Mason Gulch Fire **Photo: Karin Kyte Romero**

Pueblo County Community Wildfire Protection Plan

for

Southwest Pueblo County, Colorado

Examples of Low Intensity and High Intensity Wildland Fire   Photos: Steve Douglas

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For

Southwest Pueblo County, Colorado

Sponsored by

Beulah Area Wildfire Mitigation Council, Pueblo County Department of Emergency Management and the Pueblo County Geographic Information System, with funding assistance through the 2003 Western States Wildland Interface Grant Program's grant #03-7580-054.

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1.0 Executive Summary

Community Wildfire Protection Plans (CWPP) are authorized and defined in Title I of the *Healthy Forests Restoration Act* (Act) passed by Congress on November 21, 2003 and signed into law by President Bush on December 3, 2003.

The Healthy Forest Restoration Act (HFRA) places renewed emphasis on community planning by extending a variety of benefits to communities with wildfire protection plans in place. HFRA recognize community plans and priorities have an important role in shaping management on federal and non-federal lands.

On July 6, 2005, lightning ignited the Mason Gulch Fire, which grew to over 11,300 acres in less than a week. The fire threatened numerous homes in Custer County and specifically in Pueblo County along Siloam Road, North Creek, and throughout the Beulah Valley area before a change in the weather and extensive fire suppression efforts halted its spread. This incident and its aftermath greatly emphasized the need to develop a strategy for protecting the communities, developments and subdivisions, and other essential infrastructure at risk in the area.

In the Summer of 2006, a core decision-making team was formed, composed of the Beulah Area Wildfire Mitigation Council, Pueblo County Department of Emergency Management, Pueblo County Geographic Information System, Pueblo County Sheriff, Rye Fire Protection District, Beulah Volunteer Fire Department, Red Creek Fire and Rescue, Pueblo Emergency Response Teams, Mountain Park Environmental Center, Colorado State Forest Service, Colorado Division of Wildlife, USDA Forest Service, National Weather Service, and Natural Resources Conservation Service. A contractor, Wildland Fire Associates, was hired to assist in the planning process.

Some homeowners in the planning area are actively practicing the mitigation measures recommended by *FIREWISE*, a tool designed to protect homes and other property from the impacts of a wildfire. However, other homeowners have taken little or no action to protect their properties from wildland fire. The inconsistent application of *FIREWISE* mitigation measures may place their neighbors at increased risk from wildfire.

The purpose of this document is to provide stakeholders and those living in the planning area with an overview of existing wildland fuel conditions, share preliminary findings, and recommend a possible course of action that will reduce the impacts of a wildland fire to the community.

2.0 Introduction

2.1 Background and History of Accomplishments

Community Wildfire Protection Plans (CWPP) are authorized and defined in Title I of the *Healthy Forests Restoration Act* (Act) passed by Congress on November 21, 2003 and signed into law by President Bush on December 3, 2003.

The Healthy Forest Restoration Act (HFRA) places emphasize on community planning by extending a variety of benefits to communities with wildfire protection plans in place. Critical among these benefits is the option of establishing a localized definition and boundary for the wildland-urban interface (WUI). A great opportunity to help shape fuels treatment priorities for surrounding federal and non-federal lands also exists.

The CWPP, as described in the HFRA, brings together diverse local interests to discuss their mutual concerns for public safety, community sustainability and natural resources. The CWPP offers a positive, solution-oriented environment in which to address challenges such as local firefighting capability, the need for defensible space around homes and subdivisions, and how to prioritize land management activities – on both federal and non-federal land.[1]

Prior to the HFRA, Pueblo County emergency officials, local volunteer fire departments and fire protection districts, the Colorado State Forest Service, the U.S. Forest Service, local homeowners and others recognized the importance of protecting their homes and business from the impacts of wildland fire. To that end, starting in September 2000, a coalition of agencies responsible for wildland fire management in the southwest portion of the county initiated a series of *FIREWISE* seminars that were presented to those living in the vicinity of Beulah, Colorado City, Rye, and Red Creek. In all, twenty-two meetings were held between 2000 and 2006. Through these meetings and other related activities the vast majority of those living in the planning area have developed a clear understanding of the importance of fuels management, treatment options, and the *FIREWISE* concept. To further the program, the Beulah Area Wildfire Mitigation Council (BAWMC) was formed and coordinators have been named for neighborhoods in the Beulah area, including but not limited to many of the home owner associations for the subdivisions located in the Beulah Valley and outside the valley along Siloam and 3-R Roads.

In 2003, the BAWMC received grant funding. These funds were used to treat a portion of the area, consisting of 52.25 acres on 42 private land parcels. Under a separate 2003 grant, the City of Pueblo received mitigation funding for Pueblo

[1] Colorado State Forest Service, 2005. Community Wildfire Protection Plans: Guidelines for Implementation. 4 pages.

Mountain Park, which is located in the southern portion of the Beulah Valley. Approximately seventy-five acres of the Pueblo Mountain Park have been treated to date using grant funds, matching City resources, and volunteer efforts. The project serves as an area to demonstrate some of the techniques available to treat fuels and what an area may look like following treatment.

The Pueblo Mountain Park treatment area ties into an area burned by a wildfire that occurred on February 22, 1996. The fire was ignited by power lines downed by 80 mile per hour winds out of the southwest. The fire threatened the Pueblo Mountain Park and homes along South Pine Drive. The fire was suppressed through a mutual aid response by eight local fire departments, helped by high fuel moisture content and scattered snow on the ground. Located on the southeastern edge of the Pueblo Mountain Park and bordering South Pine Drive, the site of the fire and mitigation work in the park are readily visible. The site serves as a reminder that fire need not severely damage mature Ponderosa pine and that mitigation efforts can blend in with natural processes.

A stand of pine immediately west of 12-mile road that burned in 1996. Note the openness of the stand (Photo: Steve Douglas September 2006)

A hillside of the west of the area burned in 1996 that was treated in 2005-06 to create openings and serve as a fire break (Photo: Steve Douglas September 2006

On July 6, 2005, the lightning ignited Mason Gulch Fire grew to over 11,300 acres in less than a week and threatened numerous homes along Siloam Road, North Creek, and Beulah Valley before a favorable wind shift halted its spread and gave firefighters a chance to suppress it. This incident and its aftermath greatly emphasized the need to address the impacts of wildfire and develop a strategy for protecting the communities, developments and subdivisions and watersheds at risk in the area.

2.2 Core Team

A core decision-making team composed of the Beulah Area Wildfire Mitigation Council, Pueblo County Department of Emergency Management, Pueblo County Geographic Information System, Pueblo County Sheriff, Rye Fire Protection District, Beulah Volunteer Fire Department, Red Creek Fire and Rescue, Pueblo Emergency Response Teams, Mountain Park Environmental Center, Colorado State Forest Service, Colorado Division of Wildlife, USDA Forest Service, National Weather Service, Natural Resources Conservation Service, and Wildland Fire Associates (Contractor) was formed[2].

An initial meeting of the Core Team was held on August 10, 2006. The purpose of the meeting was to identify stakeholders and encourage their participation and define the roles they will play in the protection of the community from the impacts of a wildfire. The team decided to concentrate the planning efforts on the southwest portion of the county, which was at the greatest risk from a catastrophic wildland fire.

The purpose of this plan is to:
1. identify and prioritize wildland fuel management projects developed by the Core Team,
2. and recommend methods of managing wildland fuels that are acceptable to members of the community and other stakeholders.

2.3 Methodology

The Core Team began by listing key stakeholders and constituencies whose involvement should be sought. Individual team members were given assignments to gather data and other information needed to complete the plan. The Beulah Area Wildfire Mitigation Council engaged the services of a contractor, Wildland Fire Associates, LLP of Rangely Colorado to recommend treatment options and to draft and finalize the plan.

As part of the process, several subdivisions located in the western portion of the planning areas were assessed. The assessments were used to determine their vulnerability to a catastrophic wildfire. The results of the assessment were included in the base map and used by the core team to identify areas of concern and make decisions (See Section 6.1 for additional details).

The Geographical Information System (GIS) Manager for Pueblo County has a comprehensive data set that was used to develop a base map of the area and

[2] A listing of core team members can be found in Section 10.0.

adjacent landscapes of interest. The data were used to make recommendations regarding areas needing protection and establishing risk-reduction priorities.

The Wildland Urban Interface (WUI) is defined as the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels[3]. Federal funds are available to complete projects in a one-mile buffer around buildings, structures, or subdivisions located in WUI areas adjacent to federal lands. The one-mile buffer standard was adopted, regardless of land ownership, to define the Wildland – Urban Interface.

The planning process and resulting recommendations also recognized the importance of the following premises when developing and implementing the CWPP for Southwest Pueblo County:

- It is important that the communities and stakeholders fully support the plan. To successfully compete for and receive grants, the community must be willing and ready, to the extent necessary, to actively participate in each identified project.
- Actions must be taken within the community by individual landowners to improve the safety of firefighters and the public in the event of a wildfire; and to reduce the likelihood of a fire originating in the community escaping initial attack and threaten nearby structures or other private or public lands.
- The plan will identify near term and intermediate actions, as well as future treatments and follow-up maintenance activities. It is necessary to recognize the importance of attempting to properly sequence treatments on the landscape by working first around and within the communities and subdivisions, and then moving further out into the surrounding landscape.
- It is quite likely, due to availability of funding, that the plan will be implemented in stages and completed based on established priorities.
- Mitigation measures should be cost effective to the extent possible.
- Treatments initiated by the communities and others should complement the fuels treatment work that has been completed to date by private landowners, the Beulah Area Wildfire Mitigation Council, the City of Pueblo, Pueblo County, the State of Colorado, the U.S. Forest Service, and others.

The overriding treatment objective is to create defensible space with a forest canopy that would be less likely to support a crown fire. As a result, a crown fire

[3] USDI/USDA. 1995. Federal Wildland Fire Management Policy and Program Review. Final Report. National Interagency Fire Center, Boise, ID, 45 p.

would revert to a surface fire and spot fires ignited in advance of a crown fire would also remain surface fires, which could be more easily attacked by wildland firefighters.

When fully implemented, the desired future conditions identified in the fuels management section of the plan can be expected to afford fire suppression personnel a greater than ninety percent success rate when defending the community against a high-intensity wildland fire. The treatments will provide for safe and effective fire suppression actions while also considering the aesthetic values important to the local residents and other stakeholders.

Aftermath of Mason Gulch Fire Photo: Peter Conlon

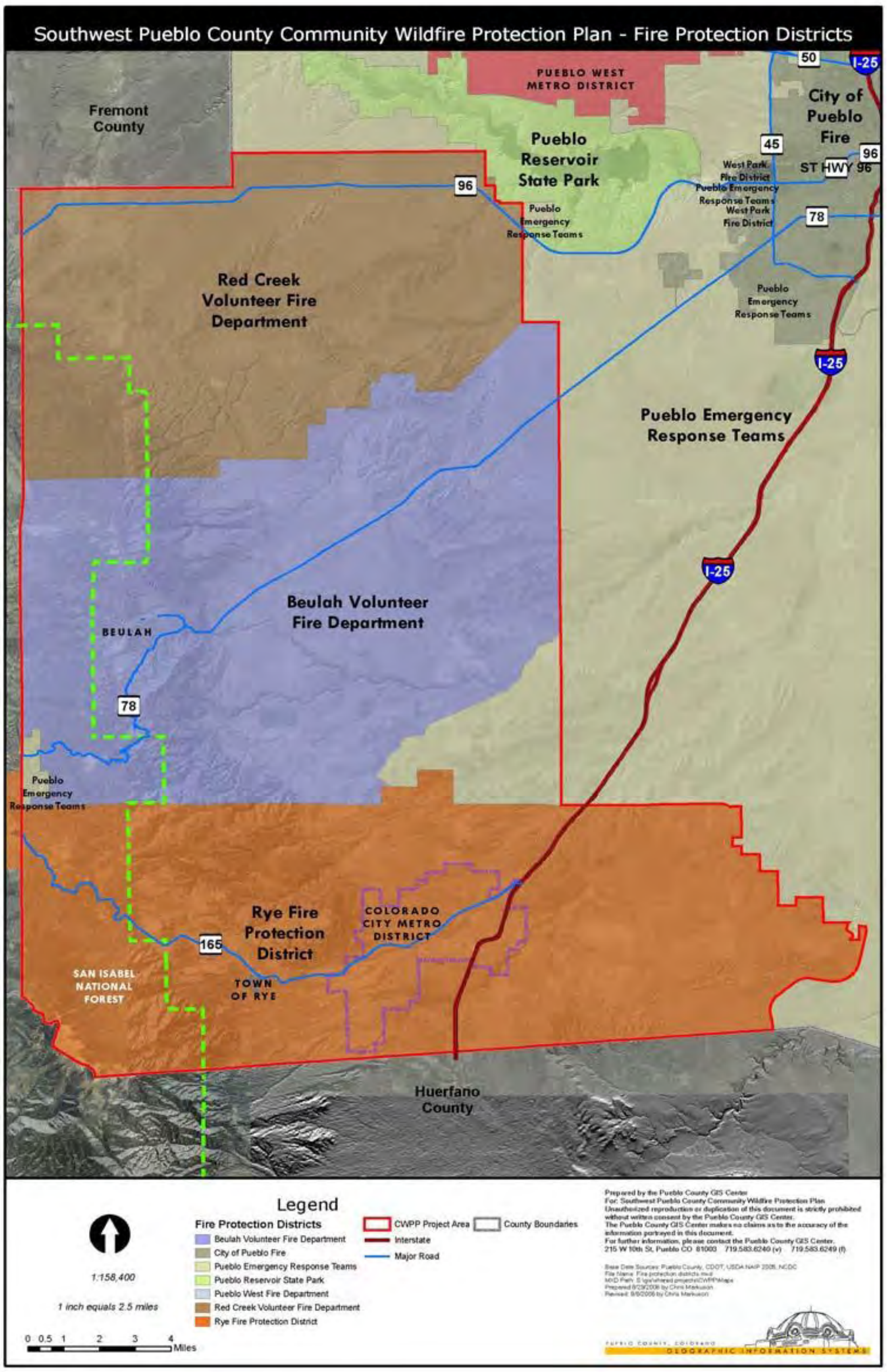
3.0 Planning

3.1 Planning Area Boundaries

The planning area is formed by the boundary between Custer and Pueblo Counties on the West and the defined response area boundaries for the Beulah Volunteer Fire Department, Red Creek Fire and Rescue, the Rye Fire Protection District (except those portion in Custer and Huerfano Counties), and an area served by the Pueblo Emergency Response Team's Fire Team (Figure 1).

The western boundary of the planning area includes a portion of the Wet Mountains, which also lie in neighboring Custer and Huerfano Counties. Their common boundary is located near the summit of the range's highest peak, 12,350 foot high Greenhorn Mountain. Wildland fire response occasionally involves two counties and, potentially it could involve all three counties. This plan only addresses current conditions and planned actions in Pueblo County with the exception of Simonson Meadows subdivision, which lies in both Pueblo and Custer Counties.

Figure 1: Planning and Fire Response Areas



3.2 Planning Process

The publication, *Preparing a Community Wildfire Protection Plan: A handbook for Wildland-Urban Interface communities*[4], was used as a guide to prepare this plan. The steps outlined in the publication were used to identify tasks. The Director of the Pueblo County Department of Emergency Management, the Pueblo County GIS Manager, and the contractor developed preliminary task recommendations. The Core Team concurred with the recommendations and agreed to provide necessary documents and information required for the completion of the plan. They also participated in the WUI identification process and the setting of priorities. Representatives of various subdivisions also participated.

Meetings were held on August 4, August 10, August 30, and September 7, 2006, with core team members and others to gather information and receive input, obtain recommendations, identify potential projects, make assignments, and set deadlines.

A decision was made by the Core Team to use Pueblo County's Geographical Information System to complete much of the analysis. A field assessment was completed for two communities and nine subdivisions located in the planning area in order to validate the process.

The contractor received necessary information from members of the core team and others. The draft plan was posted on the contractor's website as it was being written so that interested parties could read and comment on the plan prior to its completion.

Forty copies of the plan will be distributed to interested parties. Public meetings are planned and will be held after the plan is finalized to further discuss the plan and its implementation. Additional projects are expected to be identified as a result.

[4] Various Sponsors. 2004. Available on the Internet at: www.safnet.org/policyandpress/cwpp.cfm

4.0 Wildland Fire Safety

While completing the wildfire hazard assessments, it was noted that a great deal of work remained to be completed within some of the subdivisions to provide a reasonable degree of protection for the individual structures and the safety of firefighters, the residents and their guests. Due to ingress and egress issues and the location of subdivisions, it may be necessary for the inhabitants to leave the subdivision quickly. To that end, an Evacuation Plan has been prepared for the southwest portion of Pueblo County (Appendix B).

Mason Gulch Fire Photo by Daniel Wells

First responders and Incident Commanders must size up the situation and develop their plan of attack accordingly. Fire departments should develop pre-attack plans for subdivisions and neighborhoods in their areas of responsibility.

Certain projects related to wildland fire safety may be included in the listing of recommended projects identified in Section 8.5.

5.0 Community Description

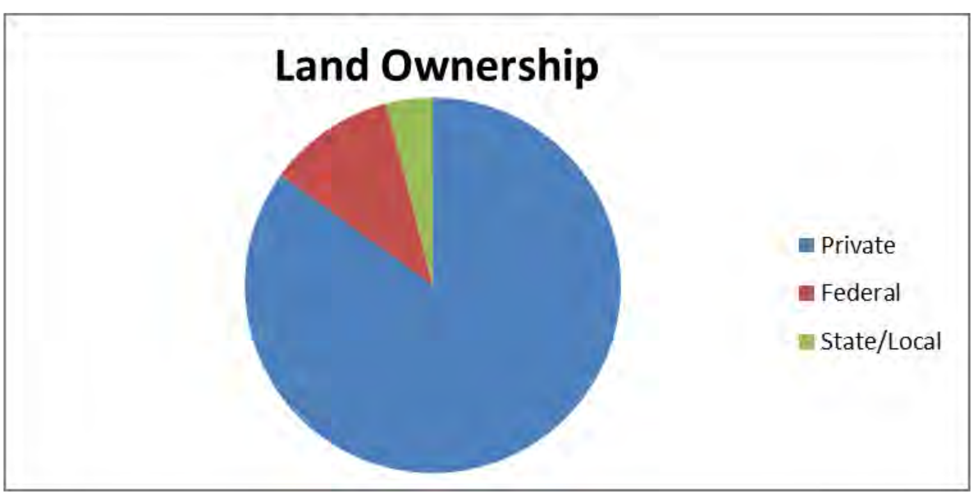
5.1 General Information

Located in the south-central portion of Colorado where the plains meet the mountains, Pueblo County was one of the original 17 counties established when the Territory of Colorado was created on February 28, 1861. Spanish land grants dominated the area prior to the arrival of large numbers of miners, loggers, farmers, and ranchers in the mid -1800's. There is little doubt that prior to settlement wildland fire played a significant role in creation and perpetuation of native plant communities. The influence of wildland fire was disrupted with the arrival of early settlers into the area. The consequences of logging, grazing, and fire suppression have lead to a more or less even-aged stands of mixed conifer, an increased accumulation of forest fuels on the ground, an increase in tree density in forested areas, and an increase of trees, brush, and other species in prairie areas.

Ranchers and farmers first settled the area. Later, parts of the area were subdivided and sold to city dwellers wanting to escape the summer heat. As the economy improved and the demographics of the country changed, more and more people began moving into the area to live on a year-around basis. Many have purchased large, 40-acre parcels located in the Wildland-Urban Interface (WUI). Some have purchased existing 50 – 80 year old summer homes and converted them to year-around homes, retaining the rustic character and setting.

The planning area encompasses 274,825 acres of which 234,825 acres are in private ownership, 31,415 are managed by the federal government, and 9,261 acres are in state and local government ownership.

Figure 2: Land Ownership in Planning Area



The Town of Rye is the only incorporated community within the planning area. Unincorporated communities in the planning area include Beulah and Colorado City. The Pike – San Isabel National Forest administers a portion of the western and southern boundary of the county. The City of Pueblo and Pueblo County have established mountain parks in the planning area.

5.1.1 Topography, Slope, Aspect, Elevation

The topography of the planning area is varied. The land rises in a series of ridges to the foothills of the Rocky Mountain chain known as the Wet Mountains. Generally, the terrain in the northeastern section of the planning area is relatively flat, while the southeastern portion is broken. Elevations range from 4,642 to 12,350 feet. Slope is not a factor on the plains, except in drainages, but can be characterized as having an east aspect; however there is enough topographic relief that all aspects are present, even on the plains.

5.1.2 Meteorology, Climate, Precipitation

The planning area rises from the plains to the summit of Greenhorn Mountain in the Wet Mountains. As a result, there are definite variations in the weather. The Wet Mountains can receive heavy snowfall and spawn severe storms that can produce lightning, hail, and lead to flash flooding.

Although floods make up about 75 percent of the state's natural disasters, experts say that Colorado is also vulnerable to a severe, long-term drought that also could have devastating impacts on people, property and the economy[5].

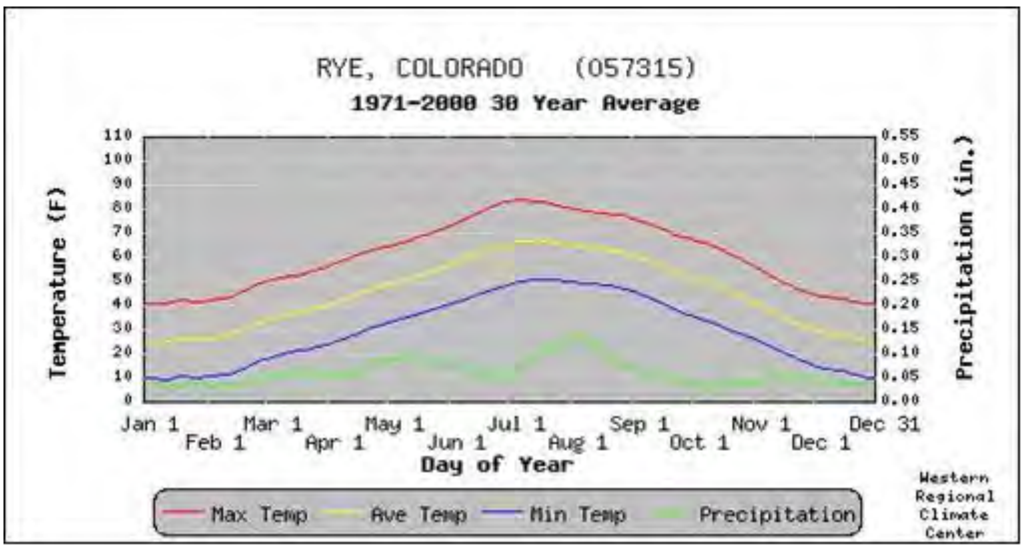
Droughts are a normal part of the climate for all regions of the United States, but are of particular concern to the arid West where any interruption of the region's already limited water supplies over extended periods of time can produce significant impacts[6]. The shift from a wet cycle to drought cycle was dramatically illustrated as Pueblo County shifted from a federally declared flood disaster in 1999 to a drought whose peak occurred during the summer of 2002 when Pueblo County was included in a federal drought declaration. One consequence of the recent drought was the streams in the Beulah Valley dried up for a period of 61 days that summer. During that period, the Beulah and Pine Drive Water Districts, which rely on surface water, were unable to directly serve their customers. Their customers were forced to rely on water hauled by tank truck from the City of Pueblo to meet their needs, though on a highly reduced scale. The current drought cycle in Pueblo County may not have ended.

