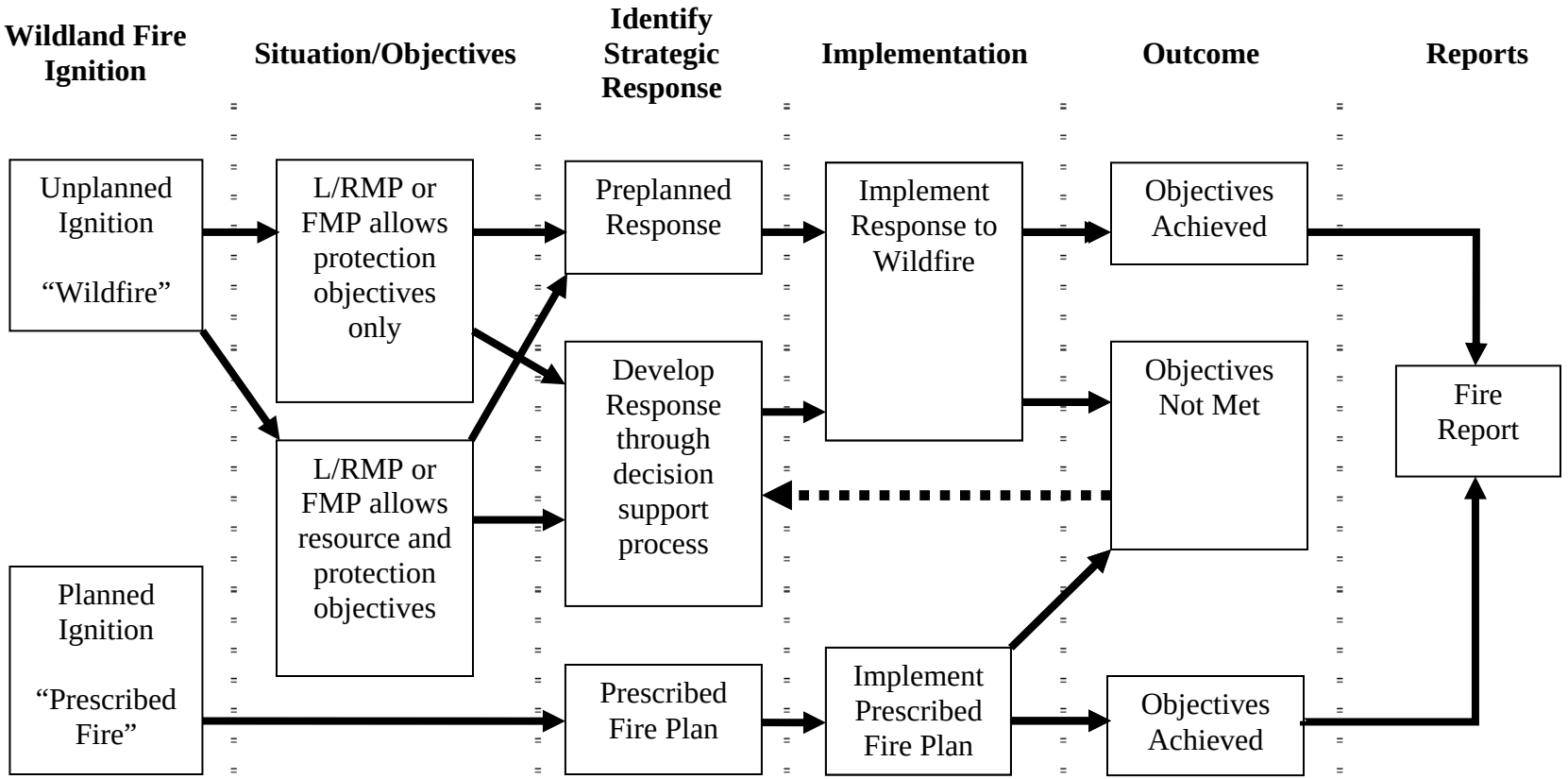
Wildfire – unplanned ignition of a wildland fire (such as a fire caused by lightning, volcanoes, unauthorized and accidental human-caused fires) and escaped prescribed fires.
(See unplanned ignition and escaped prescribed fire).

Wildland Fire – a general term describing any non-structure fire that occurs in the wildland.

Wildland Urban Interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

Appendix B: Wildland Fire Flowchart

This chart depicts, in general, the process to be taken given an ignition, regardless of source. Management actions depend on the provisions in the approved Land, Resource and Fire Management Plan and/or Fire Management Plan for an area. This chart is generally applicable to most agencies' fire management programs. However, specific exceptions may exist.



Appendix C: What Changed 2004 to 2009

The following provide some of the significant modifications that were made to the guidance in the "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (2004)" in drafting the "Guidance for Implementation of Federal Wildland Fire Management Policy (2009)." To simplify the discussion the "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (2004)" will be referred to as "Strategy" and the "Guidance for Implementation of Federal Wildland Fire Management Policy (2009)" will be referred to as "Guidance".

Strategy: Provided seven operational clarification statements

> Guidance: Provides nine statements of guidance for implementation.

Strategy: Operational Clarification statement 1) "Only one management objective will be applied to a wildland fire. Wildland fires will either be managed for resource benefits or suppressed. A wildland fire cannot be managed for both objectives concurrently. If two wildland fires converge, they will be managed as a single wildland fire."

> Guidance: "A wildland fire may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives."

Strategy: Operational Clarification statement 2) "Human caused wildland fires will be suppressed in every instance and will not be managed for resource benefits.

> Guidance: "Initial action on human-caused wildfire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety."

Strategy: Operational Clarification statement 3) "Once a wildland fire has been managed for suppression objectives, it may never be managed for resource benefit objectives."

> Guidance: "A wildland fire may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives."

Strategy: Operational Clarification statement 4) "The Appropriate Management Response (AMR) is any specific action suitable to meet Fire Management Unit (FMU) objectives. Typically, the AMR ranges across a spectrum of tactical options (from monitoring to intensive management actions). The AMR is developed by using FMU strategies and objectives identified in the Fire Management Plan."

Guidance: The term Appropriate Management Response is removed from implementation guidance with "Response to Wildland Fire" as the policy area defining the actions for managing a wildland fire.

Strategy: Operational Clarification statement 5) "The Wildland Fire Situation Analysis process is used to determine and document the suppression strategy from the full range of responses available for suppression operations. Suppression strategies are designed to meet the policy objectives of suppression."

Guidance: "Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions.

Strategy: Operational Clarification statement 6) "Wildland fire use is the result of a natural event. The Land/Resource Management Plan, or the Fire Management Plan, will identify areas where the strategy of wildland fire use is suitable. The Wildland Fire Implementation Plan (WFIP) is the tool that examines the available response strategies to determine if a fire is being considered for wildland fire use."

Guidance: "Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions."

Strategy: Operational Clarification statement 7) "When a prescribed fire or a fire designated for wildland fire use is no longer achieving the intended resource management objectives and contingency or mitigation actions have failed, the fire will be declared a wildfire. Once a wildfire, it cannot be returned to a prescribed fire or wildland fire use status."

Guidance: "Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions."

Strategy: Policy Implementation Flowchart

Guidance: Updated Appendix F: Wildland Fire Flowchart from Review and Update of the 1995 Federal Wildland Fire Management Policy (2001) to reflect implementation terminology of planned and unplanned ignitions. (See Appendix B)