Based on over 44 years of records (1948-1992) recorded at a remote weather station (RAWS) at Rye, the annual average temperature for the Rye area is

[5] Office of the Governor. 1999. Public Invited To Governor’s Flood and Drought Preparedness Conference. Press Release. Available on the internet at www.state.co.us/owenspress/11-10-99a.htm
[6] Ibid

61.8° F. The average temperature range during that period of time varies from a high of 82.7° F in July to an average minimum temperature of 12.7° F in January. Average annual precipitation is 22.6 inches. The wettest month is August, which receives on average 3.25 inches of precipitation, and the driest month is January, which averages less than an inch (0.96”). The Rye area receives 65 inches of snow a year, on average[7]. The graph below, developed by the Western Climate Center using more recent data, displays temperature and precipitation trends for the Rye area[8]. The data from the Rye RAWS is considered to be representative of the weather conditions in the planning area.

Figure 3: 30 Year Temperature and Precipitation Averages – 1971-2000



Source: Western Regional Climate Center

5.1.3 Hydrology

Three municipal watersheds are located within the planning area provide surface drinking water for Colorado City, Rye, and Beulah (Table 1). These watersheds are extremely important to the communities that depend on them. The Wet Mountains presumably serve as a recharge point for deep aquifers. Much of the central and eastern portion of the planning area is either in the outcrop area of or is capped by Dakota Sandstone and serves as its recharge area. Dakota Sandstone is the most prominent sedimentary bedrock aquifer in Pueblo County.

[7] The Desert Research Institute. Available on line at http://www.wrcc.dri.edu/ [8] Ibid

Table 1: Community Water Supplies – Southwest Pueblo County

System	Area Served	Source
Colorado City Metro District	Colorado City	Surface
Diamond Shamrock No 4062	Colorado City	Well
KOA Pueblo's Colorado City	Colorado City	Well
Rye, Town of	Rye	Surface
YMCA – Camp Jackson	Rye	Surface
San Isabel Boy Scout Ranch	San Isabel	Surface
Lazy Acres Girl Scout Camp	San Isabel	Well
Beulah Water Works District	Beulah	Surface
Pine Drive Water Company	Beulah	Surface
Pine Drive Water District	Beulah	Surface
Pueblo Mountain Park WS	Beulah	Surface
Red Mountain Youth Camp	Beulah	Well
Mountain Shadows	Beulah	Well
Signal Mountain	Beulah	Well

Lake San Isabel lies on the Pueblo County-Custer County line, the western boundary of the planning area. The St. Charles River and other smaller perennial and intermittent streams flow from the southwest to northeast through the planning area.

Large fires in the Front Range, especially the Hayman Fire (2002) and Buffalo Creek Fire (1996) have demonstrated the importance of protecting watersheds. For example, a flash flood that occurred shortly after the Buffalo Creek Fire caused a great deal of damage to local infrastructure, greatly impacted a water storage facility operated by the Denver Water Board, and most importantly took two lives.

Heavy rains over the Mason Gulch Fire (2005) area in June and July of 2006 resulted in significant runoff in North Creek and Red Creek which damaged access roads and deposited extensive debris downstream from the burn. As indicated previously, several water systems in the planning area rely on surface water to provide the majority of the drinking water to the local community. The protection of these water sources from the impacts of a high-intensity wildland fire is extremely important.

5.1.4 Ecosystem Types

The elevational gradient of the planning area provides a wide range of ecosystems including shortgrass steppe, Lower ecotone shrubland, Lower montane, Upper montane, Subalpine forest, Forest-alpine ecotone, and Alpine tundra. The eastern portion of the study area is composed of short-grass prairie that gives way to stands of Piñion-Juniper, montane, and alpine forests in the west.

5.1.5 Threatened and Endangered Species and Species of Concern

The planning area is within the historic range of the Mexican spotted owl (*Strix occidentalis lucida*) and includes an activity area. Some river bottoms on the eastern plains serve as winter range for Bald eagle (*Haliaeetus leucocephalus*). Both are listed federally and by the State of Colorado as a threatened species. The Ferruginous hawk (*Buteo regalis*) is listed as a State Species of Concern. Although it has no special status, Albert's squirrel (*Sciurus aberti*) is classed as a Species of Interest by the State and is a resident in the Beulah Valley.

Plant species requiring special protection are the Birdsfoot Violet (*viola pedatifida*) and the Calypso Orchid (*Calypso bulbosa*).

Bird species on Audubon's or Colorado Partners in Flight "High Conservation Priority Species" lists or those in need of special consideration due to habitat requirements or loss include the Cordilleran flycatcher (*Empidonax occidentalis*), Virginia's warbler (*Vermivora virginiae*), Western bluebird (*Sialla mexicana*), Lewis's woodpecker (*Melanerpes lewis*), Flammulated owl (*Otus flammeolus*), Band-tailed pigeon (*Columba fasciata*), and Williamson's sapsucker (*Sphyrapicus thyroideus*).

The habitat needs for these and other species will be considered when finalizing individual projects.

5.2 Homes, Businesses, and Essential Infrastructure at Risk

Ranches, small groupings of homes, and freestanding homes are present throughout the planning area. Widely scattered homes located on large 40 acre lots are prevalent in subdivisions, especially in the western portion of the planning area. The total population for the planning area, according to the 2000 census is 5,112. Of that total, 650 live in the Beulah Valley, 1636 live in Colorado City, and 198 live in Rye[9]. The median home value within the planning area is $137, 622.

A variety of businesses, some of which cater to area visitors, as well as churches, and other local businesses provide area services are located in Colorado City, Rye and Beulah. Beulah has two primary water companies, both of which rely on surface water to supply their constituents. Rye and Colorado City each are served by their own water company; both rely on surface water (Table 1). Electrical power, telephone service, and cable and Internet service are provided primarily by local companies; i.e., San Isabel Electric Association, Rye Telephone Company and Pine Drive Telephone Company.[10]

[9] 2000 Census [10] The maps documenting improvements, areas of concern, evacuation routes, etc. can be found at the back of this plan.

Elementary students and middle school students attend schools in Beulah, Rye, and Colorado City, and high school students attend school in Rye or elsewhere. The nearest medical facilities are located in Pueblo.

5.3 Other Community Values at Risk

Recreational and day use activities (picnicking, fishing, hunting, hiking, mountain biking, etc.) are important to the area's economy. Key recreational areas include Pueblo Mountain Park, Rye Mountain Park, Boy Scout Camp, Girl Scout Camp, YMCA Camp, and Lake Isabel. Designated as a Scenic and Historic Byway by the State of Colorado, the scenic views from State Highway 165 are enjoyed by many visitors to the area.

The Mountain Park Environmental Center and a nearby pavilion are listed on the historic register. The Squirrel Creek Camping Area, the first facility of its type to be designated by the federal government, is of historic significance. Two ranches in the area, 3R and Bears Head (formally the Don K), are considered to be historic, as is a Centennial Farm located in Beulah Valley.

Parts of the 3R Ranch are important elk and mule deer wintering grounds and other critical or significant habitats of interest include old aged stand (6" diameter or larger) oak brush. This is a very important food source primarily for black bear and turkey. It is important that some stands of this age class of oak remain viable and productive. However, manipulation of some of these stands will produce the desired mosaic of age classes[11].

5.4 Emergency Services

5.4.1 General Information

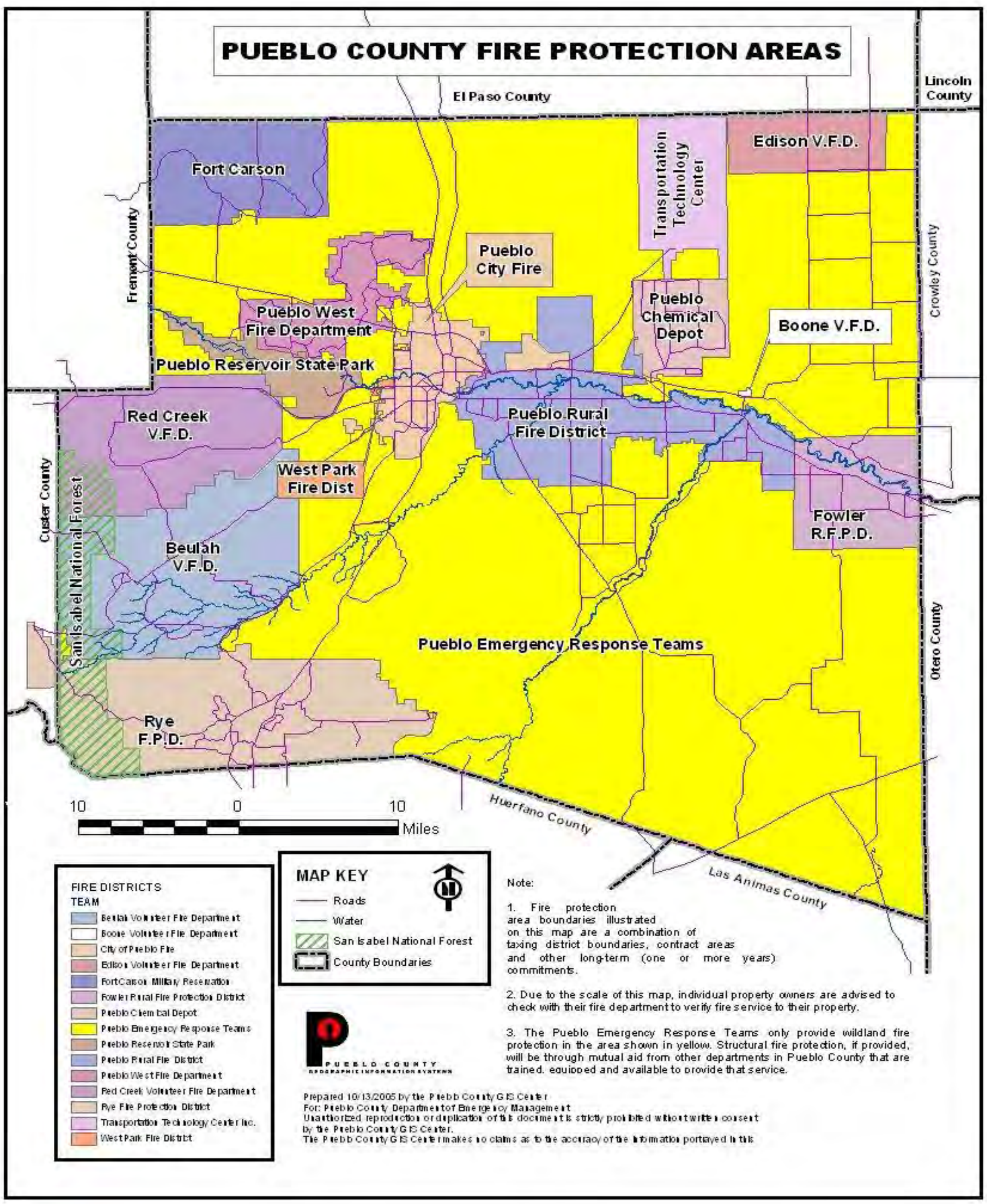
Wildland fire suppression services in Pueblo County are provided by nineteen (19) private, local, state and federal agencies (Figure 4). They are from north to south across Pueblo County:

- U.S. Army – Fort Carson
- Transportation Technology Center, Inc.
- Edison Volunteer Fire Department
- Colorado Division of Wildlife & Division of Parks & Recreation – Pueblo Reservoir State Park
- Pueblo West Fire Department
- West Park Fire District (Volunteer)
- City of Pueblo Fire Department
- Pueblo Rural Fire Protection District
- U.S. Army – Pueblo Chemical Depot
- Boone Volunteer Fire Department

[11] Colorado Department of Resources – Division of Wildlife

- Fowler Rural Fire Protection District
- Red Creek Volunteer Fire & Rescue
- Beulah Volunteer Fire Department
- Rye Fire Protection District
- Pueblo Emergency Response Teams' – Fire Team
- U.S. Forest Service, Colorado State Forest Service & Colorado Department of Corrections – San Isabel National Forest

Figure 4: Pueblo County Fire Protection Districts



Significantly, for over a decade the majority of these departments have routinely provided each other support during wildland fire suppression activities in the form of mutual aid – both within and outside of the wildland-urban interface. The overarching goal has been the timely suppression of wildland fire in order to protect life and property. Lessons learned (and re-learned) in 1994 on Storm King Mountain encouraged Pueblo County firefighters and policy-makers to adopt standardized wildland fire fighting training (beginning with basics taught in S-130/190), to acquire and use wildland fire personal protective equipment, to acquire appropriate wildland fire apparatus (when afforded the opportunity), and to use the Incident Command System in an ever increasing fashion.

The value of those lessons was reinforced on February 22, 1996, when seven local fire departments from Pueblo County and the County Sheriff joined the Beulah Volunteer Fire Department in the suppression of a wind-driven fire near the Pueblo Mountain Park. Nearly ten years and over a thousand responses later, eight local departments from Pueblo County directly participated in the suppression of the Mason Gulch Fire (2005), while being backed up in their service areas by other local resources.

This background serves to emphasize the fact that the four fire departments that directly serve the Southwest Pueblo County Community Wildfire Protection Planning area will be supported and reinforced through mutual aid from other departments in the County. This also illustrates that resources will leave the planning area to provide mutual aid elsewhere in Pueblo County, as well as in Custer and Huerfano Counties.

5.4.2 Structural and Wildland Fire Protection

The Beulah Volunteer Fire Department, Red Creek Volunteer Fire & Rescue, and Rye Fire Protection District provide structural and wildland fire protection in the planning area. The Pueblo Emergency Response Team's Fire Team provides wildland fire protection in a portion of the planning area, but it does not directly provide structural fire protection. The USDA Forest Service has first response responsibility for wildland fire suppression on forest service lands within the San Isabel National Forest, and may receive assistance in that process by the State of Colorado, through the Colorado State Forest Service and the Colorado Department of Corrections. A more detailed description of each of the local departments and Pueblo Emergency Response Team's Fire Team can be found in sections 5.4.2.1-5.

The resources of and relationship between the wildland fire response agencies in southwest Pueblo County (and to a lesser degree, the remainder of Pueblo County) are reviewed and updated annually in the Annual Fire Operations Plan (AOP). Since 1994 the Pueblo County Department of Emergency Management has facilitated the writing of the AOP. The Pueblo County Sheriff, Pueblo Board of County Commissioners, Colorado State Forest Service, U.S. Forest Service and U.S. Bureau of Land Management formally sign it. In addition, the AOP serves as a surrogate for a formal mutual aid agreement, and is also signed by most or all of the other wildland fire response agencies in Pueblo County.

5.4.2.1 Red Creek Volunteer Fire & Rescue

Red Creek Volunteer Fire & Rescue is the northern-most local wildland fire response agency in the planning area and is the newest fire agency in Pueblo County. The department was formed in 1998 and has a total response area of 107.5 square miles. Prior to being formed, the Beulah Volunteer Fire Department covered approximately half of its response area and the Pueblo Emergency Response Teams covered the other half. The Red Creek response area is not formally defined under the Colorado Special District Act, rather it is a response area operating under informal agreements with the properties it serves. Those properties include the Newton, Roper, Vaughn and Savage subdivisions, as well as some other properties, including a one-mile wide area north of Colorado Highway 96. The department is fully voluntary, both in terms of its staffing and its funding. Red Creek Volunteer Fire & Rescue operates out of a new fire station located at 2579 Canyon Heights Road, with a staff of 17 volunteer fire fighters. Their equipment includes one Type 6 engine, one 1,200 gallon tender, one support vehicle, and associated equipment.

5.4.2.2 Beulah Volunteer Fire Department

The Beulah Volunteer Fire Department has served its community with pride since 1949. In some cases up to three generations of fire fighters; men and women alike have been involved. Like Red Creek, Beulah is a completely voluntary service, including its staff, funding and service area. Beulah’s service area currently encompasses 150 square miles, all in Pueblo County. The department operates primarily out of one fire station, located at 8898 Grand Avenue, Beulah. A few of their engines are stationed at the homes of its volunteers, both to distribute resources across the response area and as a reflection of an engine inventory that exceeds the station’s storage capacity. Discussions are underway regarding the construction of a satellite station northeast of Beulah off of Colorado Highway 78 on Waterbarrel Road. The Department staff consists of 20 volunteer fire fighters. Their equipment includes three Type 3 engines, five Type 6 engines, and associated equipment.

5.4.2.3 Rye Fire Protection District

The Rye Fire Protection District (District) is a special district, receiving income from property tax revenue generated in the district. The District was formed in 1938 and provides structural fire, wildland fire, hazardous material, and emergency medical response services to their service area. The District has evolved from a service staffed entirely by volunteers (except a nominally paid Chief) to a staff consisting of seven full-time salaried employees and fourteen part-time employees. The District has undergone a careful expansion of its response (and taxing) area in the past several years, expanding primarily in Pueblo County, but also in Custer County along Colorado Highway 165 and to a lesser degree, south into Huerfano County south of Rye. Their current service area in Pueblo County consists of 157 square miles. The District operates out of two stations, one in Rye at 6051 Boulder Avenue and one in Colorado City at 4495 Bent Brothers. The Rye Fire Protection District's equipment includes two Type 2 engines, one Type 3 engine, one Type 6 engine, one Type 2 tender, 3 support vehicles, two Type 2 ambulances and various associated equipment.

5.4.2.4 Pueblo County Sheriff

Under the provisions of C.R.S. 30-10-512 and 30-10-513 respectively, the Pueblo County Sheriff is to act as Fire Warden, responsible for wildland fire suppression in unincorporated Pueblo County. Up until late 1989, the Pueblo County Sheriff directly provided wildland fire response services in unincorporated Pueblo County, outside of established fire response areas. The Sheriff provided that service with his paid and volunteer staff. Under an informal (handshake) agreement with the Pueblo County Emergency Management Director, the Department of Emergency Management (DEM) undertook the task of providing wildland fire response with members of its volunteer Pueblo Emergency Response Teams (PERT). Under that agreement, DEM/PERT provides wildland fire suppression services in Pueblo County, at the behest of and under the color and authority of the Sheriff's statutory authority. The Sheriff retains his statutory responsibilities as Fire Warden, with DEM/PERT helping to meet his wildfire response and suppression responsibilities. Both parties (Sheriff and DEM Director) of that original agreement are still in place in their respective positions.

5.4.2.5 Pueblo Emergency Response Teams' Fire Team

The Pueblo Emergency Response Teams (PERT) actually consist of three teams: Wildland Fire, Search & Rescue, and Dive Rescue/Recovery, with inhouse emergency medical personnel, who are at times organized as a fourth team and at other times integrated into the three core teams. The teams are organized under the Pueblo County Department of Emergency Management's Office of Emergency Preparedness (OEP). The Department and OEP are responsible for the recruiting, training and equipping of PERT volunteers, utilizing paid DEM/OEP staff, and managing a mix of Pueblo County funds and grant funds.

Typically, 80-85 percent of all PERT responses annually involve the fire team. Those responses are for "anything burning" in the PERT Fire Response Area. If the fire involves the wildland or vehicles, PERT responders act to directly suppress the fire. If it involves a burning structure, PERT requests mutual aid support from an available structural fire department and provides external support for that response, typically involving water resources. PERT is neither equipped nor trained to provide entry to a burning structure, nor is it statutorily responsible for structural fire response. The PERT Fire Response Area in Pueblo County currently consists of 1,466 square miles, of which 14.7 are in the planning area. Its response area would expand if a department such as Beulah or Red Creek were to decide to stop providing initial response for an area. Their response area contracts when a new department (like Red Creek) is formed or when a department (such as Rye) expands its service area.

PERT Fire currently responds with fire equipment out of a warehouse located at 920 North Main Street in Pueblo, or alternately from the DEM warehouse at 411 Bell, in the Pueblo Memorial Airport Industrial Park. All other DEM equipment that may respond to a wildland fire is housed in the Pueblo Memorial Airport Industrial Park. The PERT Fire Team currently consists of 27 volunteers, supported by three DEM Representatives (one of which is the volunteer coordinator) and a half-time warehouse person. Their fire equipment consists of two Type 6 Engines, one Type 3 Engine, one 1,300 gallon Tender and one fire cache trailer. The department's other equipment available to support wildland fire consists of five 4WD utility vehicles, one 2WD utility vehicle, two mobile command vehicles (one large and one small), four 16' utility trailers with barricades, cones and signs, three trailer-mounted variable message boards, two ATVs and various associated support equipment.

Going to work – Mason Gulch Fire Photo: USDA Forest Service

5.4.3 Communications

The Pueblo County Sheriff's Communications Center (PCSO Comm Center), which is part of the Pueblo County Emergency Operations Center, provides Emergency-911 dispatch services (E-911) to all fire departments based in and serving rural Pueblo County. This service area includes all the local fire response agencies serving the planning area, as well as most of the other local departments providing them mutual aid. Along with the E-911 telephone service, the PCSO Comm Center also provides emergency notification to the residential public through the Emergency Preparedness Network (EPN), sometimes referred to as "Reverse 911". EPN was used ten times during the 2005 Mason Gulch Fire to first prepare the affected public for evacuation and then on July 10th to evacuate a large portion of the Beulah area.

The PCSO Comm Center currently uses traditional wide-band VHF and UHF radio frequencies to communicate with fire, EMS, law enforcement, public works, emergency management and other responders. Pueblo County is in the process of migrating from those traditional frequencies to narrow-band and digital frequencies, following the direction of federal regulations and technological change. The change will incorporate the use of Colorado's 800 MHz Digital Trunked Radio System (DTRS), maintain the ability to communicate on existing VHF and UHF channels as long as is needed, develop the capability to communicate on the UDSA Forest Service's new narrow-band digital VHF channel and will utilize gateway technology to integrate these various channels as needed during multi-agency and mutual aid responses. These changes are anticipated to take place between 2006 and 2009, using a variety of federal grant funds, E-911 surcharge revenues and local funds. Funding to make necessary additions to the DTRS tower network in Pueblo County has already been received.

5.5 ISO Ratings

The ISO rating for the Rye Fire Protection District is a 6 or a 9, depending on location. The ISO rating for Red Creek's response area is 9. The ISO rating for Beulah Fire Department's response area varies with water access and distance from the station in Beulah. In the Beulah Valley, within the service areas of Beulah Water District and Pine Drive Water Districts, the ISO rating is 6. Outside that area but within 5 miles of the station, the rating is 9. Beyond 5 miles, the ISO rating is 10.

6.0 Community Risk Assessment

6.1 Environmental Factors

6.1.1 Fuel Hazards

The planning area has been impacted by several years of severe drought, which has severely stressed trees and made them susceptible to attack by insects and disease, including a moderate to heavy infestation of dwarf mistletoe (*Arceuthobium* spp.).

Forest insects and diseases have increased fuel loads. Piñon Ips beetle (*Ips confuses*) and Twig beetle (*Pityophthorus sp.*) have attacked Piñon pine, Mountain pine beetle (*Dendroctonus ponderosae*) and Ips (*Ips pinii*) have caused mortality in Ponderosa pine, and Spruce beetle (*Dendroctonus rufipennis*) and Fir engraver (*Scolytus ventralis*) have attacked spruce and fir trees stressed by the drought and other factors.

Native aspen stands show impacts thought to be drought related, as evidenced by myriad diseases and insects that have attacked them.[12] The presence and impact of insect infestations and occurrence of dwarf mistletoe can be expected to increase and contribute to the existing fuel load.

Dense forest regenerated in the wake of grazing, logging, and fire suppression have resulted in vast stands of trees having approximately the same age and size, particularly in lower montane forests dominated by ponderosa pine and Douglas-fir. Historically, fires kept lower montane forests more open and patchy. While fire was a relatively frequent natural disturbance, these forests became adapted to periodic fire and were far less vulnerable to massive crown fires. The lack of subsequent effects of fire after Euro-American settlement allowed most of these trees to survive, creating continuous canopies of even-aged trees that are now under stress from competition for resources, and dense ground fuels and fuel ladders that carry fire into the forest canopy[13]. The lack of fire has also allowed ground fuels to increase and Gamble oak and shade loving species to encroach into existing stands, creating additional ladder-fuels that will contribute to fire spread and intensity. The heavy fuels combined with mountainous topography make wildfires occurring in these stands difficult to suppress[14].

The primary National Forest Fire Labs (NFFL) fuel model for the area is Fuel Model 10 (NFDRS FM G) – Short Needle Cast; Heavy Dead. Crowning out,

[12] Lewis Page, et al. 2005. 2004 Report on the Health of Colorado's Forests. Colorado Division of Forestry. Denver, CO. 32 pp. [13] Ibid. [14] Maps concerning fuels and fuel loading can be found at the back of this plan.

spotting, and torching of individual trees is more frequent in this fuel situation, leading to potential fire control difficulties[15].

6.1.2 Fire Weather

Frequent summer thunderstorms are common. Lightning caused wildland fires occurred historically and continue to occur under present forest and climate conditions. In a mixed-conifer forest dominated by ponderosa pine and Douglas-fir (to a lesser extent piñon/juniper), the duff depth and fuel moisture are key to ignition.

Recent periods of drought though not unprecedented historically, are common and have been a contributing factor to large fire development. An observed phenomenon that may become more of a factor is the gradual warming of the environment. Gradual warming can contribute to earlier snowmelt and heavy runoff, lower fuel moisture, isolated rainstorms and are more conducive to surface runoff than moisture absorption. The early loss of snow cover and a patchy rainfall with a lower absorption rate may contribute to lower live and dead fuel moistures.

Low relative humidity, below average live and dead fuel moisture, low duff moisture, above average fuel loading, moderate to high winds, and periods of drought are known to contribute to large-scale wildland fire development.

Crown Fire – Mason Gulch Fire
Photo: USDA Forest Service

A tool developed by the National Wildfire Coordination Group (NWCG) indicates that combining an ignition source with a RH <15%, temperature >85 degrees, live fuel moisture for conifer <100% - for oak <115%, 20’ wind speed >15 mph, and an Energy Release Component (ERC) above 65 (90 percentile), with atmospheric instability resulting in a Haines Reading of 5 – 6, and high probability of ignition will result in conditions that are

[15] Anderson, Hal E. 1982. Aids to determining fuel models for estimating fire behavior. USDA For. Serv. Gen. Tech. Rep. INT 122, 22p. Intermountain Forest and Range Experiment Station, Ogden, UT.

just right for a high intensity, catastrophic wildland fire that will be difficult to control[16].

Many of these same factors are combined with fire danger ratings and certain weather phenomenon outlined below to determine whether the National Weather Service should issue fire watches or warnings:

> Predominant Weather Pattern: Strong west or southwest flows aloft across the Rocky Mountain region. This creates the potential for stronger winds mixing down to the surface, and because of the natural land barrier of the Sangre de Cristo Mountains and Front Range creates downslope drying conditions for the eastern areas. The normal months for peak wildfire activity in the Wet Mountains are July, August and September; however, prolonged drought conditions heighten fire danger by drying out the fuels and making them more susceptible to ignitions during fire weather conditions.
>
> Dry Thunderstorms: Low relative humidity below 8,000 feet elevation with moist air aloft sets the stage for dry thunderstorms. Add to that mix an upper air disturbance that passes over the region during the peak heating period, a dry thunderstorm outbreak becomes likely. The weather pattern that is most conducive to a dry thunderstorm outbreak is a large surface high pressure to the south or southeast and southwest wind flow above 14,000 feet elevation. This provides for the low relative humidity near the surface with higher relative humidity aloft. This pattern is most common during the June to early July period. If a prolonged drought is in progress the situation becomes more critical.

6.2 Risk of Fire Occurrence

The 11,300 acre Mason Gulch Fire of July 2005 sounded a loud warning to the residents of the Red Creek, Beulah Valley, and the surrounding area. The fire was started by lightning in neighboring Custer County and led to the evacuation of many local residents. This is a pattern that may well be repeated in the future.

The probability of fire is highest in lower elevation forests and decreases with elevation because the amount of precipitation received tends to increase as the elevation increases. The increased precipitation contributes to higher fuel moisture and humidity that reduce the probability of ignition and impede fire spread. Nonetheless, even in mid- to upper-elevation forests, drought and low fuel moistures can make most forests vulnerable to fire.

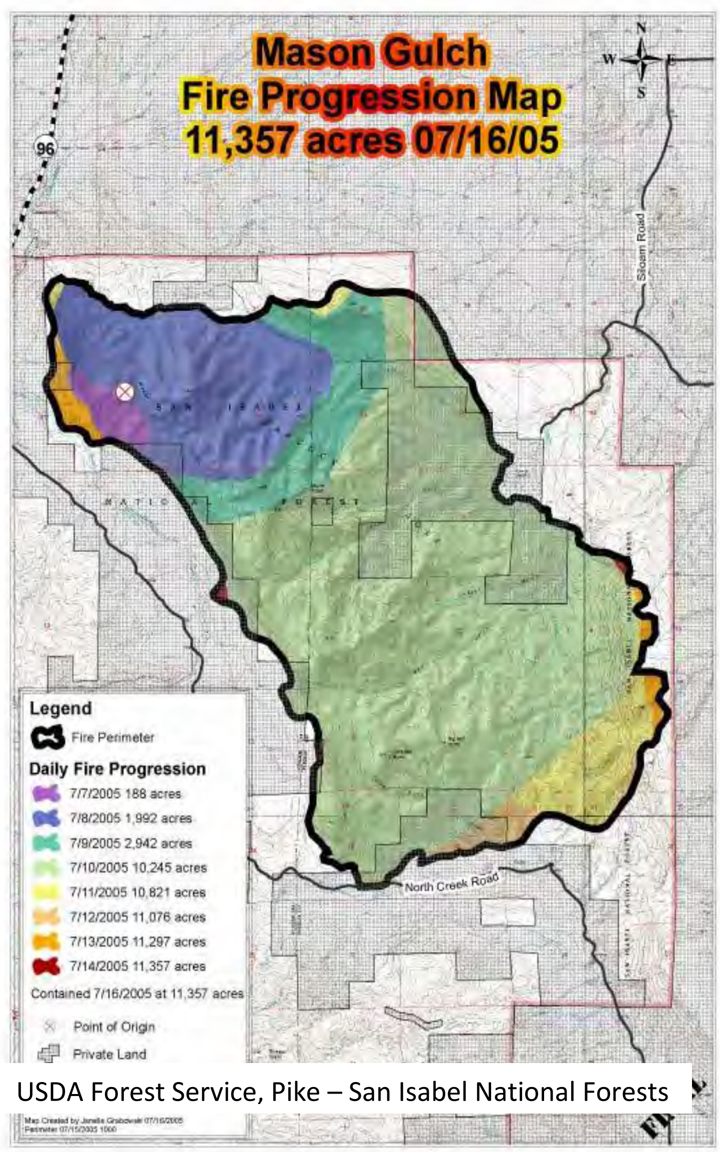
Generally, fire causes can be grouped into three primary sources; lightning strikes, problems with power lines, and human caused, including debris burning,

[16] NWCG. Pocket Card for Pine/San Isabel National Forest – Wet Mountains FDRA. Available online at http://famweb.nwcg.gov/pocketcards/pikesanwet.htm

unattended campfires, smoking, escaped control burns, vehicle accidents, children playing with matches, etc. Other than the Mason Gulch Fire and a few other exceptions, wildland fires on average tend to be relatively small (10 acres or less) and are suppressed within the first burning period.

Under the right set of circumstances and environmental conditions, a wildfire occurring in the planning area is capable of rapid rates of spread and can exhibit extreme fire behavior, as demonstrated by the Mason Gulch Fire. The map on the following page (Figure 5) illustrates that a wildfire is capable of burning over 7,300 acres (Over 11 square miles) and advancing over six miles in six hours, primarily as a plume-dominated wildfire.

Figure 5: Mason Gulch Fire Progression Map



USDA Forest Service, Pike – San Isabel National Forests

Table 2: Wildfire Occurrence by Cause 1995 - 2005

Department	Cause				
	Lightning	Human Caused	Power Lines	Railroad	Total
Beulah Valley VFD	28	29	3	0	60
Pueblo County DEM	1	1			2
Red Creek F&R					
Rye FPD					667
USDA Forest Service					

Source: Fire Departments and USDA Forest Service records

A structure fire that threatened wildland fuels Photo: Steve Douglas

7.0 Risk Assessment: Identifying and Evaluating Assets at Risk

7.1 Overview

Preparing a Community Wildfire Protection Plan recommends the development of a community wildfire risk assessment process to help the core team and community members more effectively prioritize areas for treatment and identify highest priority uses for available financial and human resources.

In order to complete a meaningful community assessment, factors such as wildland fuel type and arrangement, risk of wildfire occurrence, infrastructure and other community values at risk, and local preparedness and firefighting capabilities must be evaluated. A modified version of the Subdivision Wildfire Hazard Rating Form created by the Colorado State Forest Service and adapted by Teller County, Colorado[17] was used to complete the assessment of the subdivisions believed to be most at risk and/or adjacent to national forest lands.

The form addresses key factors such as fuels and topography, subdivision design, structure vulnerability to wildland fire, and fire protection. Elements are rated numerically (Appendix C). The results of the assessment were included in the base map and used by the core team to aid in the decision-making process.

7.2 Methodology

On August 4, 2006, the Director of the Department of Emergency Management and the contractor completed a general tour of the planning area to gain an overview of the area and identify areas of concerns and evaluate completed projects. The tour began in Pueblo and followed SR 96 to Siloam Road to SR78 to Beulah. While in the Beulah Valley area they discussed the Beulah Highlands Development, the watersheds and Pine Drive/South Pine Drive neighborhoods, and toured Pueblo Mountain Park. They then followed SR 78 to SR 165 through San Isabel, Rye, and Colorado City before returning to Pueblo via I-25.

During the period August 28 – 30, 2006, the contractor, accompanied by either a Homeowner Association representative or a member of the fire department having jurisdiction, completed a survey of 11 communities or subdivisions located in the western portion of the planning area.

The key elements identified on the Subdivision Wildfire Hazard Rating Form were assessed and documented for each subdivision that was visited. The values documented on the Subdivision Wildfire Hazard Rating Form were transferred to a Wildfire Hazard Rating Summary sheet and used to enhance the base map,

[17] Commissioners. 2005. Community Wildfire Protection Plan – Teller County, Colorado. Available on line at http://www.co.teller.co.us/commissioners/TheCWPP.pdf.

and referred to by the core team during the final rating and decision-making process.

7.3 Data Analysis

7.3.1 Catastrophic Fire Potential

Two of the rating elements, fuel density and slope, were used to rate the potential of a catastrophic wildfire impacting a given subdivision. The ratings could range from a low of 2 (Grass with scattered trees or oak brush and a slope less than 20%) to a high of 17 (Dense, continuous conifers and/or thick oak brush, and a slope greater than 45%). Risk Ratings of Low, Moderate and High were selected in order to conform to national standards and to simplify the planning process.

Table 3: Catastrophic Fire Potential

Rating Range	Potential	Description
2-8	Low	Light fuels, moderate terrain
9-12	Moderate	Medium fuel loading that requires moderate winds (8pmh at mid-flame height), intermediate terrain
13-17	High	Heavy fuel loading with dead fuel on forest floor, steep slopes

Mason Gulch Fire Photo: Peter Conlon

7.3.2 Vulnerability of Structures

The remaining 12 factors were used to assess how vulnerable the entire subdivision was to wildfire. The assessment looks at factors such as the design of the subdivision, wildfire response capabilities, and structure construction materials, defensible space, and location of utilities.

Table 4: Community Vulnerability Factors

Factor	Description
Subdivision Design	
Ingress/Egress	□ Number and condition of roads in and out of the subdivision
Primary Road Width	□ Width of primary roads
Accessibility	□ Road steepness, condition, adequate bridge(s)
Secondary Road Terminus	□ Ability to turn around at the end of the road
Average Lot Size	□ Self explanatory
Street Signs	□ Street signs present at major intersections. House numbers present
Wildfire Response Capabilities	
Response Time	□ Response time to a wildland fire
Hydrants	□ Type and profile of hydrants
Draft Sources	□ Alternate water sources
Structure Vulnerability	
Materials	□ Combustibility of building materials
Defensible Space	□ Amount of defensible space around a home
Utilities	□ Placement of electrical and gas service

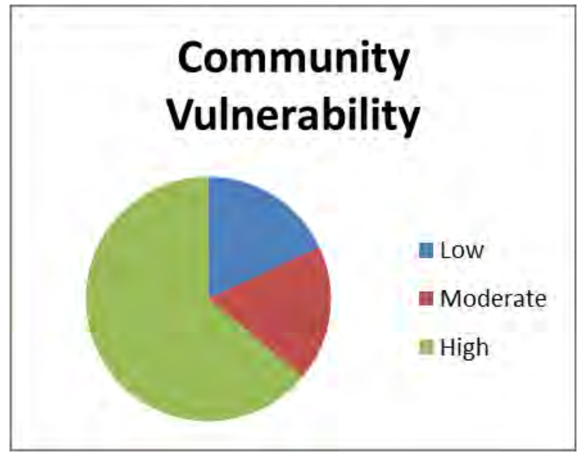
Table 5: Rating Factors to Determine Community Vulnerability

Rating Range	Level of Vulnerability	Description
6-18	Low	Well prepared – Low vulnerability
19-27	Moderate	Problem areas exist. Action is required
>28	High	Significant problem areas exist that place the entire subdivision at risk

7.4 Summary of Findings

Of the nine subdivisions and the two communities that were assessed, 27 percent (1 Subdivision and 2 communities) fell into the Low category, 18 percent (2 Subdivisions) were rated as Moderate, and 55 percent (6 Subdivisions) were ranked in the High category for being at risk from a catastrophic wildland fire. When assessing community vulnerability, two were ranked in the low category (18%), two in the moderate category (18%), and seven in the high category (64%). (Figure 6; Appendix C).

Figure 6: Summary of Findings



Pueblo Mountain Park – Pavilion area Photo : Steve Douglas

8.0 Mitigation Strategy: The Action Plan

8.1 Desired Future Conditions

The important goal of this plan is protecting the communities and homeowners from a catastrophic wildland fire. Many recognized that years of fire suppression and other factors have contributed to an unhealthy forest, which is prone to attack by insects and disease, and vulnerable to wildland fire.

Full support by the community and stakeholders of the plan is imperative. Actions must be taken within the communities and around individual homes to provide for the safety of firefighters and the public in the event of a wildfire. One of the components of a successful program is to provide on-going educational opportunities to fully inform homeowners about *FIREWISE*. Recognizing the importance of attempting to properly sequence treatments on the landscape by working first around individual homes and within the communities and then moving further out into the surrounding landscape is necessary. The most critical communities to improve first are located in the lower montane forests dominated by ponderosa pine. These forests and communities are most at risk of severe fire.

The desire of the stakeholders is to reduce the amount of hazardous fuels within and adjacent to the community, reduce and regulate fuel loading and modify the vegetation structure and stand composition as necessary to protect life, property and resources. Thinning trees and reducing ground and ladder fuels will accomplish this. When fully implemented, the stand composition in combination with a *FIREWISE* community will provide for firefighter and public safety and afford fire suppression personnel a greater than ninety percent success rate when defending a community or isolated home against a wildland fire, while respecting the aesthetic values important to the local residents and visitors.


Ponderosa Pine Stand Photo: Steve Douglas

The landscape should take on an appearance of what may have existed naturally and historically when it is completed. A mosaic of complex vegetation patterns and types that would have evolved naturally with ecological and geological processes will be present. The landscape vegetation should generally be less continuous, with more openings, a variety of seral stages and different vegetative communities in a random patchwork.

A great deal of effort has gone into developing and implementing a fuels treatment plan for Pueblo Mountain Park. The residents of Beulah Valley are generally pleased with the work completed to date. Many of the standards and recommendations outlined in the Forest Stewardship Plan (Appendix D) can be used to establish guidelines for future fuels treatment projects developed for the planning area.

8.2 Mitigation Goals and Objectives

8.2.1 Goals

The primary mitigation goals are to:

- provide for firefighter and public safety;
- protect public and private property and cultural and natural resource values from a wildfire;
- create and maintain healthy watersheds that are not as vulnerable to ecological events outside the historical range of variability;
- coordinate efforts to secure adequate fuels treatment funding;
- and continue to build on the existing *FIREWISE* education programs.

8.2.2 Objectives

- Provide defensible space around individual structures and for each community as a whole by reducing the wildland fuel load.
- Create different vegetative communities and vegetation patterns that are less continuous, include more random openings, and consist of a variety of age classes.
- Coordinate fuel management activities to take full advantage of fuels mitigation work completed by the Forest Service and others.
- Create shaded fuel breaks in appropriate locations.
- Establish lines of communication with stakeholders necessary to set project priorities, request and receive funding, carryout fuel management projects, and fully implement the key elements of the *FIREWISE* program.
- Formalize a means of systematically monitoring and evaluating fuel loading to ensure that projects that are completed are properly maintained to provide the desired results.
- Provide homeowners and others with the information necessary to fully implement the *FIREWISE* program on a property-by-property basis.
- Enhance ecosystem health by reducing the fuel loading and stand composition to more natural levels.
- Use a variety of treatment methods that will provide the least impact to the community and neighboring lands and utilize, when possible, the by-products.

8.3 Past and Current Projects

A fuels treatment project was recently completed on the southern boundary of Pueblo Mountain Park, and various other locations were treated in the Beulah area using a grant received from the Colorado State Forest Service. The USDA Forest Service has completed fuels reduction efforts on a 5,000 acre project adjacent to the Red Creek subdivision that included both private and public lands. They have also completed 365 acres of mechanical treatments adjacent to the Vaughn and Savage Subdivisions. These projects were intentionally located along the forest boundary and were designed to reduce the risk to the wildland urban interface for high intensity crown fires. In the Red Creek, Vaughn, Savage, Beulah and Rye areas the canopy base height is typically low where the existing vegetation types is woodland, such as piñon-juniper or oak brush. Treatments incorporating mechanical or hand thinning or multiple prescribed fires that take out the small trees and limb up the larger trees were implemented to reduce the probability of passive and active crown fire in these types by increasing the canopy base height and reducing crown bulk density. These efforts have reduced the canopy cover to some extent but as shown with the 2005 Mason Gulch wildfire they have also dramatically increased the amount of defensible space between forest lands and the subdivision. The project will continue in the future years.

A grant secured from the Colorado State Forest Service was used by the Savage Home Owners Association to create a segment of shaded fuel break. The completed fuel break is about 35 to 40 feet wide on both sides of the main access road leading to homes located in the western part of the subdivision.

San Isabel Electric Association has resumed vegetative treatments on selected segments of its rights-of-way where trees are encroaching into the powerlines. Their efforts achieve dual goals of reducing the possibility of wildland fire occurrence, while also reducing the impact of winter storm damage to powerlines caused by falling trees. Many of the powerline rights-of-way are within the rights-of-way of public roads and offer an opportunity for a series of win-win opportunities when shaded fuel breaks are developed along those coinciding right-of-ways.

The Colorado State Forest Service, the Pueblo County Department of Emergency Management, and the Rye Fire Protection District have been working with landowners to create or increase the amount of defensive space around their homes and other improvements. The results of their efforts and the lessons learned from the Mason Gulch Fire have led many individual homeowners to take it upon themselves to create defensible space around their homes.

8.4 Future Projects

The Mason Gulch Fire called attention to the need for substantial fuel breaks to halt the advance of a catastrophic wildfire. The Core Team decided to make the creation of shaded fuel breaks along area roads and trails their top priority. The location or placements of several of the proposed fuel breaks are reminiscent of trigger points established during the Mason Gulch Fire. The significant difference between trigger points and fuel breaks is the first represents a point or line where additional evacuation is called for when reached by a rapidly advancing fire, while the second represents a line where the advancing fire may be slowed or stopped.

The USDA Forest Service is in the process of planning a larger landscape scale project that would create and place fuels treatments to maximize future options for wildland fire use, reduce wildfire hazard and protect assets, and improve landscape conditions. Some of the work would be to create shaded fuel breaks along area roads such as SR 165 and SR 78, known locally as 12-Mile Road. The project would incorporate subdivisions such as San Isabel Estates and Aspen Acres. In addition to treating forest service lands, the Forest Service would like to use the "Good Neighbor Authority", when necessary and feasible and in accordance with the program, to treat private land in order to create a continuous shaded fuel break and strategic placement of treatments (SPOT) that would enhance suppression efforts in the event of a catastrophic wildland fire. Once the proposed action, known as Highway 165 Project, is finalized, it will be subjected to the NEPA process before the Forest Service can proceed with the project.

Because the USDA Forest Service is in the early stages of planning, now would be an excellent time to pursue a joint project between local landowners and the USDA Forest Service. This would allow stakeholders and the USDA Forest Service to take advantage of open grasslands in the southwest portion of the Beulah Highlands development and treat fuels on the northern aspect of the Squirrel Creek drainage. With adequate time spent in joint-planning, over time it may be feasible to create a series of shaded fuel breaks from North Creek to Rye by incorporating the projects discussed above with work completed at Pueblo Mountain Park and other smaller projects.

Another related project identified by the Core Team at their meeting on September 7, 2006, was to work with the landowner to create a 500 foot wide shaded fuel break on both sides of Deiffendeffer and Oldham Roads that would provide an additional line of defense.

Other fuel treatment projects include completing follow-up treatment in Rye Mountain Park, treating additional lands in Pueblo Mountain Park, selectively logging the north-facing slope on Signal Mountain, and creating additional shaded fuel breaks along roads in the Savage Subdivision.

A community could host an annual clean-up week when a chipper could be brought in to treat the residue of the hazardous fuel reduction projects carried out by individual property and homeowners. The debris could be loaded on a truck hauled to a nearby area to be disposed of by prescribed fire.

The Core Team is exploring the feasibility of borrowing, leasing, or purchasing an Air Curtain Destructor that could be used to dispose of large quantities of woody material that have no commercial value.

8.5 Available Treatment Options

8.5.1 Thinning and Fuel Removal

Open stands of timber with limited ladder fuels are less susceptible to crown fires. Firefighters are better able to manage an incident in open stands of timber by taking direct suppression action or burning out ahead of an advancing flaming front. The best way to accomplish this is to cut and remove excess vegetation.

> ***Thinning*** is used to treat fuels in forested areas by reducing ladder fuels and creating more space between larger trees.
>
> ***Fuel Removal*** is used to decrease fuel loading by removing the dead component and the live vegetation that can contribute to wildland fire intensity. Removal increases the distance between individual plants or clumps of bushes on the forest floor. Fuel removal is also used around structures to reduce or eliminate fuels near homes and outbuildings in order to create more defensible space.

A combination of thinning and fuel removal is often necessary to treat an area in order to decrease stand density or to create a shaded fuel break[18]. This combination is often used to create defensible space, as well.

The use chainsaws to cut materials on slopes greater than 40% may be necessary. However, mechanical equipment such as a tracked, self-leveling Timbco unit (right) could be used on slopes 55% or less to reduce small trees and brush to surface fuels that can later be treated with prescribed fire or allowed to decompose naturally, as appropriate. The number and distribution of trees left remaining on the

[18] A shaded fuel break is created by removing some of the trees and other vegetation in order to increase the distance between the crowns of trees to lessen the likelihood of a crown fire and reduce the intensity of a surface fire.

site would depend on the predominant tree species and the slope. Trees should not necessarily be evenly spaced. Small groups of trees should be left to create a mosaic of uneven age classes of trees. Large trees should be favored, as should more fire adapted species such as Ponderosa pine and mature fir (located primarily on north facing or higher elevation slopes). Scattered brush, both single plants and groups of plants, should be left in more open sites. Openings should be created in the forest to encourage the regeneration of pine and grass and forbs and to create habitat favored by birds and wildlife.

The shaded fuel breaks and the open forest stands should be treated in stages. The purpose of the treatments are to create an area – defensible space – that will be less conducive to crown fire, provide safe passage for vehicles and, in many cases, provide areas where firefighters can fight a wildfire safely. In most instances, a wildland fire would not be able to advance as quickly in the treated areas and more than likely would drop from the crowns to the ground. This would provide firefighters a better chance, by burning out the surface fuels or taking other suppression action in advance of a wildland fire, to halt its spread.

The July 9, 2005 burnout operation on the west flank of the Bears Head Ranch complex helped shut down this July 10, 2005 fire advance. No structures were lost.

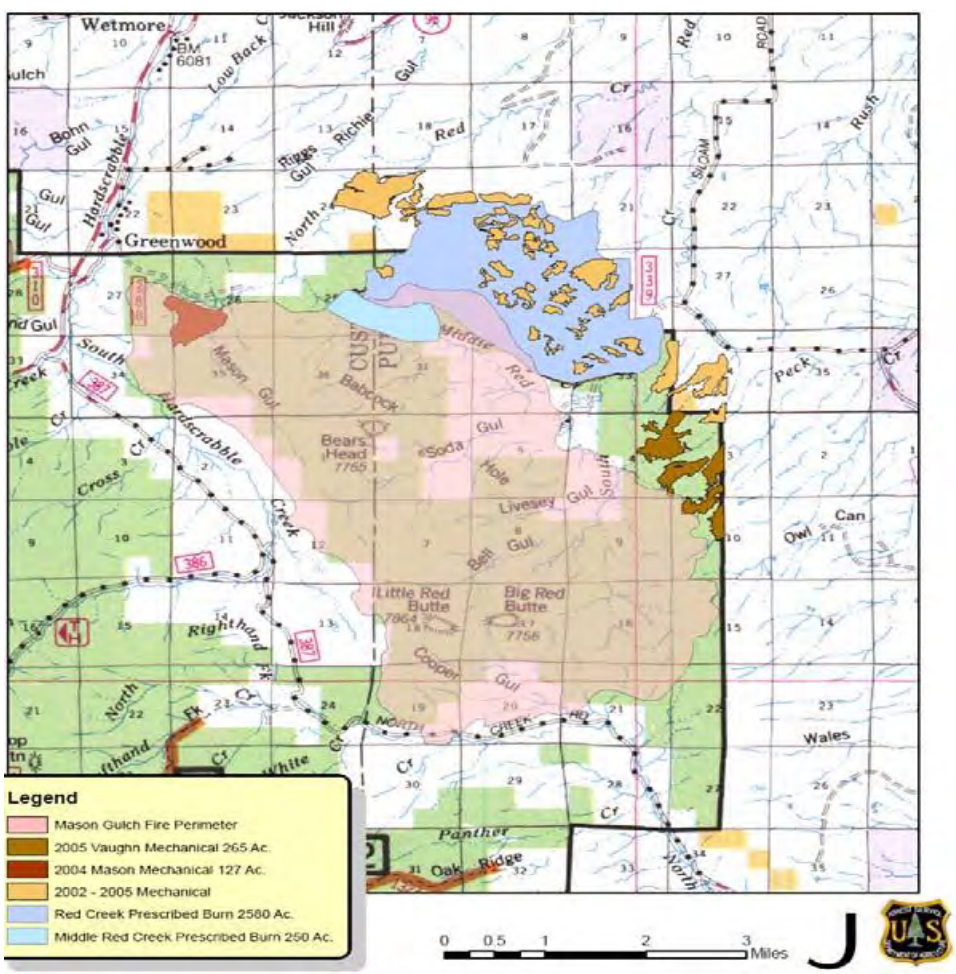
Photo: USDA Forest Service

The treatment of fuels around dwellings is expected to be an ongoing process. Vegetation as it is cut could be removed from the site to an area where it could be burned in the Air Curtain Destructor (See Section 8.3.3: Slash/Biomass

Disposal) or the residue could be chipped on site. Unless useful for other purposes, such as mulch, the chipped materials should be blown back into the forest wherever possible to provide for soil protection and to return nutrients to the soil. (Chips should not be more than about two inches deep, otherwise a smoldering fire will likely be lethal to trees by damaging root systems and the root collar).

8.5.2 Prescribed Burning

Prescribed burning has a place in a fuels management program. It is anticipated that prescribed fire may be used to treat residue following thinning treatments. A low-intensity prescribed fire would reduce the amount of woody debris and return nutrients to the soil. Prescribed fire use would be based on a fuels assessment following the initial treatment. Prescribed fire was used in March and April 2000 to treat 2,830 acres in the Red Creek and Middle Red Creek areas (Figure 7).



Pile burning may also have a place because it may be safer to implement than broadcast prescribed burning. Pile burning can be a more economical and environmentally sensitive way to dispose of debris when compared to dragging the debris to a road to be chipped or hauled to another location for disposal.

Proper technique for pile burning Photos: Steve Douglas

Qualified personnel would carry out prescribed fire operations. In order to mitigate the impacts from smoke, Colorado air quality regulations and permitting process will be closely adhered to. Guidance to reduce the impacts of smoke can be found in <u>Smoke Management Guide for Prescribed and Wildland Fire</u> – 2001 Edition, which is available at http: www.nwcg.org.

8.5.3 Slash/Biomass Disposal

A method of reducing the amount of particulate matter released into the atmosphere from the burning of forest residue is to use an Air Curtain Destructor. The Air Curtain Destructor is an extremely efficient method to dispose of logging debris and brushing and thinning residue. The amount of particulates released into the atmosphere during the burning process is greatly reduced.

The various communities could schedule a *FIREWISE* cleanup weekend and provide a chipper to reduce the debris or truck to haul the debris to the Air Curtain Destructor site for disposal. Additional information about an Air Curtain Destructor can be found in Appendix F.

8.5.4 Forest Products Utilization

The selective harvesting of merchantable timber could be an important component of some thinning projects. The timber could be selectively harvested to reduce the stand density and to create openings. Pueblo Wood Products, a pallet manufactured in Pueblo, will buy small diameter wood delivered in eight foot or longer lengths. McComb Lumber and The Woodworks are traditional saw mills in Fremont County that will buy saw log quality timber. Individual property owners would initiate their own contracts with sawmills.

Local homeowners would be encouraged to use suitable residue from their own property for firewood. Another option would be to sell the material to businesses that market firewood. White fir may be sold to individuals or to merchants as Christmas trees.

Table 6: Comparison of Treatment Methods

METHOD	SLOPE	COST/ACRE	PROS	CONS
Cut, Remove by hand, Chip	Flat to Steep	$1,200 – 2,500	Low tech Broad range of applications	Labor intensive Steep slope increases cost
Masticator	<55%	$800 – 1,300	Efficient Low slash	Not suitable for very steep slopes. Need place to turn around. Soil disturbance.
Broadcast	All	**$114** Size of treatment area dependent	Can mimic nature Cost effective	Possibility of escape. Requires experienced personnel. Smoke concerns. Water quality concerns
Thinning/Pile Burning	All	Cut and Pile $1,000 (estimated) Burn **$114**	Low tech Broad range of applications	Labor intensive. Smoke concerns.

METHOD	SLOPE	COST/ACRE	PROS	CONS
Logging	All	Dependent on commercial value	Utilizes product Removes biomass	Lack of available markets. Soil disturbance
Firewood or Christmas tree sales	All	None to a few hundred dollars for program administration	Utilizes product. Removes biomass	Possible liability issues

Source: **Bold Numbers** Living with Fire: Protecting Communities and Restoring Forest May 2006. Red Numbers: John Grieve, Area Forester, Colorado State Forest Service. September 2006.

8.6 Priorities

For planning purposes, the projects identified in this plan have been divided in three groups: High Priority, Medium Priority, and Low Priority. However, that is not to say that a low priority project should not be implemented before a projected deemed to be of higher priority. Progress in implementing this plan is highly dependent on receiving funding from grants and other non-appropriated funds. Obviously, smaller grants are often easier to receive than larger ones, and some projects may be implemented within existing department or agency budgets.

8.6.1 High Priority Projects

Creating shaded fuel breaks approximately 500' wide from the centerline of SR 165 on both sides of the highway from Rye to Lake Isabel and along 12-Mile Road (SR 78), where feasible; from Highway 165 to Beulah is a key element of this plan.

Such things as signing wildfire evacuation routes, sponsoring annual community cleanup days in the various communities, continuing the *FIREWISE* program, providing for additional protection of watersheds, implementing additional treatments at Pueblo Mountain Park and Rye Mountain Park, and working with San Isabel Electric Association to develop shaded fuel breaks are highly desirable.

8.6.2 Moderate Priority Projects

Completing a Red Zone survey of each structure in the Beulah Valley area including Beulah, North Creek, Pine Drive, South Pine Drive Squirrel Creek, and Middle Creek to determine their survivability, and conducting follow-up treatments at Rye Mountain Park are important to the over-all protection of homes and other values at risk in both areas. Conducting a similar Red Zone survey in the Rye area would also be important.

8.6.3 Low Priority Projects

Selectively logging the north face of Signal Mountain, and purchasing or leasing an Air Curtain Destructor to be shared by stakeholders are goals worth pursuing.

8.7 Plan Update Process

This plan is a living document. It will be necessary to update the plan will be as conditions change, new projects are added, or as projects identified in the plan are completed. Copies of the plan have been placed in 3-ring binders so that it can be easily updated in the future.

9.0 Summary and Conclusions

9.1 Next Steps

Building consensus will continue to be important within the Core Team and the communities and subdivisions in the planning area. Regular meetings must be held to make public the plan to local residents and to solicit input and support the process. The plan must be updated to reflect the changes to the various communities and subdivisions as new development takes place and initial projects are completed. Identifying and developing future projects should involve receiving input and comments from the communities and subdivisions in the planning area. The Core Team must work cooperatively to achieve larger goals.

The members of the Core Team must be proactive when seeking additional funds to complete future projects. Hazard fuel funds for some federal and state agencies have already been used to complete past projects. There will be ever-increasing pressure to cutback funding for future Wildland Urban Interface projects in light of increasing federal deficits. Creative financing will be the order of the day.

Areas that have been treated receive will need to receive follow up treatment. The open nature of sheltered fuel breaks lend themselves well to the regeneration of certain tree species, brush, and other fuels that could impact the ability of firefighters to manage a wildland fire. If ignored, defensible space created around dwellings and along roads can soon be lost to new plants filling the void. For example, Gambles oak regenerates quickly after it has been cut or burned, and takes a lot of work to keep under control. Aggressive measures, such as treatment with herbicides to hold it in check so that the areas with heavy concentrations of oak won't have to be treated year after year, may be necessary.

Future changes in ambient air quality standards may also impact the ability to use prescribed fire to manage fuels.

9.2 Conclusions

Incidents like the one occurring during the 2005 fire season at Mason Gulch point out the value of maintaining a *FIREWISE* community. The education and involvement of the property holders and homeowners are important to the success of the *FIREWISE* program. There must be full buy-in and large-scale participation by all homeowners. To do otherwise renders a shaded fuel break ineffective and places an entire community, subdivision, or neighborhood at risk. Therefore, it is important that each community, subdivision, neighborhood, and individual homeowner must take actions necessary to lower structure ignitibility, a key component of the *FIREWISE* program and participate fully in any fuel treatment project that is being implemented. Building design and materials appropriate for firewise construction have been ably described by Peter Slack in his book *Firewise Construction: Design and Materials.* Additional guidance can also be found in *Forest Home Fire Safety,* publication number 6.304, available from the Colorado State University Cooperative Extension.

The amount of debris generated by creating defensible space around hundreds of homes, treating vacant lots, and creating over 30 miles of 500± foot wide shaded fuel breaks will be significant. The slash and debris created must be disposed of in an efficient, cost-effective manner. Prescribed burning is a good way to accomplish fuel reduction, however there are many limitations to the use of prescribed fire including high cost, air quality concerns, limited resources, proximity to homes, etc. Unfortunately, there are few options for disposing of merchantable materials. Many programs are successfully using an Air Curtain Destructor to burn debris created by fuels management programs. This piece of equipment should be evaluated early in the process to test its feasibility. If it appears that it would have broad scale application, one should be acquired early on in the treatment process.

To better provide for public safety, there is a need to develop evacuation plans and improve the safety zone/shelter in place areas for certain subdivisions. Site specific evacuation plans would provide detail at the subdivision level and interface with the more general evacuation plans developed by Pueblo County that are included in this plan. The location of safety zones should be clearly identified and their locations made known to all those living in the subdivision.

To successfully compete for limited Wildland Urban Interface funding, it is important to show that other mitigation measures have been initiated or are in place. By quickly initiating low-cost/no-cost projects within the community, the stakeholders will demonstrate a willingness to take the actions necessary to protect their community. This can be accomplished by continuing the community wildland fire education program and by treating fuels on and near homes and privately owned vacant lots.

9.3 Some Closing Thoughts

Forest health in Colorado has become an issue that has moved from the back burner to the forefront as ski areas and municipalities in Summit County, for example, are spending hundreds of thousands of dollars annually to treat a severe outbreak of Mountain pine beetles. There is a lot of speculation by that conditions are only going to get worse as the beetles migrate to the east side of the Continental Divide. Officials in Jefferson County are already bracing for the possibility of a heavy infestation of Mountain pine beetles as beetles migrate from Summit County. Millions of Piñon pine were also killed by Piñon ips beetles in southwestern Colorado.

attaIn a recent issue of the Rocky Mountain News (September 11, 2006), an article called attention to the overall health of aspen stands in Colorado. Mortality from unknown causes in many areas was approaching ten percent.

The odds are against the Wet Mountains escaping the problems experienced in other regions in Colorado.   As forest health deteriorates, the possibility of another catastrophic wildfire occurring in the planning area increases.

Agencies, local residents, and other stakeholders must work together to proactively prepare for future wildland fires and changes in forest health. In the case of fire, the best offense is a good defense.

Bears Head Ranch back burning operations July 9, 2005   Photos: USDA Forest Service

An example of a good defense – a shaded fuel break, following a back burn of slash and ladder fuel on July 9, 2005. This stand of Ponderosa withstood aggressive fire advances of the Mason Gulch Fire July, 10, 2005.   Photo by Steve Douglas

10.0 Core Team Members

Name	Organization	Phone	E-Mail
Bob Marino	Beulah Area Wildfire Mitigation Council	719.485.3605	jtmarino@fone.net
Steve Douglas	Pueblo county Emergency Management	719.583.6201	steve.douglas@co.pueblo.co.us
Chris Markuson	Pueblo County GIS	719.583.6244	chris.markuson@co.pueblo.co.us
Dan Corsentino	Pueblo County Sheriff	719.583.6131	sheriff@co.pueblo.co.us
Phil Daniels	Rye Fire Protection District	719.676.3522	pdaniels@ryefire.org
Ron Jones	Beulah VFD	719.485.3209	22250rwj@fone.net
Ted Thurman	Red Creek Fire & Rescue	719.485.3247	redcreedfire@fone.net
Lee Gladney	Pueblo Emergency Response Teams	719.544.0583	lee@pueblobearing.com
Dave VanManen	Mountain Park Environmental Center	719.485.4444	mpec@fone.net
John Grieve	CO State FS	719.275.6865	csfscc@rmi.net
Al Trujillo	CO Division of Wildlife	719.561.5300	Al.Trujillo@state.co.us
Dave Toelle	USDA FS	719.269.8500	Dave_Toelle@blm.gov
Bill Fortune	Nat'l Weather Service	719.948.9429	william.fortune@noaa.gov
Richard Rhoades	Natural Resources Conservation Service	719.543.8386 x3	Richard.rhodes@co.usda.gov
Carl Douhan	Wildland Fire Associates (Contractor)	303.978.1349	cdouhan@dim.com

10.1 Declaration of Agreement

The undersigned below served as Core Team members and participated in the development of the plan. Each concurs with the adoption of the Community Wildfire Protection Plan for Southwest Pueblo County and recommends its approval and adoption by the Chairman of the Beulah Area Wildfire Mitigation Council.

Submitted by: ______________________________
Carl Douhan, Wildland Fire Associates, Contractor

Concur: ______________________________
Dan Corsentino, Pueblo County Sheriff

Concur: ______________________________
Steve Douglas, Pueblo County Emergency Management

Concur: ______________________________
Chris Markuson, Pueblo County GIS

Concur: ______________________________
Phil Daniels, Rye Fire Protection District

Concur: ______________________________
Ron Jones, Beulah Volunteer Fire Department

Concur: ______________________________
Don Geanetta, Red Creek Fire and Rescue

Concur: ______________________________
Lee Gladney, Pueblo Emergency Response Teams

Concur: ______________________________
Dave Van Manen, Mountain Park Environmental Center

Concur: ______________________________
John Grieve, Colorado State Forest Service

Concur: ______________________________
Al Trujillo, Colorado Division of Wildlife

Concur: ______________________________
Dave Toelle, USDA Forest Service - Bureau of Land Mgt.

Concur: ______________________________
Bill Fortune, National Weather Service

Accepted: ______________________________
Bob Marino, Beulah Area Wildfire Mitigation Council

One of several signs posted following the Mason Gulch Fire (2005) Photo: Karin Kyte Romero

Prepared by

WILDLAND FIRE ASSOCIATES
228 West Main Street
Rangely, Colorado 81648
Telephone: 970.675.2225

September 20, 2006

APPENDIX A: GLOSSARY OF WILDLAND FIRE TERMS

As Defined in the National Fire Plan

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, or county 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.

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 also Bladder Bag.)

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

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 also Backpack Pump.)

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 firestorm. (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.

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.

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.

Chain: A unit of linear measurement equal to 66 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.

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

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 and spreading slowly.

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

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.

Deployment: See Fire Shelter Deployment.

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

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 (Communications Center): The implementation of a command decision to move a resource or resources from one place to another.

Dispatcher (Communications Officer): 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, leaves, and immediately above the mineral soil.

E

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, or 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, and 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 comparatively high surface area-tovolume ratios, 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.

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

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 is regulated by state or local authority.

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.

Fire Storm: Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirls.

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 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.

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 grasslike 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.

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 coordination and effective utilization

Ground Fuel: All combustible materials below the surface litter, including duff, tree or shrub roots, punchy 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 fireline built with hand tools.

Hazard Reduction: 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, and 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.

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

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.

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 suit worn 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 e.g., 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 wind and smoke conditions, topography, and to lead air tankers to targets and supervise their drops.

Light (Fine) Fuels: Fast-drying fuels, generally with comparatively high surface area-tovolume ratios, 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, which 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.

Multi-Agency Coordination (MAC): A generalized term which 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: A group formed under the direction of the Secretaries of Agriculture and the Interior and comprised of representatives of the U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, National Park Service, U.S. 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, 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.

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.

Personnel 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 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, and 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.

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, crass, 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.

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

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.

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 blowup in the vicinity.

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

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.

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 sarks 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.

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.

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, which 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,

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

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.

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 prestated resource management objectives in predefined geographic areas outlined in fire management plans.

Wildland Urban Interface: The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Wind Vectors: Wind directions used to calculate fire behavior.

Appendix B: Southwestern Pueblo County Wildfire Evacuation Plan

Southwestern Pueblo County Wildfire Evacuation Plan

Revised April 2013

Scenario:

A catastrophic wildfire is burning in southwestern Pueblo County. Local fire officials, the Pueblo County Sheriff, or th e Board of County Commissioners, or the Executive Policy Group have determined the need for an immediate evacuation of one or more areas.

Assumptions:

A. The public will receive and understand official information related to evacuation.

B. The public will act in its own interest, and evacuate dangerous areas spontaneously or when advised to do so by local government authorities.

C. People who refuse to follow evacuation instructions will be left alone until all that are willing to leave have evacuated. Then – time and conditions permitting – further efforts may be made to persuade the "stay puts" to evacuate.

Basic Plan:

A. The decision to evacuate is made by competent authority.

B. Local fire / law enforcement / utility workers may canvass the areas, time and conditions permitting, announcing the evacuation via public address systems.

C. The Emergency Preparedness Network (EPN … otherwise known as "Reverse 911") will probably be utilized by the Pueblo County Sheriff's Communication Center to notify the public in the area at risk, using the telephone system and an incident-specific recorded message of up to 28 seconds in length.

D. Evacuees will be directed to evacuation routes out of the affected areas.

E. Traffic control points will be established, staffed by law enforcement, fire, or other personnel, to deny entry and to document those who leave the area.

F. The American Red Cross may establish a shelter or shelters for evacuees in appropriate areas of the county, depending on the incident-specific need.

G. All locations and routes in this plan are suggested. Fire conditions and other factors may necessitate changes to this plan.

Beulah Area

<u>Please see attached map</u>

PRIMARY EVACUATION ROUTES

• Colorado Highway 78 -	Eastbound to Pueblo Westbound to Colorado 165
• Colorado Highway 96 -	Eastbound to Pueblo

SECONDARY EVACUATION ROUTES

• Siloam Road –	North to Highway 96; or, South to Highway 78.
• 3R Road –	Northbound to Highway 78; or east bound to Crow Cutoff/Burnt Mill Road.
• North Creek Road –	North to Highway 96; or, South to Highway 78.
• Oldham Road –	East to 3R Road; or, West to Highway 78.

TRAFFIC CONTROL POINTS

Not all locations will be utilized. These are suggested locations. Other locations may be established as appropriate.

- Colorado Highway 78(Pine Drive) @ Central Ave.
- Colorado Highway 78 @ 3R Road
- Colorado Highway 78 @ Colorado Highway 165
- Colorado Highway 78 @ Siloam Road

SUGGESTED SHELTER LOCATIONS

- Pueblo School District #60 – South High School

EMERGENCY EQUIPMENT INGRESS ROUTES

- Colorado Highway 78 westbound from Pueblo.

EMERGENCY EQUIPMENT STAGING AREAS

- Grand View Baptist Church – 8326 Highway 78 West
- Pueblo School District #70 – Beulah School – 8734 Schoolhouse Lane

Rye/Colorado City Area

Please see attached map

PRIMARY EVACUATION ROUTES

- Colorado Highway 165 - Eastbound to I-25 Westbound to Colorado Highway 96.

SECONDARY EVACUATION ROUTES

- Park Road - Eastbound to Highway 165.
- Old San Isabel Road - Eastbound to Highway 165.
- Hayes Street - North to Boulder Avenue
- Hunter Road - North to Greenhorn Road
- Greenhorn Road - Eastbound to Highway 181
- Highway 181 - North to Highway 165.

TRAFFIC CONTROL POINTS

Not all locations will be utilized. These are suggested locations. Other locations may be established as appropriate.

- Colorado Highway 165 @ Main Street
- Hunter Road @ Greenhorn Road
- Colorado Highway 165 @ Old San Isabel Road
- Colorado Highway 165 @ Highway 181

SUGGESTED SHELTER LOCATIONS

- Craver Middle School – 4850 Crow Cut Off Road

EMERGENCY EQUIPMENT INGRESS ROUTES

- I-25 south from Pueblo.
- Colorado Highway 165 westbound from I-25

EMERGENCY EQUIPMENT STAGING AREAS

- Colorado City Metropolitan District – Greenhorn Meadows Park – Highway 165 @ Cibola Street
- Pueblo School District #70 -Rye High School

References: Pueblo County Local Emergency Operations Plan – Revision 2004 – Annex K – Evacuation, and Annex N- Fire.

Southwestern Pueblo County Fire Emergency Evacuation Contacts

Pueblo county Sheriff's Communications Center	On Call Supervisor	583-6250
Pueblo County Sheriff Emergency Services Bureau	Kirk Taylor Mark Mears, Chief	583-6250 671-2065/583-6250
Pueblo County Board of Commissioners	Terry Hart Liane "Buffie" McFayden Sal Pace	583-6050 583-6537 583-6536
US Forest Service	Pueblo Interagency Dispatch Center Supv.	553-1607
American Red Cross	On Call	560-6167
Salvation Army	On Call	303-296-2456

<u>Rye/Colorado City</u>

Rye Fire Protection District – Chief	Steve Bennett	676-3522/489-2223
Rye Fire Protection District – Alternate	Jim Beach	676-3522/671-5436
San Isabel Electric Association		547-2160
CO City Metropolitan District (Water)		676-3396
Town of Rye (Water)	Tom Holgerson	676-3302

<u>Beulah</u>

Beulah Fire Protection & Ambulance District – Chief	Bryan Ware	485-2367/(419)656-5887
Beulah Fire Protection & Ambulance District – Chief	Kurt Thompson	485-5275/(719)250-2001
District – Alternative – Captain		485-3400
Pine Drive Telephone Company		485-3400
Pine Drive Water District (Pres./Info)		485-3434/3666
Beulah Water Works Dist. (Pres./Info)		485-3142/3376
San Isabel Electric Association		547-2160

Pueblo County Sheriff's Office

Kirk M. Taylor Sheriff
J.R. Hall Undersheriff

Charlene Graham
Bureau Chief
Law Enforcement

Mark A Mears
Bureau Chief
Emergency Services

Darlene Alcala
Bureau Chief
Detention

What is the Emergency Telephone Notification System (ETNS)?

Emergency telephone notification is a public safety tool that proactively places telephone calls to inform citizens of pending dangers and public safety issues. The system places calls on behalf of the appropriate public safety agency such as the fire and police chiefs.

Why do we need it?

Natural disasters and accidents such as floods, fires, chemical spills and public safety incidents such as missing children, or suspects at large occur with little or no warning. Often traditional methods of notification-sirens, TV and radio announcements, door-to-door notification/may not be targeted enough, may not allow for adequate delivery of specific information and may not be the best use of our resources. This system allows emergency officials to identify, notify, and provide instructions to as many citizens as needed in minutes. By delivering specific information to specific audiences we are better able to motivate the community to react in situations such as evacuating the area or assisting with a missing child search.

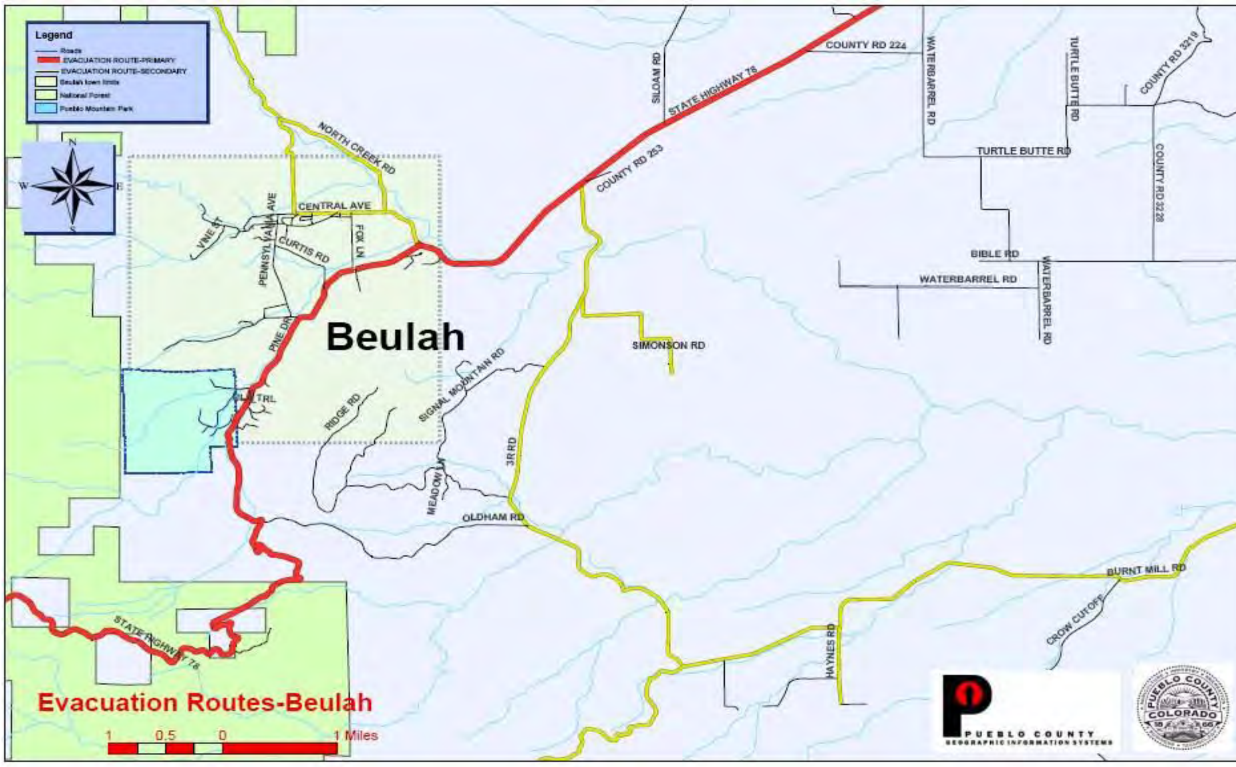
How does it work?

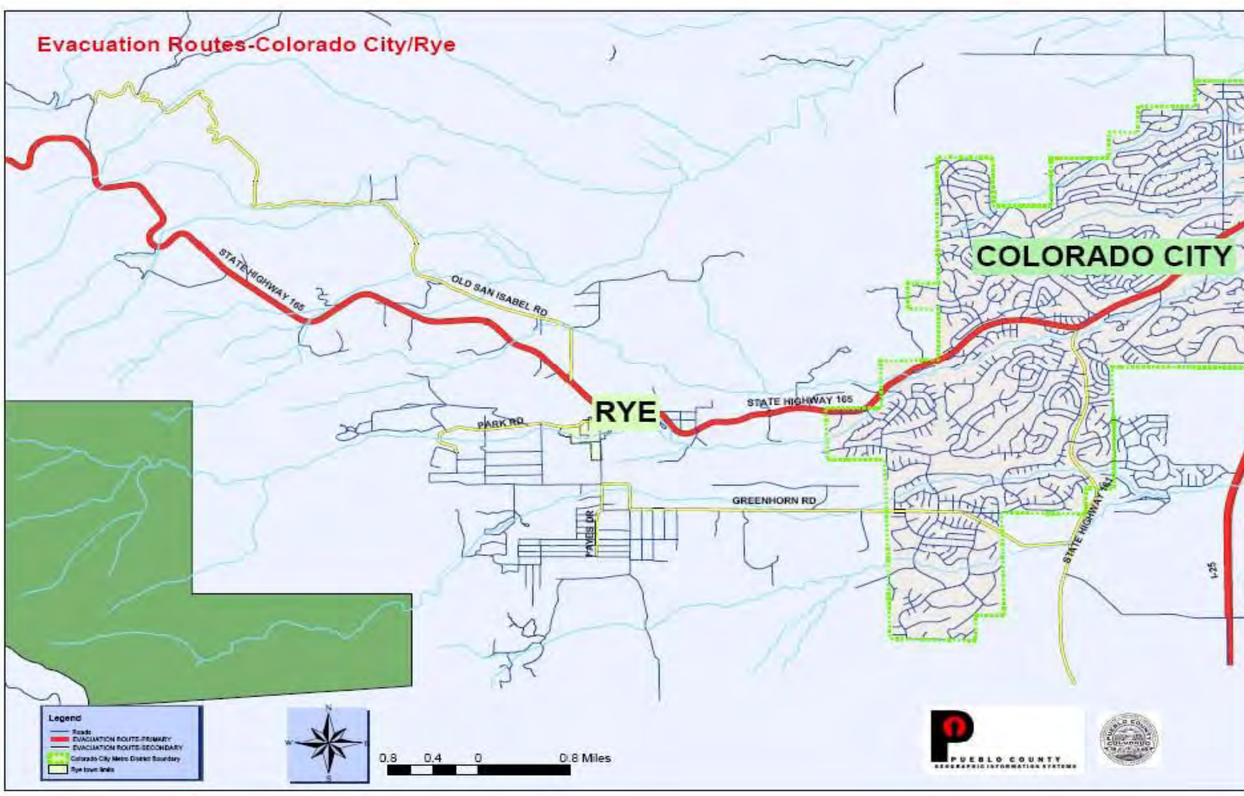
We can activate the system in a highly targeted area via any phone or the internet any time from any location. We can map the affected area, record a message and send the message on its way. Within moments calls reach the affected community to deliver simultaneous warnings and critical instructions. We use an extract of the county's enhanced 9-1-1 database and registered Voice over IP (VoIP) and cellular phones as the data source for telephone numbers so both published and non-published numbers are dialed. The system is able to process thousands of calls simultaneously and will leave a message if answering machine picks up a. If it reaches a busy signal, it will try back in number of times to reach the intended party.

What you need to know if we activate the system

- Don't call 9-1-1 after you receive an alert message unless the message directs you to do so. This will keep 9-1-1 open for other emergencies
- You may repeat the message by following the prompts given.
- The system generates your phone number only, not your name, so your privacy is not compromised.
- Don't hang up in the middle of the message. The entire message must be left for the system to notify us that it was received.
- If you have an unlisted or unpublished number, don't worry. Because we extract information from 9-1-1, you're number is included in our data- base.
- If you have call-blocking or privacy features on your phone you will need to deactivate the blocking feature to receive notifications via this system. We advise, should a wild fire threat be imminent, you consider disabling the feature until the threat passes.

In just a few minutes time YOU can help protect your family and make sure you're informed… Register your Cellular and voice over IP (VoIP) phones with local 911 centers by visiting www.pueblocountyoptin.com If you don't have internet access you can call 719-583-6222.


Legend
Roads
EVACUATION ROUTE-PRIMARY
EVACUATION ROUTE-SECONDARY
Beulah town limits
National Forest
Pueblo Mountain Park
Beulah
NORTH CREEK RD
CENTRAL AVE
PENNSYLVANIA AVE
CURTIS RD
FOX LN
VINE ST
PINE DR
RIDGE RD
SIGNAL MOUNTAIN RD
MEADOW
3R RD
OLDHAM RD
SIMONSON RD
COUNTY RD 253
STATE HIGHWAY 78
SILOAM RD
COUNTY RD 224
WATERBARREL RD
TURTLE BUTTE RD
COUNTY RD 3219
COUNTY RD 3228
BIBLE RD
BURNT MILL RD
CROW CUTOFF
HAYNES RD
Evacuation Routes-Beulah
1 0.5 0 1 Miles
PUEBLO COUNTY
GEOGRAPHIC INFORMATION SYSTEMS
PUEBLO COUNTY
COLORADO


Evacuation Routes-Colorado City/Rye
STATE HIGHWAY 165
OLD SAN ISABEL RD
RYE
PARK RD
GREENHORN RD
PINES DR
COLORADO CITY
I-25
Legend
Roads
EVACUATION ROUTE-PRIMARY
EVACUATION ROUTE-SECONDARY
Colorado City Metro District Boundary
Rye town limits
0.8 0.4 0 0.8 Miles
PUEBLO COUNTY
GEOGRAPHIC INFORMATION SYSTEMS

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Helpful Information For Evacuees

A mandatory evacuation triggers additional living expenses, which are covered under most standard homeowners' policies. Evacuated residents should also hang on to their receipts because they can either file a claim later or if there is any damage to their home many of those out-of-pocket expenses will also be reimbursed.

The Pueblo County Sheriff's Office and the Rocky Mountain Insurance Association (RMIA) has this advice for homeowners impacted by wild fires:

- Residents evacuated from their homes should contact their insurance agency as soon as possible to let them know where they can be reached. Advise them at that time if you need additional living expenses while you are out of your home. Registering on American Red Cross's "Safe and Well" site also lets out of town family members and emergency response agencies know you are safe and provides them with a contact number for you.
- Keep receipts. Out-of-pocket expenses during a mandatory evacuation are reimbursable under most standard homeowner policies.
- Make a home inventory list before a fire and put it with your other vital documents. Take these documents with you when you are being evacuated. ***Always put safety first and leave your home immediately when asked by authorities.*** However, if there is sufficient time to gather items, these documents should be one of the first things you grab. Consider keeping a second home inventory list away from your property. Another way to document is to take pictures or video of every room in your house before you are evacuated.
- RMIA asks that you be prepared to give your agent or insurance representative a description of any damage. Your agent will report the loss immediately to your insurance company or a qualified adjuster. Smoke and damage from firefighting efforts (i.e. slurry damage) is covered up to your policy limits.
- After a fire, take photos of the damaged areas. These will help with your claims process and will assist the adjuster in the investigation. Also, prepare a detailed inventory of all damaged or destroyed personal property. Be sure to make two copies -- one for yourself and one for the adjuster. Your list should be as complete as possible, including a description of the items, dates of purchase or approximate age, cost at time of purchase and estimated replacement cost.
- To prevent further damage once you are able to return to your home, make whatever temporary repairs you can. To prevent theft or other damage, cover broken windows, damaged roofs and walls. Save receipts for supplies and materials you purchase..

Serious losses will be given priority. If your home has been destroyed or seriously damaged, your agent will do everything possible to assure that you are given priority.

Appendix C: Community Risk Assessments

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **Bartlett Trail**	Number of Lots:
Rated by: C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	**X**

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	
- >45%	**7**	**X**

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	**X**

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	**X**

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	
-Not present	**2**	**X**

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	
-Less than 30% of sites improved	**10**	**X**

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	
-All above ground	**2**	**X**

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	**X**
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	**X**

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	**X**

Notes (Continue on Back): Installing 2 22,000 gal water tanks. Heavy Fuels. Minimal clearance on roads. Power lines could serve as an ignition source. Big Kill on slopes above and in subdivision

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **Colorado City**	Number of Lots:
Rated by: C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	**X**
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	

2. Topography
Predominant Slope:

- Less than 20%	**1**	**X**
- Between 20 – 45%	**4**	
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	**X**
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	

2. Primary Road Width:

-Minimum 24 feet	**1**	**X**
-Less than 24 feet	**3**	

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	**X**
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	**X**
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	**X**
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	**X**
-Between 30-70% of sites improved	**5**	
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	**X**
-One underground – one above	**1**	
-All above ground	**2**	

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	**X**
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	**X**
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back): B4:
Best represented by a 1

C1: Best represented by a 3

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **Cuerna Verde Subdivision**	Number of Lots: /11
Rated by: C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	**X**
-Dense, continuous conifers and/or thick oak brush	**10**	

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	**X**
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	**X**
-Steep Grade, Tight Turns	**5**	

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	**X**
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	**X**
-More than 10 acres	**3**	

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	**X**
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	
-All above ground	**2**	**X**

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	**X**
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	**X**

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back):
Good safety zone. Heavy fuels in rear of homes.

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **Hidden Creek**	Number of Lots: 19/7
Rated by: P. Daniels and C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	**X**
-Dense, continuous conifers and/or thick oak brush	**10**	

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	**X**
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	**X**

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	**X**
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	**X**
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	
-All above ground	**2**	**X**

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	**X**
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	**X**

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	
-Sources w/in 21-45 min round-trip	**1**	**X**
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back): B4:
Access road could be a problem.
B4: Best represented by a 2
C1: Best represented by a 3
Mitigation Plan, Good Safety Zones

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **San Isabel Mtn Estates**	Number of Lots: 19/7
Rated by: P. Daniels and C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	**X**

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	**X**
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	**X**

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	**X**

5. Average Lot size:

-Less than 1 acre	**1**	**X**
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	
-Less than 30% of sites improved	**10**	**X**

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	
-All above ground	**2**	**X**

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	**X**
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	**X**

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	
-Sources w/in 21-45 min round-trip	**1**	**X**
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back):
Access road could be a problem
No defensible space.

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Red Creek Fire and Rescue	Subdivision: **Savage**	Number of Lots: 19/4
Rated by: Dave Harper and Carl Douhan	Date: 08/28/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	**X**

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	**X**
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	**X**

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	**X**
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	**X**
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	**X**
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	**X**
-All above ground	**2**	

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	**X**

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	
-No hydrants or pump-site	**2**	**X**

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back): Has brushed Ponderosa Pine Dr. and some roads brushed for Mason Gulch Fire

B4: Best represented by a 2
C1: 4 houses non-flammable roof and walls and 2 non-flammable roof

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Beulah VFD	Subdivision: **Signal Mountain**	Number of Lots: 46/22
Rated by: L. Amey, F. Elmer, C. Douhan	Date: 08/28/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-“Thinned” Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	**X**

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	
- >45%	**7**	**X**

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	**X**
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	

2. Primary Road Width:

-Minimum 24 feet	**1**	**X**
-Less than 24 feet	**3**	

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	**X**
-Steep Grade, Tight Turns	**5**	

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	**X**
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	**X**
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	**X**
-All above ground	**2**	

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	**X**

2. Hydrants

-500 gpm hydrants-<1000’ spacing	**0**	
-Hydrants or pump-site - < above	**1**	**X**
-No hydrants or pump-site	**2**	

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back):
150,000 gal water storage. Will add a third emergency access road.

B4: Best represented by a 3
C1: 9 houses non-flammable roof and walls, 11 non-flammable roof, and 2 w/ flammable roofs.

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Pueblo Em. Response Team	Subdivision: **Simonson Meadow**	Number of Lots: ?/4
Rated by: Carl Douhan	Date: 08/28/2006	

A. FUELS AND TOPOGRAPHY
1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-“Thinned” Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	**X**

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	
- >45%	**7**	**X**

B. SUBDIVISION DESIGN
1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	
-Less than 24 feet	**3**	**X**

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	**X**

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	**X**

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD
1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	**X**
-Between 30-70% of sites improved	**5**	
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	**X**
-All above ground	**2**	

D. FIRE PROTECTION
1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	**X**

2. Hydrants

-500 gpm hydrants-<1000’ spacing	**0**	
-Hydrants or pump-site - < above	**1**	**X**
-No hydrants or pump-site	**2**	

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	**X**

Notes (Continue on Back):
Building a 4th house. Not evaluated.

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Rye FPD	Subdivision: **Town of Rye**	Number of Lots:
Rated by: C. Douhan	Date: 08/29/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	**X**
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	

2. Topography
Predominant Slope:

- Less than 20%	**1**	**X**
- Between 20 – 45%	**4**	
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	**X**
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	

2. Primary Road Width:

-Minimum 24 feet	**1**	**X**
-Less than 24 feet	**3**	

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	**X**
-Smooth Road, grade > than 5%	**3**	
-Steep Grade, Tight Turns	**5**	

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	**X**
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	**X**
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	
-Between 30-70% of sites improved	**5**	**X**
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	
-All above ground	**2**	**X**

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	**X**
-Within 16-30 minutes	**2**	
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	**X**
-No hydrants or pump-site	**2**	

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back): B4:
Best represented by a 1

C1: Best represented by a 3

SUBDIVISION WILDFIRE HAZARD RATING FORM

Fire District: Red Creek Fire and Rescue	Subdivision: **Vaughn**	Number of Lots: 28/13
Rated by: H. Lammerts and C. Douhan	Date: 08/30/2006	

A. FUELS AND TOPOGRAPHY

1. Fuels/Density

-Grass w/ scattered trees or oak brush	**1**	**X**
-"Thinned" Conifers (10 ft. or more between trees – trimmed up 10 ft.)	**3**	
-Sagebrush/willow	**5**	
-Moderately dense conifers or oak brush	**7**	
-Dense, continuous conifers and/or thick oak brush	**10**	

2. Topography
Predominant Slope:

- Less than 20%	**1**	
- Between 20 – 45%	**4**	**X**
- >45%	**7**	

B. SUBDIVISION DESIGN

1. Ingress/Egress

-Two or more roads, primary route	**0**	
-One road, primary route, plus one alternate	**2**	
-One way in or out	**3**	**X**

2. Primary Road Width:

-Minimum 24 feet	**1**	**X**
-Less than 24 feet	**3**	

3. Accessibility – Primary Road:

-Smooth Road, grade less than 5%	**1**	
-Smooth Road, grade > than 5%	**3**	**X**
-Steep Grade, Tight Turns	**5**	

4. Secondary Road Terminus

-Loop road or cul-de-sacs w/ turn around radius greater than 45 feet	**1**	**X**
-Cul-de-sacs w/ turn around radius less than 45 feet	**2**	
-Dead-end road <200 ft in length	**3**	
-Dead-end road >200 ft in length	**5**	

5. Average Lot size:

-Less than 1 acre	**1**	
-Between 1 and 10 acres	**2**	
-More than 10 acres	**3**	**X**

6. Street Signs

-Present	**0**	**X**
-Not present	**2**	

C. STRUCTURE HAZARD

1. Predominant Materials:

-Roof and siding materials not wood	**1**	
-Flammable siding/non-flammable roof (includes mobile homes)	**3**	**X**
-Flammable roof	**5**	

2. Defensible Space Completed

-More than 70% pf sites improved	**1**	**X**
-Between 30-70% of sites improved	**5**	
-Less than 30% of sites improved	**10**	

3. Utilities (Gas and/or Electric)

-All underground	**0**	
-One underground – one above	**1**	**X**
-All above ground	**2**	

D. FIRE PROTECTION

1. Response Time:

-Within 15 minutes	**1**	
-Within 16-30 minutes	**2**	**X**
Greater than 31 minutes	**3**	

2. Hydrants

-500 gpm hydrants-<1000' spacing	**0**	
-Hydrants or pump-site - < above	**1**	**X**
-No hydrants or pump-site	**2**	

3. Drafting Sources
(Complete if no hydrant/pump-site)

-Sources w/in 20 min round-trip	**0**	**X**
-Sources w/in 21-45 min round-trip	**1**	
-Sources>46 minutes round-trip	**3**	

Notes (Continue on Back): Fuels are 50% oak/PJ. New house not rated.
B4: Best represented by a 1. C1: 7 houses non-flammable roof and walls and 4 non-flammable roof; 2 w/ flammable roof.

Community Wildfire Protection Plan: Southwest Pueblo County, Colorado

Appendix D: Pueblo Mountain Park – Beulah, Colorado

For: Mountain Park Environmental Center (MPEC),

Pueblo Mountain Park

By: Steve Douglas

MPEC Volunteer

August, 2012

1.0 Introduction

The Pueblo Mountain Park (Park) is a 611 acre park owned by the city of Pueblo, which purchased the undeveloped land in 1920. The park has been managed by the Mountain Park Environmental Center (MPEC) on behalf of Pueblo since 2008. The Park, its location, history, natural resources and improvements have been well described in the ***Pueblo Mountain Park FOREST STEWARDSHIP PLAN*** (Stewardship Plan) prepared for Pueblo by John Grieve (District Forester – Colorado State Forest Service, Canon City District) in February, 2002. The Plan was included as Appendix D of the original (2006 version) of the ***Pueblo County Community Wildfire Protection Plan for Southwest Pueblo County, Colorado*** (CWPP). In this amended version of that CWPP, the Stewardship Plan is included in its original form as Attachment 1 of Appendix D. This Appendix D contains Park-specific information for the CWPP and draws heavily on details and recommendations included in the Stewardship Plan. Work on this appendix is supported by and draws from work performed in the Park from 2010 to 2012 under a 2010 Colorado Wildland Urban Interface Grant (Project Number 5367490-003), conducted by MPEC.

Efforts to improve and/or maintain healthy forest conditions and wildfire mitigation programs in the Park are divided here into three sections, i.e. Facilities Maintenance, Vegetation and Fire Response Planning. Ongoing efforts in each of these categories are essential in mitigating the potential for uncontrolled wildland fire activity in and around the Park, as well as supporting safe and effective firefighting efforts in and around the Park when needed. Tasks described herein are stated in general terms, intended to be applied in the short-and long-term. They reflect variables that are either unknown or may be difficult to quantify and prioritize, as well as the volunteer and paid resources needed to perform those tasks.

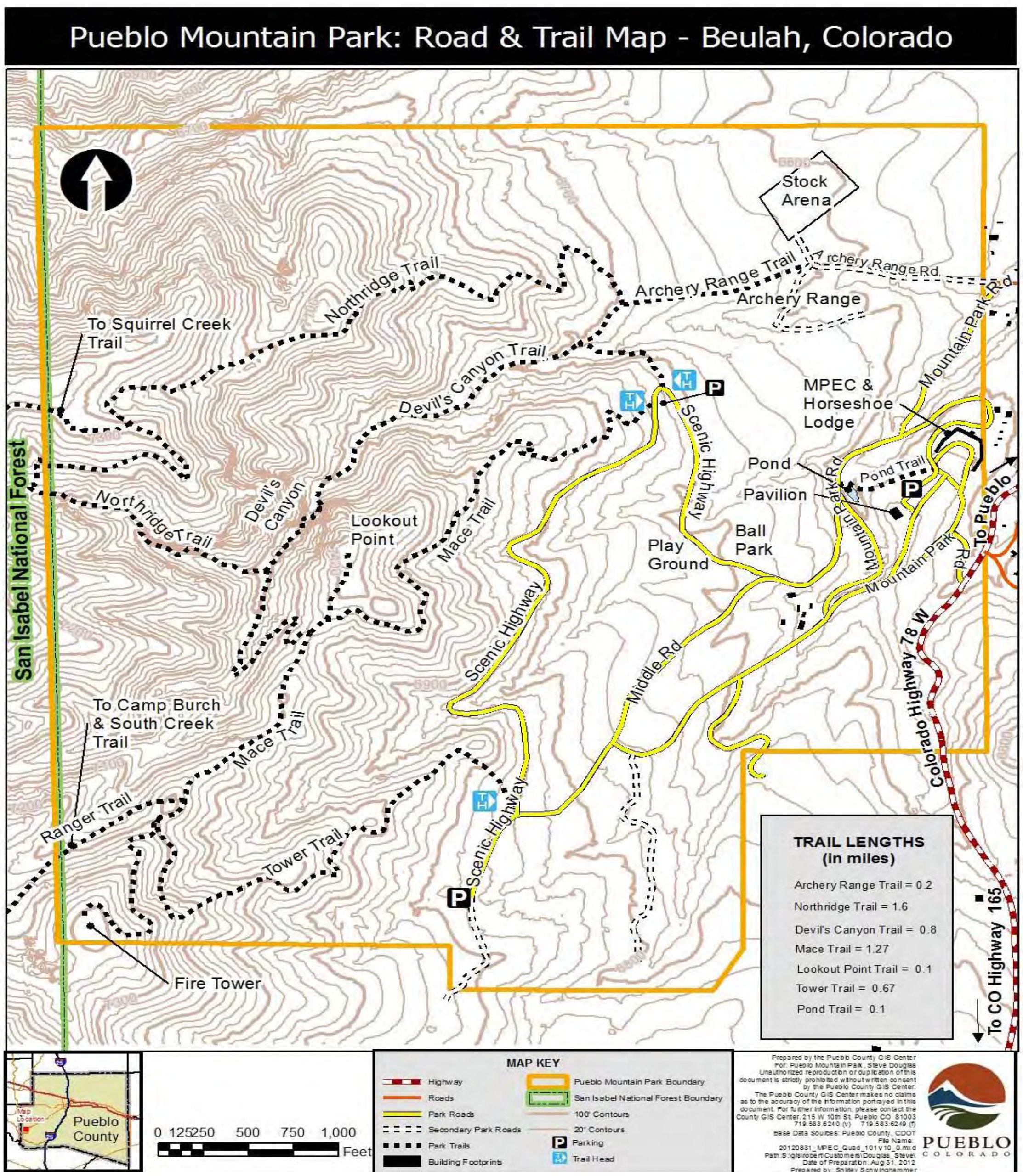
2.0 Facilities Maintenance

Facilities in the Park range from historic structures with cultural values to protect, to a network of basic roads and trails that are important for routine Park activities as well as emergency response and fire control. The entire Park is listed on the National Registry of Historic Places.

2.1 Roads/bridges/culverts

There are 3.8 miles of gravel road in the Park that are generally open for public use. Included in that inventory is the upper section of the Scenic Highway that may be left unplowed (snow) and closed to vehicular access in winter and spring months. This is intended to optimize its use for winter activities and minimize road damage when the road base is saturated with moisture.

FIGURE D-1: Pueblo Mountain Park Infrastructure



NOTE: This map was produced by the Pueblo County Geographic Information System (GIS) Center. See Appendix H for an 11” X 17” format version.

There are two lesser used sections of gravel road in the park, both of which have access limited by gates that are usually closed and locked. The Water Road is a one-lane road, 0.3 miles in length that is generally closed to public vehicular use, but is used by Park personnel to perform water system maintenance and other activities. The Archery Range Road provides access to the Archery Range, the Stock Arena and the two largest meadows in the Park. The road is 0.4 miles in length. That access is generally closed to general public vehicular use, except during scheduled events in that portion of the Park.

The roads, their peripheral drainage ditches and culverts require routine maintenance to minimize rutting and washouts, and to keep them passable for routine and emergency use. The bridges are typically historic stone structures that require routine maintenance of the waterway and stone work. They are essential to road access throughout the Park, especially along the Upper Scenic Highway, aka the High Road.

2.2 Trails

There are 5.4 miles of established and maintained trails in the Park, all of which serve the western part of the Park. These trails are utilized for hiking and horseback riding. The Northridge and Tower Trails actually connect with trails that extend approximately seven miles westward to Colorado Highway 165 (see ***Southern Front Range Trail Guide***, Third Edition, by Nadia N. Brelje for details). The trails serve recreational, maintenance and fire access needs, and require routine maintenance. That maintenance includes the trail surface itself as well as removal of encroaching vegetation.

2.3 Archery Range

The Park's facilities include an eighteen station Archery Range located in a heavily wooded drainage in the northern portion of the park. The targets are linked by a trail system. It is designed and used as a walking range by local archers, preparing for bow hunting each year. The range trails are not part of the trail system noted above.

2.4 Buildings

Building maintenance, from a wildland fire mitigation perspective, includes routine maintenance of electrical service and systems, as well as removal of leaves and other combustible materials from roofs and gutters. It also includes routine efforts to remove combustible materials (leaves, grass, brush, wood piles, etc.) from around the structures. It is also important to routinely maintain water and other fire suppression systems that serve the buildings.

The Stock Arena is located in the north meadow and is accessed via the Archery Range Road. The Arena's facilities (a fenced arena and associated bleachers) were used extensively in the past, but are not currently being utilized.

For reference, the MPEC offices have been moved to the newly renovated Horseshoe Lodge or "Lodge" as shown on Figure D-1, above.

2.5 Water System

The Park was historically served by a water system that originates at a gallery-styled collection system in the gravels of South Creek, near the Park's south boundary. The system has recently become unusable due to significant water leakage through deteriorating infrastructure. The Park's two residences are served by cisterns filled with trucked-in water. The Horseshoe Lodge and Pavilion are served by a tap from the Pine Drive Water District.

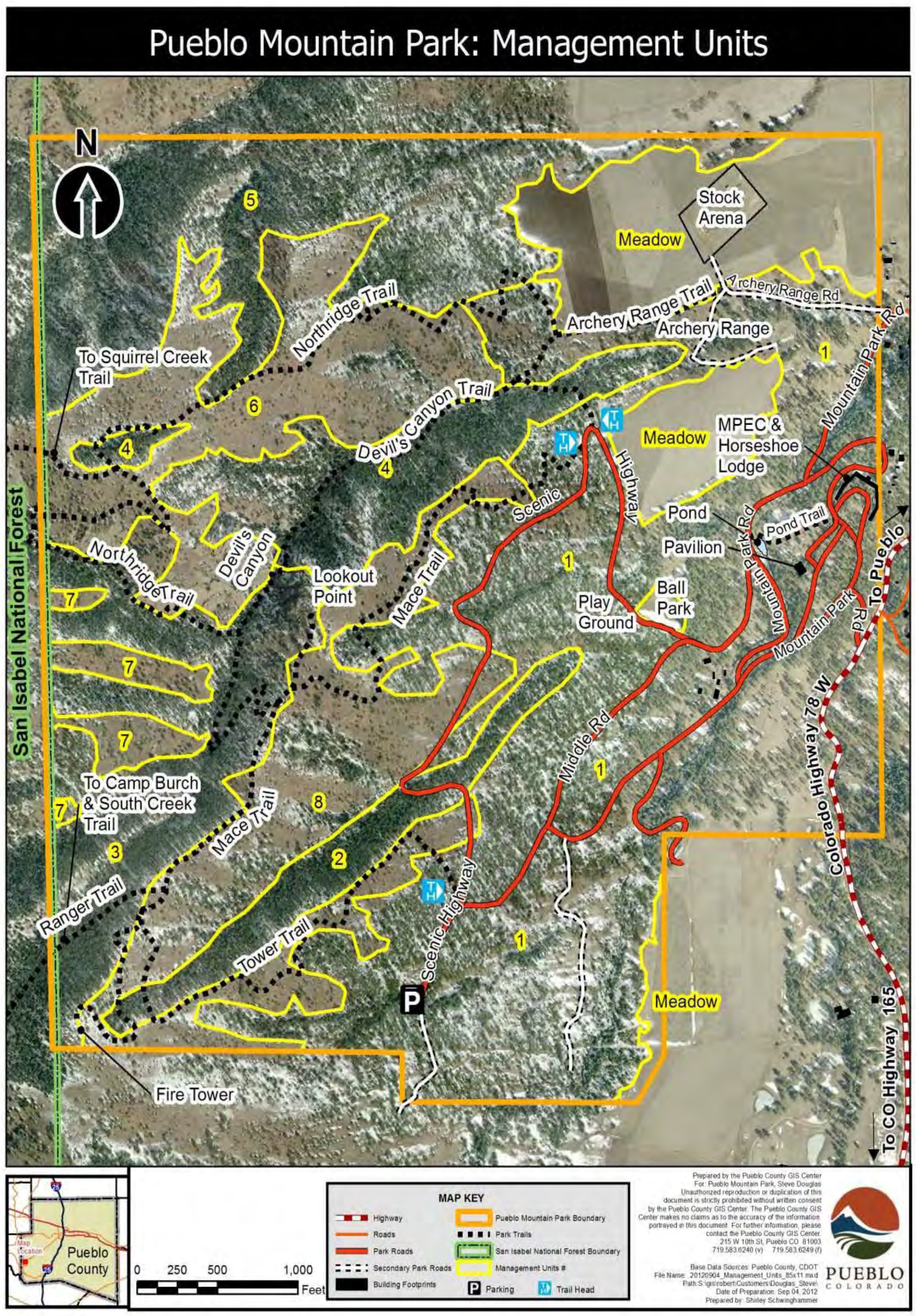
Stream flows in the Park vary greatly by year and season, and generally do not provide reliable sites for drafting of water for firefighting purposes. One general exception to this is a pond located west of the Pavilion and accessed via the Park's Middle Road. In certain years, even this pond dries up to the point that it is not a viable water source for fire fighting.

3.0 Vegetation

The Park's vegetation has been well described in the *Forest Stewardship Plan*, which identifies management units based largely on dominant vegetation and, to a lesser degree, on geography. Eight such management units, plus three meadows have been identified within the Park. Units one through five are forested areas where the dominate vegetative type consists of trees. The remaining units six through eight are mountain shrub lands in which oak brush and other shrub species or mixtures of trees and shrubs dominate.

The majority of the Park's infrastructure (buildings and roads), as well as most of its high use areas (picnic sites, Ball Park and Archery Range) are located in management unit 1. It is the Park's largest management unit, covering approximately 240 acres. As illustrated by Figure D-1, that area of the Park is also characterized by gentle topography and low relief, except for some areas adjacent to streams. A portion of the Upper Scenic Highway cuts across units 2 and 8. The western portion of the Archery Range is in unit 4. The Park's trail heads are all located in unit 1, but for most of their length, they transect portions of units 2-8. The Park's three meadow areas are undeveloped, with the exception of the Stock Arena in the north meadow. The meadows are maintained as non-irrigated hay fields, which are harvested when growth is sufficient to warrant it.

Figure D-2: Management Units



NOTE: This map was produced by the Pueblo County Geographic Information System (GIS) Center. See Appendix H for an 11" X 17" format version.

3.1 Timber

Trees in the Park's forest include ponderosa pine, Douglas fir, white fir, Rocky Mountain juniper, one-seed juniper and pinon pine. In some cases, mature Gambel oak in the Park reach heights of 20 feet and diameters of 9 inches. Ponderosa pine is by far the dominant tree species in management unit 1. The average ponderosa pine in that unit is 55 feet tall, measures 11 ½ inches in diameter and is 107 years old. Exceptional ponderosa pines in the unit measure twice that size.

The lack of clearing wildland fires and mechanical thinning of trees has resulted in significant infilling of younger trees around more mature ones. In some areas of the Park white fir, Douglas fir and ponderosa pine saplings have grown to stand densities sufficient to be referred to as "dog hair", creating hazardous fuel load conditions.

3.2 Brush/understory

Gambel oak is the dominate shrub species in all of the Park's management units. Mountain mahogany and currant are also common shrubs in the Park. In units six through eight, shrubs are the dominant form of vegetation. Incursions of oak are occurring in stands of ponderosa pine present in management unit 1; replacing grassy clearings that once were interspersed throughout the forest. Dense stands of ponderosa pine, Douglas fir and white fir saplings are having a similar effect. The overall impact is a significant increase in hazardous fuel loading, creating extensive ladder fuels.

3.3 Meadows

The Park's north meadow spans 40.7acres and the middle meadow (just south of the Archery Range) is 13.9 acres. The south meadow is just a fraction of a large meadow that is on private property. It is roughly equal in size to the park's north meadow. The Park's meadows are maintained as non-irrigated hay meadows, predominantly having non-native grass species with some native species. They routinely produce stands of grass sufficient to harvest. The harvesting process has the beneficial effect of removing large quantities of light flashy fuel and lowering the potential for incursions of shrubs and saplings, thus maintaining open spaces.

3.4 Selective Thinning

It has been decades since the Park's vegetation has been reduced by logging or significant wildland fire activity. As a consequence, the vegetative cover became quite thick in most areas, except some dominant east and southeast facing steep slopes with minimal soil cover. The *Forest Stewardship Plan* makes note of this condition, as well as infestations of mountain pine beetle, dwarf mistletoe and other parasites, i.e., a generally unhealthy forest condition. Those conditions have been exacerbated by drought conditions that have persisted since 2000.

Figure D-3: Mountain Pine Beetle Infestation 2001

(Source: *Pueblo Mountain Park FOREST STEWARDSHIP PLAN, 2002*)

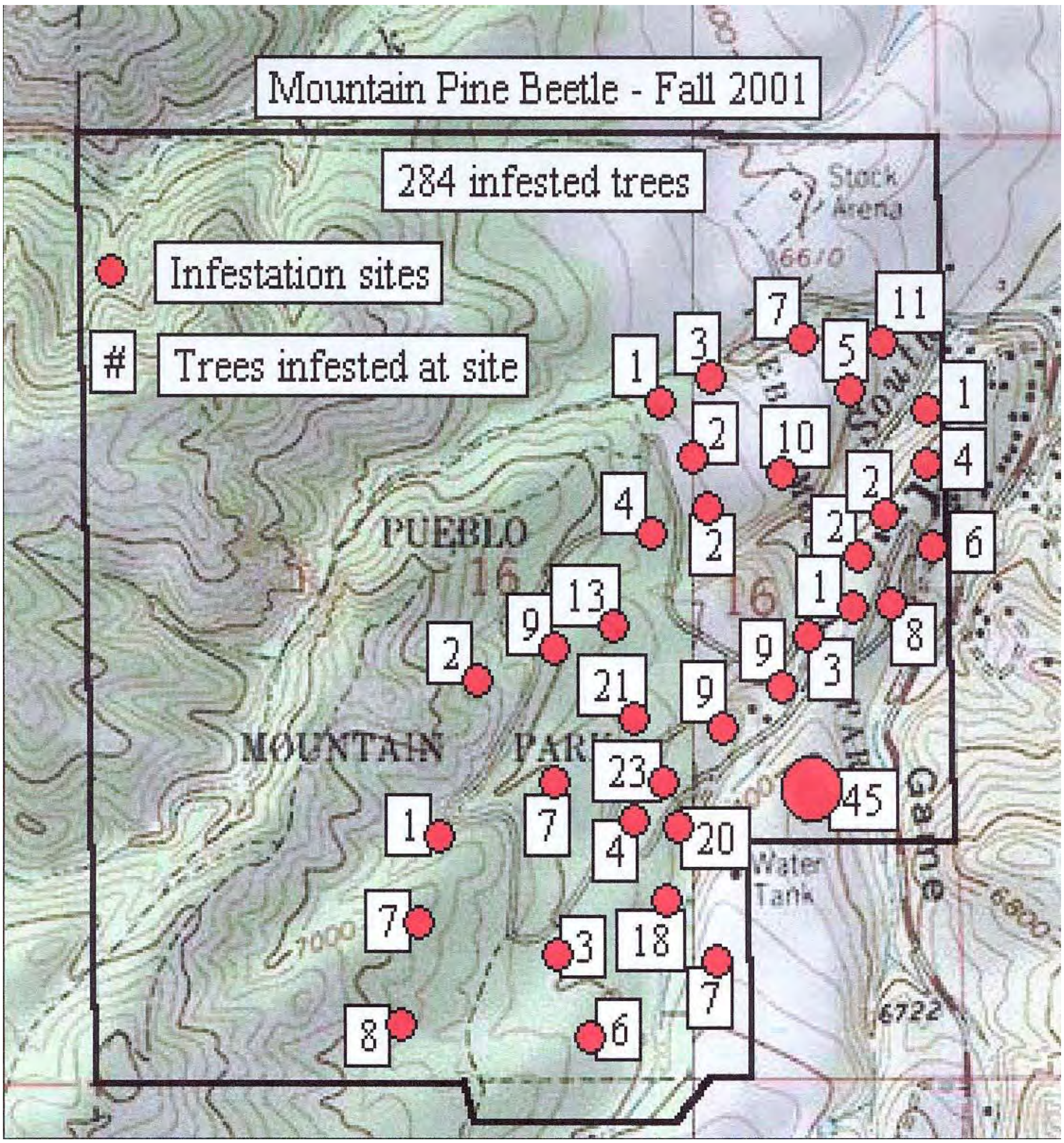


Figure D-3 illustrates mountain pine beetle activity within the Park in the fall of 2001. A collective effort of Park personnel, MPEC, Pueblo County Emergency Management, sawyers from local fire departments, the Pueblo County Sheriff's Inmate Labor Crew, the Pueblo Southside Landfill and others resulted in the selective cutting of the infested trees and removal of the resulting wood from the forest by late June, 2002. That effort has had a significant impact on the potential spread of mountain pine beetle in the Park since then. It is understood that a mountain pine beetle population will remain in the forest as part of the normal ecosystem and that population will infect trees when conditions are right for that to occur. Pockets of mountain pine beetle infected trees have been found in and removed from unit 1 since 2002.

The *Forest Stewardship Plan* made clear recommendations regarding the need for forest thinning to occur. That recommendation has been implemented from 2002 through the present, first with removal of mountain pine beetle infested trees. That was followed by other selective thinning to create defensible space around the Park's principal structures and wider-scope thinning efforts to reduce hazardous fuel loading in general. The most recent effort (2010-2012) is to create a shaded fuel break along roads and meadows located mostly in management unit 1. That most recent effort treated 101 acres of the Park. Those areas thinned are illustrated in Figure D-4.

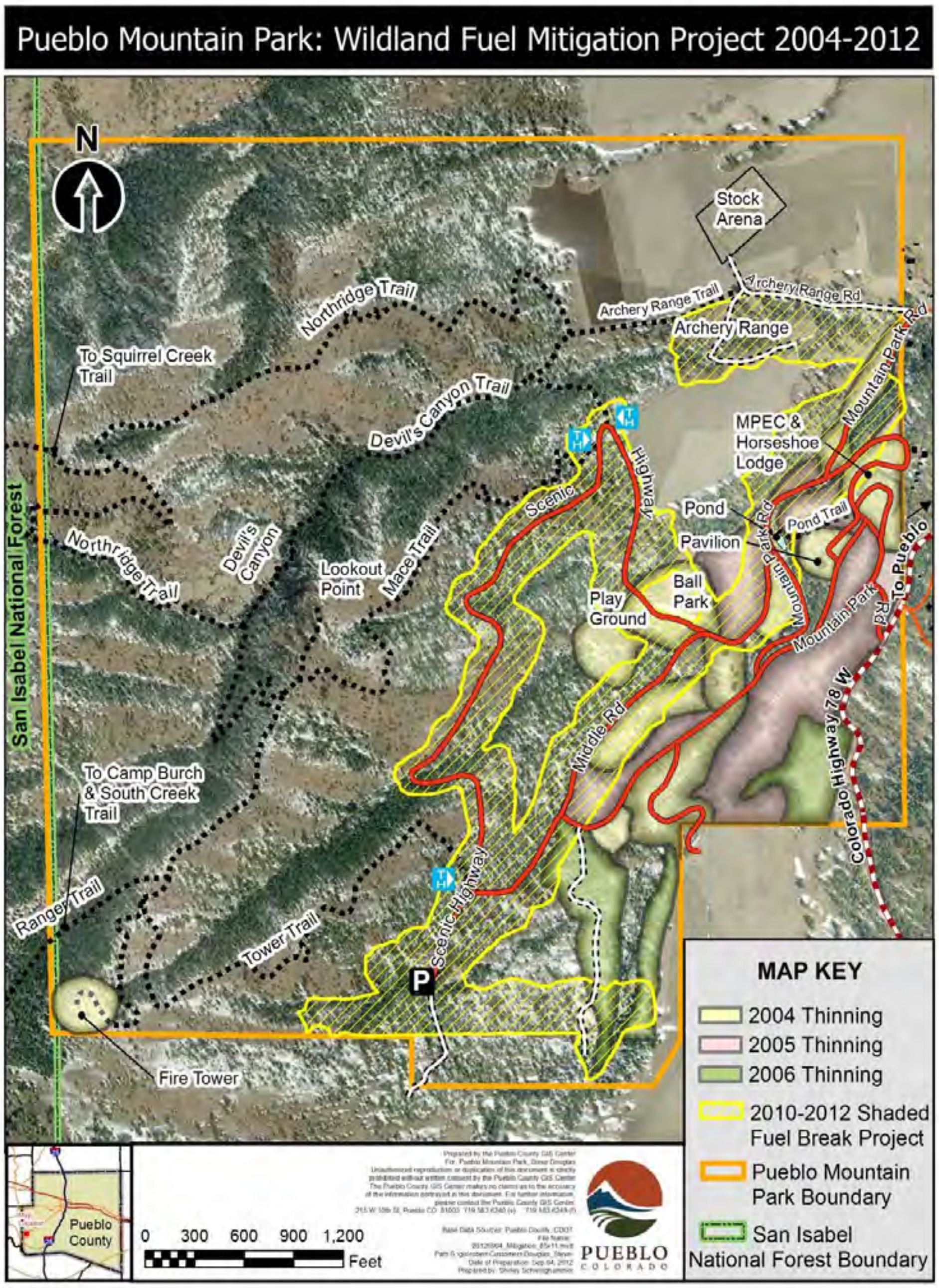
Fuel, topography and weather are the three primary factors affecting wildland fire behavior. The sources of wildland fire ignition are typically characterized as natural and manmade. Naturally caused ignitions are typically from lightening. Man caused ignitions can be accidental or intentional. They can also come from problems with infrastructure (faulty wiring, downed power lines, etc.).

Mitigating the potential for wildland fire is most effective when directed at fuel conditions and the potential for man caused fire. Topography and access also impact our ability to mitigate hazardous fuel loading. For these reasons, the majority of efforts to mitigate wildland fire potential in the Park have been focused on hazardous fuels reduction in management unit 1.

Strategically, unit 1 is important in terms of limiting spread of wildland fire in the Park, from the Park to the watershed south and west of it, from the Park to residences east and north of it, and from those same residences to the Park. South Pine Drive (aka Colorado Highway 78 West) is located just east of the Park and is significant in terms of emergency access and egress for the Beulah Valley, its potential as a fire line and also its potential to serve as the origin of man caused fires. It is also significant as the right-of-way for the Pine Drive Water District's main water line and associated hydrants.

Trail maintenance, including routine removal of vegetation that naturally tends to encroach on those trails is also a priority. Those efforts serve to support fire fighter

Figure D-4: Pueblo Mountain Park Thinning Project 2004-2012



NOTE: This map was produced by the Pueblo County Geographic Information System (GIS) Center. See Appendix H for an 11” X 17” format version.

access to the Park's west flank, increase the potential for trails to be improved as fire lines if needed, and reduce the potential for spread of man caused fires along the trails. That maintenance is particularly important in terms of limiting the potential of fire spread in units two through five, i.e., the forested units in the western half of the Park that are characterized by steeper topography and the general lack of road access. Those two conditions limit the potential for significant mechanical thinning of hazardous fuels, while increasing the potential for rapid fire spread.

3.5 Slash Treatment

Thinning projects generate large amounts of material to be removed, otherwise that material just becomes dry hazardous fuel that covers the forest floor and inhibits growth of grass and other desirable plants. Tree trunks and large diameter limbs may be put to beneficial use as saw logs, log bumpers and fire wood. The renovation of the Park's Horseshoe Lodge included installation of two large efficient biomass burners, providing heat to the facility. Approximately 40 cords of wood are consumed annually in those burners, providing a beneficial use of wood generated through routine thinning efforts.

The small diameter branches and brush cut in the thinning process is referred to as slash. Slash generated in the Park is disposed of in three ways, i.e., it may be burned, chipped or broadcast and left to decay naturally. At this point, vegetation in the Park is generally so abundant that thinning it to a healthy forest standard generates too much slash to only dispose of it with the broadcast/decay method.

Photo D-1: Log bumpers for parking and access control

Photo By: Steve Douglas

Extensive chipping of slash has been performed as part of grant-funded thinning projects from 2004 to th present, but it is expensive to do and still leaves biomass to remove, either mechanically, with fire or through natural decay. Grant funding has become more difficult to obtain and it generally requires a local match (typically 50% minimum), so using those funds for chipping takes away from other important aspects of the thinning project, such as cutting trees and understory. Still, it may be desirable to chip slash when there is not time to wait for conditions suitable for burning, as long as the slash is reasonably close to locations accessible with a chipper and funds are available to support chipping.

In the initial stage of thinning an area, chipping may be the safest and most effective way to remove slash, if there are not sufficient open spaces to build and burn slash piles. In many cases of initial hazardous fuel mitigation, the process of selective thinning of an area can create open spaces sufficient for slash pile burning. Creating those openings helps meet the dual goals of removing hazardous fuels and creating clearings that are part of a healthy ponderosa pine forest mosaic.

Fire is part of the natural process of forest growth and sustainability. It releases essential nutrients. If the fire is not too intense, the soil is not damaged. The challenge with building and burning slash piles is to put them in the right place relative to surrounding vegetation, keep them small enough to not damage the underlying soil and to keep the fires under control. A total of 377 slash piles were burned in the Park between the fall of 2011 and spring of 2012 without incident, i.e., the fires were kept under control by Park personnel and volunteers, without involving the local fire department other than to notify it of plans to burn on specific days. The protocol used in the Park for burning slash piles is provided as ATTACHMENT 2.

Weather is a key element in the process of controlling slash pile fires. Snow is used to limit fire intensity. Piles are not burned on days when the weather forecast calls for wind. And, the piles are kept small enough to allow them to be extinguished (with snow) if the wind comes up unexpectedly.

How the slash piles are constructed and the size material that is put into them are also important elements in slash pile burning. Piling slash in mounded piles (instead of windrows, as you might if the slash were going to be chipped) works well for a number of reasons. Mounds fit better in small clearings, which may be a limiting factor when initial thinning is being done. Capping a slash pile with bows helps keep the pile dry, whether it is tarped before snow covers it or if snow is allowed to cover the fuel itself. A cap of bows can minimize damage to tarps by branches poking holes in them, which becomes more likely as snow weighs down the tarps.

A tight cap of bows itself can keep snow from penetrating the entire pile and making it difficult or impossible to burn. Bows of brush such as Gambel oak do not seal the top of a pile as well as those from pine or fir, so when possible, it helps to build mixed piles of slash with oak branches on the inside and save the pine or fir bows for the cap. All or a portion of the snow cap can be shoveled off just prior to burning. Snow caps left on piles during burning can help control the rate of burn, which can be important when burning in smaller clearings.

Photo D-2: Mounded Slash Pile (for burning)

Photo by: Steve Douglas

Photo D-3: Windrowed Slash Pile (for chipping)

Photo by: Dave Van Manen

What goes in the slash piles is important. The burn piles created in the Park as part of the thinning process are piled by hand, so they are generally lacking the dirt that often comes when machinery is used to make piles. Minimizing dirt in the piles allows them to burn more efficiently due to better air flow through the pile. Also, the Park's slash piles are typically made up of small diameter wood, with the larger wood being used as firewood or log parking bumpers. Occasionally, larger diameter (4"-8") wood is included if it is decayed to the point that it is not viable as fire wood. Inclusion of that wood in the burn piles is part of general hazardous fuel reduction. It is wood that is generally burned when fire is allowed to burn naturally through the forest, but remains and becomes hazardous fuel when fire is suppressed.

Building slash piles for burning as described above, allowing the slash to dry and then keeping the material dry creates a pile that will burn with high intensity, especially in the initial 15-30 minutes of the burn. What is created is a pile of light, dry flashy fuel that is open to effective air flow throughout the pile. Experience has taught us that we should expect flame lengths coming from such a pile to be four or five times as long as the pile is high. In the initial and most active period of the pile burning, we have learned to expect flame lengths of 20-25 feet from a 5 foot high pile. It is for that reason that placement of slash piles, careful attention to wind conditions and the presence of sufficient snow cover to dampen fire activity is absolutely essential. That experience also reinforces our procedure that includes keeping the piles themselves relatively small. "Small" in this case is defined as a pile that is no more than 5 feet high, with an area that can be reasonably covered with a 9' x 12' tarp. Piles that are larger than that can create fire conditions in excess of what we can manage with routine Park resources, unless we are able to build them in large clearings.

Photo D-4: Small pile slash burning in the Park, using snow to control fire
(Winter 2011-2012)

Photo by: Steve Douglas

The other advantages of keeping the burn piles small are that it reduces the time needed to burn them completely and it minimizes the potential for damaging the underlying soil. We prefer to have our burn piles reduced to a pile of gray ash, or at least, small embers by the end of the work day. If the ash and embers are then scattered across the snow, the result is a wider distribution of nutrients and more rapid regeneration of vegetation in the burned area.

Photo D-5: Ash pile remaining after slash pile burned.

Photo by: Steve Douglas

Piles built and protected in the manner described here typically take 2-4 hours to go from first ignition to final ash and hot embers. Ten or more closely spaced piles can be burnt sequentially by two workers in a day. Unless the piles are in a large clearing and the potential for flames to get into nearby live fuel is essentially nil, our procedure is to start one pile at a time and let it get past the initial intense burning phase before starting the next pile on fire.

Smoke generated by burning slash should be a consideration. Dry piles of slash built and burned as described above typically produce very little smoke, especially after the initial intense burning period. Damp piles and/or those with a snow cap left in place will produce much more smoke than the same pile if it had been burned with the fuel dry. Air quality and esthetics should be a concern, but it is also important to keep in mind that one goal of a thinning project is to reduce large concentrations of hazardous fuel. If that effort is not made, the uncontrolled wildfire that can result will likely take a much larger toll on air quality, esthetics and the environment in general.

Photo D-6: Photo taken August, 2012 of ash and cinders remaining after a small slash pile was burned the previous winter.

Photo by: Steve Douglas

3.6 Prescribed Burning

Thinning and general vegetation management in the Park described above relies heavily on physical labor and use of appropriate equipment, in concert with slash removal through pile burning and/or chipping. Throughout the life of the Park, significant efforts have been made to reduce the potential for man-caused fires, and to actively suppress fires started naturally or accidentally. Likewise, extreme care is taken to keep slash pile fires under control. It is abundantly clear from the pattern of vegetation in the Park prior to 2002 and from re-growth of vegetation (especially Gambel oak) in areas treated since 2004 that keeping the vegetation from returning to a hazardous and unhealthy level will require constant and focused efforts. Those efforts may continue to replicate work done in the past ten years, with a significant investment in labor and funds, or they may be augmented with the use of prescribed burning.

In *A Guide for Prescribed Fire in Southern Forests,* prescribed burning is defined as "The controlled application of fire to wildland fuels in either a natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time produce the intensity required to attain planned resource management objectives." That language can also be applied to western forests. Key words included in that definition are *controlled*, *specific*, *predetermined*, *planned* and *objectives*. The Colorado State Forest Service provides excellent information regarding prescribed burning, available on-line at http://csfs.colostate.edu/pages/fire-tool.html.

Experience continues to illustrate that prescribed fire that is not contained within the planned area can have extreme and unintended consequences. We only need to look to experience from the March, 2012 Lower North Fork Fire in Jefferson County, Colorado to see how critical the loss of control of a prescribed burn can be. Control of prescribed fire relies on proper planning and preparation, as well as evaluation of current fuel, weather (current and projected) and resource conditions.

The application of prescribed fire has advantages over mechanical methods (cutting and chipping) and slash burning in that it removes fuel accumulations and distributes nutrients in a widespread fashion. It is a good forest management tool to use after efforts have been made to reduce the heavy concentrations of hazardous fuels that have accumulated in areas such as the Pueblo Mountain Park. Those efforts, as described above, include thinning of shrubs and timber, and removal of ladder fuels. They significantly reduce the potential for torching and crown fires during prescribed burns. Without the use of prescribed fire or ongoing efforts to manage growth of shrubs and saplings, the positive impacts of hazardous fuels mitigation projects can be lost in as little as a decade. For perspective, Gambel oak has already grown back to heights of four and five feet in areas of the Park that were treated in 2004-2006.

3.7 Future Thinning and Maintenance

Approximately 25% of the Park has been thinned to remove hazardous fuels and restore healthy forest conditions in the past ten years. All of that work has been focused on the eastern half of the Park, that being primarily in management unit 1. Some of that work has also resulted in shaded fuel breaks being established across heavily wooded portions of management units 2 and 4. It is recommended that continued thinning efforts be made in the remainder of management unit 1, because of its topography, accessibility and proximity to higher levels of public use. Those efforts can also be realistically extended to the eastern portion of management unit 5, where topography and access across the north meadow is viable. Maintenance of vegetation along trails across the west half of the Park is also recommended as a wildland fire mitigation and firefighter access effort. This is especially important in those areas where trails cut through stands of Gambel oak.

In contrast, expanding hazardous fuels reduction and healthy forest efforts in the majority of the western half of the Park is particularly challenging due to access, topography and heavy fuel loading. If resources are available to reduce hazardous fuels in that area, consideration should be given to doing so. Thinning and maintenance in the eastern portion of the Park mentioned above should remain a priority.

Systematic maintenance of treated areas is essential to maintaining healthy forest conditions and to avoid repeated buildup of hazardous fuels. That maintenance will likely involve a mix of labor-intensive mechanical methods, controlled and prescribed fire, as well as the potential use of chemicals for control of Gambel oak.

4.0 Fire Response Planning -Access

Vehicular access to the Park via public roads relies on Colorado Highway 78 West (78W), aka Pine Drive and South Pine Drive or “12-Mile”, as it is known locally. The Park’s main (east) entrance is directly off of 78W. Its north entrance is via Mountain Park Road, which is a graveled side road off of 78W. It is possible to access the Park from the south across private property, via a dirt road that connects with the Upper Scenic Road on the south edge of the Park. That access also relies on 78W. It is also possible, with the proper vehicles under dry conditions, to access the Park from the north, but that calls for driving across a private meadow adjacent to the Park’s north meadow. Access to that private property is via Squirrel Creek Road.

It is important to note that the state’s right-of-way of 78W through most of the Beulah Valley is through ponderosa pine forest that is occasionally not thinned to the extent needed to serve as safe access for firefighters under extreme fire conditions. Specifically, there are a few “choke points” where ponderosa pine crowns overlap above the roadway and a few other places where roadside understory is quite dense. A significant portion of the private property that fronts on 78W through that same area also currently lacks thinning sufficient to provide defensible space for the structures there. In other words, there is a high loading of hazardous fuel along a few sections of 78W in the Beulah Valley, which could raise concerns about emergency access or egress for fire fighters approaching from the north to respond to a large wildland fire in or around the Park.

Highway 78W represents two of only three escape routes from the Beulah Valley. The segment described above exits the northeast side of the Beulah Valley enroute to Pueblo. Highway 78W also exits the south end of the Beulah Valley and leads to Colorado Highway 165, which is approximately ten road miles from the Park. That ten-mile segment also has accumulations of hazardous fuel along much of its length. It has been the subject of plans for a shaded fuel break and has gone through a federal environmental review, but thus far has not received federal funding.

4.1 Fuel breaks

The 2010-2012 hazardous fuels mitigation project in the Park was designed as a shaded fuel break project (see Figure D-4). The fuel break produced is typically 300 feet wide and wider in some selected places. Placement of the fuel break was intended to serve multiple purposes, i.e. to interrupt hazardous fuel loading at critical locations, to reduce fuel loading in high use areas, and to enhance escape routes and safety zones in support of fire fighter safety.

To meet the first of those goals, shaded fuel breaks were established across a band of heavy fuel at the Park's south boundary, and on the north through most of the Archery Range area. The former improves the potential of stopping fire from leaving or entering the Park at its south boundary, thus either protecting the Park or the watershed south of it. The latter minimizes the potential for fire starting on 78W, or in the meadows north and south of the Archery Range from spreading upslope along an identified potential crown fire path into the watershed on the western and southern flanks of the Beulah Valley.

The shaded fuel break extending southwest through the Park to the south boundary area encompasses a high use section of road that has the majority of the Park's picnic areas. Those picnic areas are complete with barbeque and fire pits. Thinning projects in 2004-2006 treated the Park's main (east) entrance, its key buildings and most of the rest of the picnic areas, which also have barbeque and fire pits. The shaded fuel break created along the Upper Scenic Highway serves the dual purpose of providing a shaded fuel break at each of the Park's trail heads, and providing a western line of defense against fire spreading from the Park into the watershed or into the Park from areas vastly more difficult to treat, because of topography and the lack of road access. Those areas include both the western margin of the Park and, on a much larger scale, the San Isabel National Forest.

The shaded fuel break was designed to enhance potential escape routes for firefighters, leading either out of the Park entirely or to meadows within the Park that could be used as firefighter safety zones. Most of those escape routes support vehicular access. The south boundary shaded fuel break provides a path for firefighters to reach the south meadow safety zone on foot.

4.2 Escape routes

Establishing viable escape routes in the Park serves multiple purposes. They are important in terms of evacuating the public from the Park in the event of a major fire threatening it. They are equally important in terms of providing firefighters relatively safe access to areas within the Park, or to safety zones within the Park. In reality, the better the job the Park does in developing and maintaining escape routes and safety zones in the Park, the more likely it is that firefighters will be deployed to fight fire there.

The shaded fuel break developed in 2010-2012 is a continuous unit. It is also directly tied to thinning projects performed in the Park in 2004-2006. Collectively, that fuel break utilizes all available roads in the Park and links them to all four access routes described above in section 4.0. It is also tied directly to all three meadow areas in the Park.

4.3 Safety zones

The Park contains three meadows, as shown in Figures D-2 and D-4. The north and middle meadows are entirely within the Park and are believed to be of sufficient size (area and dimension) to serve as firefighter safety zones; defined as an area in which firefighters can be safely staged during an intense wildland fire without needing to deploy their fire shelters. The safe use of those meadows would depend on the amount of grass in the meadow at the time of the fire. To that end, it is important that the meadow grass continue to be harvested whenever there is sufficient grass to warrant that effort. Whether or not the grass is harvested, it is likely that all or part of the meadow would be burned to support its use as a safety zone in an actual fire emergency. The meadow located in the southeast corner of the Park is actually part of a much larger meadow located on the neighboring private property. The entire meadow would need to be considered for use as a safety zone.

Photo D-7: Middle Meadow with hay harvested (August, 2012)

Photo By: Steve Douglas

The potential safety zones in the Park would be an important fire management consideration if the 78W escape route away from the Park were threatened. As noted above, there are portions of 78W through the Beulah Valley and south of it that could be lost as an escape route if fire were to overtake them. With that in mind, having access to viable safety zones within the Park should be considered a critical element in deciding whether or not to deploy fire crews in the event of a major fire in the area.

5.0 Conclusions

The Pueblo Mountain Park is a 611 acre forested property on the south end of the Beulah Valley. It is surrounded by private and public lands in the wildland-urban interface of southwestern Pueblo County, and on a larger scale, southeastern Colorado's Wet Mountains. The hazardous fuels that have accumulated in the Park are not unlike those on the surrounding properties, including but not limited to the San Isabel National Forest. It is part of the watershed that the Beulah Valley relies on for its community water supplies. In terms of events that may start wildland fires, the Park has the added potential that comes with public use of the forest, park roads and trails, picnic sites, barbecues and established fire pits. In contrast, vested interests of Pueblo (who owns the Park), the Mountain Park Environmental Center and its staff (who manage the Park and use it well as an outdoor classroom), and the general public that enjoy the Park's amenities all have an interest in preserving the Park and protecting it from damaging fire.

The Park has the option of being an example of healthy forest management where uncontrolled wildland fire is less likely to occur, regardless of cause, or it can represent a fixed hazard to the surrounding community and forest if healthy forest management is not practiced. The *Forest Stewardship Plan* and efforts made from 2002 to present to reduce hazardous fuels in the Park represent significant information and efforts aimed at the goal of returning the Park to healthy forest conditions. They also provide an example of what those efforts entail and what results they produce.

Appendix D – Attachment 1

PUEBLO MOUNTAIN PARK

FOREST STEWARDSHIP PLAN

Section 16 (excluding the SE quarter of the SE quarter) and approximately 11 acres in the northern portion of Section 21 Township 23 South, Range 68 West, Sixth Principal Meridian, Pueblo County, Colorado.

For

Pueblo City Parks and Recreation Department
800 Goodnight Avenue
Pueblo, Colorado, 81005
(719) 566-1745

Prepared By:
John Grieve
Colorado State Forest Service, Canon City District
515 McDaniel Blvd.
Canon City, Colorado, 81212
(719) 275-6865

February 2002

TABLE OF CONTENTS:

OBJECTIVES:

The purpose of this plan is to guide the City of Pueblo Parks and Recreation Department toward the achievement of the following goals:

1. Reduce the immediate and potential impact of mountain pine beetle infestation.
2. Reduce the destructive potential of wildfire within the park.
3. Maintain or enhance the aesthetic and recreational values of the park.
4. Provide for long-term forest health.

The Pueblo City Parks and Recreation Department identified these objectives during meetings and site visits to the park. Mountain pine beetle has, and is currently causing significant mortality among the park's ponderosa pines. Dense tree cover and undergrowth provide ample fuel for wildfires. Dead and dried trees, killed by mountain pine beetle add to the destructive potential of wildfires and detract from the park's aesthetic and recreational values. The value of the park as an amenity of the City of Pueblo is largely dependent upon the health of the park's forest, therefore; it must be maintained.

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GENERAL DESCRIPTION AND DISCUSSION:
Location, terrain and climate

Pueblo Mountain Park is located about 24 miles southwest of Pueblo, Colorado, via Highway 78. The town of Beulah is about one and a half miles north of the park. The (approximately) six hundred acre park is owned by the City of Pueblo and is managed by the City's Parks and Recreation Department.

The park covers the majority of section 16 and a small tract in the northern portion of section 21. Both sections are in Township 23 South, Range 68 West, of the sixth principal meridian. The topography in the eastern half of the park consists of gentle, east to northeast facing slopes. Short, steep slopes are found adjacent to northeast flowing drainages that lead into South Creek. South Creek enters the park from the south and flows north by northeast through the eastern third of the park. The creek flows out of the park near the northeast corner. Game Gulch passes through the southeastern edge of the park, just west of CO. Hwy 78.

The terrain in the western half of the park is notably more steep and rugged. A pavilion and observation tower located atop a peak at the southwest corner of the property, marks the highest point in the park at 7400 feet. From this peak, a high ridgeline extends north by northeast and forms the eastern rim of Devils Canyon. The western rim of the canyon is very steep; nearly vertical rock faces provide a sharp contrast to the mostly forested slopes above the canyon. (See cover photo) The drainage in the canyon bottom is known as Devil's Dribble. It is little more than a moist strip of ground. The flow of water is very low and mostly subterranean. Where the canyon bottom is solid rock, water is pushed to the surface but quickly disappears again where the bottom becomes fractured or covered with soil.

Historical climatic data for the area around the park could not be found. The following climatic information was extrapolated from historical data collected in Pueblo and Westcliffe, and compiled by the Natural Resource Conservation Service.

The climate in the area around the park can be characterized as mild. Summers are warm but not intolerably hot, with daily high temperatures averaging about 80 to 85 degrees. Winters are cool but daily high temperatures often extend above freezing. Average winter low temperatures can dip into single digits and a few days will have low temperatures far below zero degrees.

Precipitation averages about 15 or 16 inches per year but may fall as low as 11 inches during a dry year or rise to 20 inches in a wet year. Most precipitation falls from April through August either as spring snows or rain and summer monsoonal rain. Cumulative winter snowfall averages about 90 inches per year.

SUMMARY:

Pueblo Mountain Park is located about 24 miles southwest of Pueblo Colorado near the town of Beulah. The 611 acre park lies almost entirely within section 16 of Township 23 South, Range 68 West. The mountain park is owned by the City of Pueblo and managed by the Pueblo Parks and Recreation Department.

Approximately 430 acres of the park is forested with dense stands composed primarily of ponderosa pine or Douglas-fir. Ponderosa pine is the dominant tree species in the roughly eastern half of the park and Douglas-fir dominates the higher ground in the western half of the park. About 115 acres in the roughly western half of the park is vegetated with brush composed primarily of Gambel oak. The remaining acreage consists of hay meadows, (three) which are located in the eastern half of the park.

The forest within the park has grown dense over the past several decades and the overcrowded conditions have not been conducive to the health and vitality of the trees. The growth rate of the trees has slowed considerably and numerous trees are suppressed. Dwarf mistletoe, a parasitic plant common in the ponderosa pines, poses a long-term threat to the health and vitality of the ponderosa pines. Mountain pine beetles pose a more immediate threat and have already exacted a considerable toll on the ponderosa pines. The resulting standing dead trees (snags) pose a potential hazard to lives and property when they inevitably fall. Insects and diseases do not currently pose a serious threat to the stands of Douglas-fir but the most overcrowded forest conditions are found in the Douglas-fir dominated stands.

Natural disturbances such as insect and disease epidemics and particularly, fires play an important role in the shaping and maintenance of forests, however; they are difficult to control and their results are often incompatible with desired forest conditions and uses. Suppressing natural disturbances over long periods of time can create forest conditions even more suitable for large scale, catastrophic disturbance such as major insect or disease epidemics or severe wildfires.

Proactive management of the forest in Pueblo Mountain Park is needed to mitigate the impacts of recent mountain pine beetle activity and the potential impacts of wildfire. Continued, long-term management is necessary to shape and maintain the park's forest in more desirable conditions. Periodic natural disturbances will still occur, but they will be less likely to have catastrophic impacts if the forest is healthy, vigorous and free of excess fuels.

Specific tasks, large and/or small in scope, should be planned and implemented annually. *Forest* management should become as routine as other park management activities. City employees, private contractors and volunteers may all be involved in various tasks. Funding for work projects may be augmented through the sale of wood products and grant programs.

Historical and Current land use.

Historical information obtained from the Mountain Park Environmental Center show that the City of Pueblo purchased the park in 1920 for a sum of six thousand dollars. George L. Williams became the first Mountain Park Superintendent and oversaw construction of most of the infrastructure and existing buildings during the 20's and 30's. Use of the park by the general public increased significantly after the first World War and an increased availability and use of automobiles. Roads were improved and infrastructure was built to accommodate the increased use. The horseshoe lodge provided overnight accommodations for a variety of groups visiting the park.

George L. Williams Jr. grew up in the house that is now occupied by the Mountain Park Environmental Center and provided additional information on the Park's history. Mr. Williams retired from the City Parks and Recreation Department in 1985.

Mr. Williams' father, George Williams Sr. supervised two full time park employees and a Civilian Conservation Corps work camp, established in the park to provide laborers for numerous construction projects. The park staff also provided services for park visitors, particularly, larger groups housed in the horseshoe lodge. Park maintenance, forest management and other work projects provided a variety of tasks for the park's staff.

There was a rock quarry near the mouth of Devils Canyon. One of the screens used to sort the rock currently straddles the trail leading into the canyon, appearing as a metal archway. A sawmill was located near the current site of the rodeo arena. The majority of timber milled came from sites outside the park but some harvesting occurred in the park. Most of the past forest management in the park consisted of sanitation cutting and clearing of small trees and brush. Some effort was made to control dwarf mistletoe infections in the lower (eastern) half of the park but very little or no activity extended above (west of) the current road system. Smaller sized trees and woody debris were either used as firewood or piled and burned.

The Park is currently used for day use recreational activities and environmental education. Use of the park by large groups has decreased in recent times. The horseshoe lodge is seldom if ever used to house overnight guests. The group picnic area and baseball field once used for large gatherings and events is underutilized. Relatively few people use the park with respect to the number and variety of natural and constructed amenities available. Opportunities abound for those seeking to get away from crowds and noise and enjoy the outdoors in semi-solitude.

Environmental education programs for people of all ages are provided by the Mountain Park Environmental Center, (MPEC) directed by Dave Van Manon. The MPEC is a nonprofit organization supported in partnership by the City of Pueblo, University of Southern Colorado and the Greenway and Nature Center of Pueblo. Small groups led by MPEC take frequent nature hikes and use the park for outdoor environmental education classes.

OBJECTIVES:

The purpose of this plan is to guide the City of Pueblo Parks and Recreation Department toward the achievement of the following goals:

1. Reduce the immediate and potential impact of mountain pine beetle infestation.
2. Reduce the destructive potential of wildfire within the park.
3. Maintain or enhance the aesthetic and recreational values of the park.
4. Provide for long-term forest health.

The Pueblo City Parks and Recreation Department identified these objectives during meetings and site visits to the park. Mountain pine beetle has, and is currently causing significant mortality among the park's ponderosa pines. Dense tree cover and undergrowth provide ample fuel for wildfires. Dead and dried trees, killed by mountain pine beetle add to the destructive potential of wildfires and detract from the park's aesthetic and recreational values. The value of the park as an amenity of the City of Pueblo is largely dependent upon the health of the park's forest, therefore; it must be maintained.

management practices may be a nuisance to local residents around the park and offensive to others from a much greater area.

The benefits of forest management will also impact locals and visitors to the park. Reducing MPB in the park will reduce the number of beetles available to infest new trees within and surrounding the park. Any effort by surrounding landowners to address MPB on their property will be enhanced by similar efforts made in the park and vice-versa. Similarly, efforts to reduce wildfire hazards will be mutually beneficial. The impacts of forest management will benefit visitors to the park by providing a more aesthetically pleasing, safer and healthier forest to recreate in.

Management of Pueblo Mountain Park is currently funded through annual appropriations or budgets to the City Parks and Recreation Department. Very little (if any) revenue is generated from park activities to support or offset its operational costs. Managing the park to achieve desired forest conditions will bring additional costs that will have to be included in annual budgets. The costs of forest management could limit implementation of forest practices and/or impact implementation of other Parks and Recreation Department activities.

Forest management costs may be offset by related revenue sources. The National Fire Plan, implemented by Congress in 2000, provides grants to help pay for implementation of forest practices that reduce wildfire hazards in wildland-urban interface areas. Much of the park is within an interface area and use of these funds could be justified. The commodity value of trees removed during the course of forest management could be salvaged and sold, providing another source of revenue.

In the recent past, the sale of wood products often paid for implementation costs and sometimes resulted in a small profit. Profits could be used to pay for other non-revenue producing management practices like tree planting. Currently the economy of the forest products industry in Colorado is very weak. Prices paid for sawlogs are low and smaller trees typically sold as firewood are not selling well at all. It is unlikely that all costs of implementation could be funded solely through timber receipts. If wood products can be sold, the receipts could help offset some of the implementation costs. If economic conditions improve in the future, wood products could fund more implementation costs. The timing and scope of implementing practices should take local economic factors into consideration. It may be prudent under current economic conditions to take smaller steps toward implementing the recommendations in this plan. Larger steps should be taken when market conditions are more favorable.

Selling wood products to help offset management costs could be misunderstood and misinterpreted as the objective of forest management. Management activities should serve to achieve the stated objectives. Those objectives do not include revenue generation, however; any commodity value attached to the parks trees should be salvaged to the extent possible to offset management costs. The City should assure that their objectives and motives for implementing any forest practice are well understood by the public. News releases and/or public meetings prior to any activity would be beneficial.

Soils:

According to Natural Resource Conservation Service (NRCS) soils maps, there are 4 soil types found in the park. Larkson loam (LbD) is the dominant soil found in the lower or eastern half of the park. It is well suited for tree growth, recreation and wildlife habitat and has a moderate erosion hazard. Pinata-Wetmore association (PW) is the dominant soil type found in the higher elevations of the western portion of the park. Recreation and wildlife habitat are potential uses noted by the soil survey if the land is well managed. This soil is not well suited for trees. The soil has only a slight erosion hazard. Wetmore-Mortenson association (WE) is also prevalent in the western half of the park. These soils have a moderate potential for tree growth if well managed. The erosion potential is low. Holderness silt loam (Ho) is the soil in the cultivated hay meadow south of the archery range. This meadow is the only location in the park where this soil type is found. The soil is well suited for pasture and grazing but has a high potential for erosion and gully formation if exposed.

Full descriptions of these soils as provided by the NRCS and a map showing their general locations within the park are shown in Appendix 1.

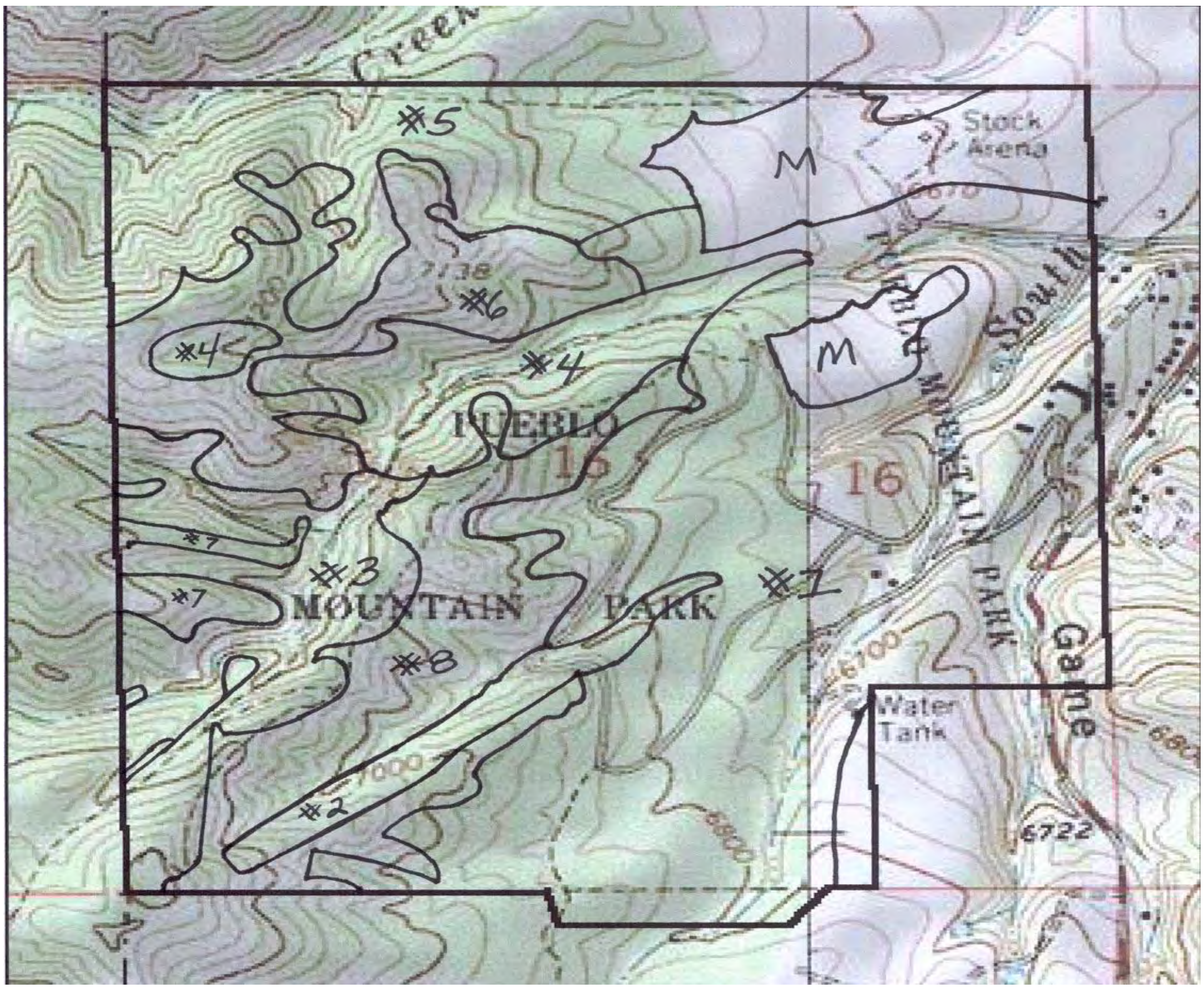
Management units:

For forest inventory and planning purposes, Pueblo Mountain Park was divided into management units. Management units were identified based on the dominant vegetation type and, to a lesser extent, on geographic location within the park. Eight management units have been identified. Units one through five are forest units where trees are the dominant vegetative type. Units six through eight are mountain shrub-lands dominated by oak brush and other shrub species or mixtures of shrubs and trees. Cultivated meadows surrounding and south of the horse arena are not addressed in this forest management plan. Nor is the sliver of meadow south of the water holding facility.

The forest stands in management units one through five were inventoried by variable plot sampling at 73 sample points. This inventory is specific for the overstory vegetation or trees, five inches in diameter or larger. A summary of the data collected is shown in Appendix 2. Units six through eight were not inventoried using this method because trees are not the dominant vegetation type, however; general observations of the trees found in these units were noted during the collection of fixed plot data in these units.

Seedling and sapling trees (under five inches in diameter) were inventoried by fixed plot sampling at 76 sample plots, 1/100 acre in size. Fixed sample plots were taken in all eight management units. Ground cover species (brush, plants, grasses) were also examined and when possible, identified. Their relative abundance was also noted. Dead woody debris was also assessed at each fixed plot to determine the relative fuel loading and fuel arrangement available to fuel and spread fire.

Management Units Map

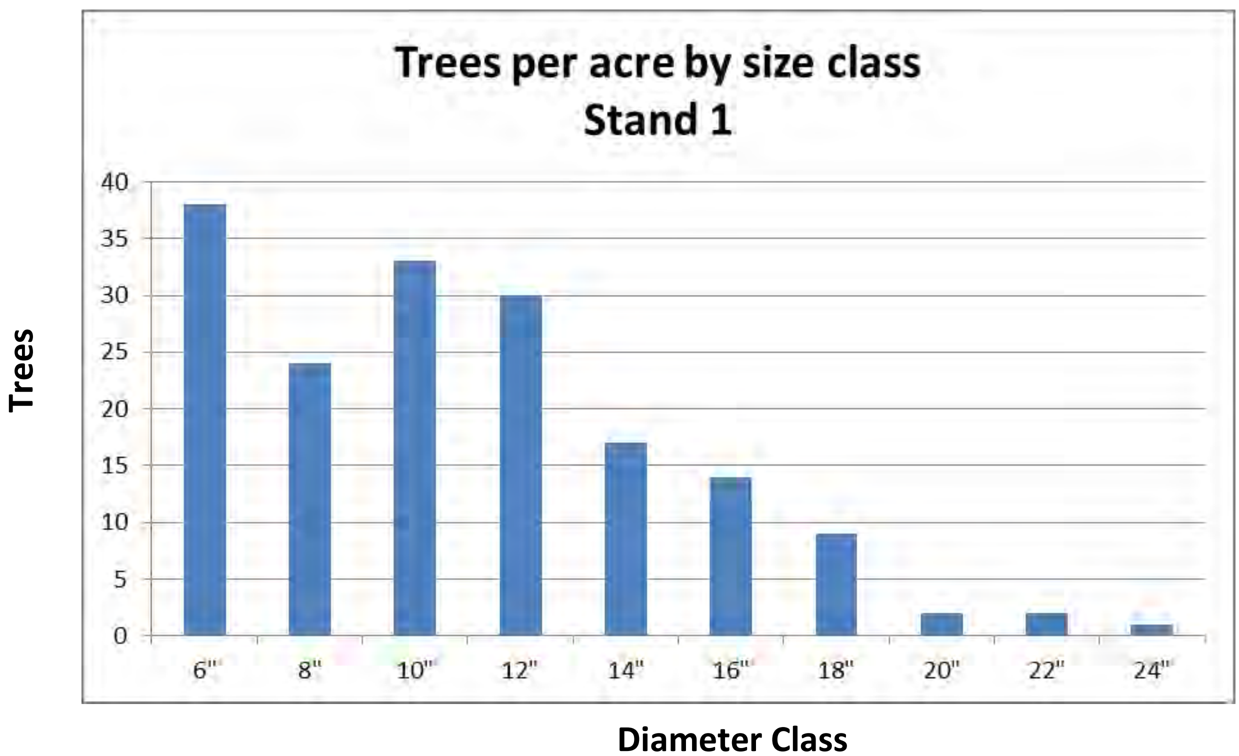


INVENTORY:

Unit One

Unit One is the largest management unit in the park and contains most of the park's developed recreational facilities and infrastructure. It is generally located in the eastern half of the park and covers approximately 240 acres.

Ponderosa pine is by far the dominant tree species in Unit One but aspen, Douglas-fir, subalpine fir, rocky mountain juniper and pinyon pine were also noted within the stand. The average ponderosa pine tree in Unit One is 55 feet tall, measures 11 ½ inches in diameter and is 97 years old. There are, on average, approximately 170 trees per acre measuring five inches in diameter and larger. The graph below shows the number of trees per acre by diameter class. It provides a general picture of the range of variability in the stand with respect to tree sizes and to some extent, tree ages. While smaller trees are typically younger, older trees with suppressed growth can also be small.



On average, the base or trunks of the trees cover about 123 square feet per acre. The area per acre occupied by tree trunks is referred to as basal area. The basal area measurement provides a more accurate measure of stocking or forest density. The number of trees per acre may seem to provide a good indication of stocking but without knowing the size of the trees the number of trees is misleading with respect to stocking.

Take for example, two stands of trees with the same average number of trees per acre. One stand has trees that average five inches in diameter and the other has trees that average nine inches in diameter. The second stand has a greater stocking level than the first even though the number of trees per acre is the same. Basal area measurements provide quick and accurate measurements of stand density and allow for easier comparison between stands.

An average basal area of 123 square feet per acre indicates that stand in Unit One is overstocked. Overstocking leads to excessive competition among individual trees for limited water, nutrients, light and growing space. Competition due to overcrowding generally reduces tree vigor and growth. Low vigor trees are generally more susceptible to insect and disease attack. The level of overstocking in Unit One varies. Basal area measurements at each sample point ranged from 60 (which may be

Unit one:

Site with a basal area of about 70. Trees are larger and have wider spacing.

Unit One:

Site with a basal area of 260. Trees are smaller and have tighter spacing.

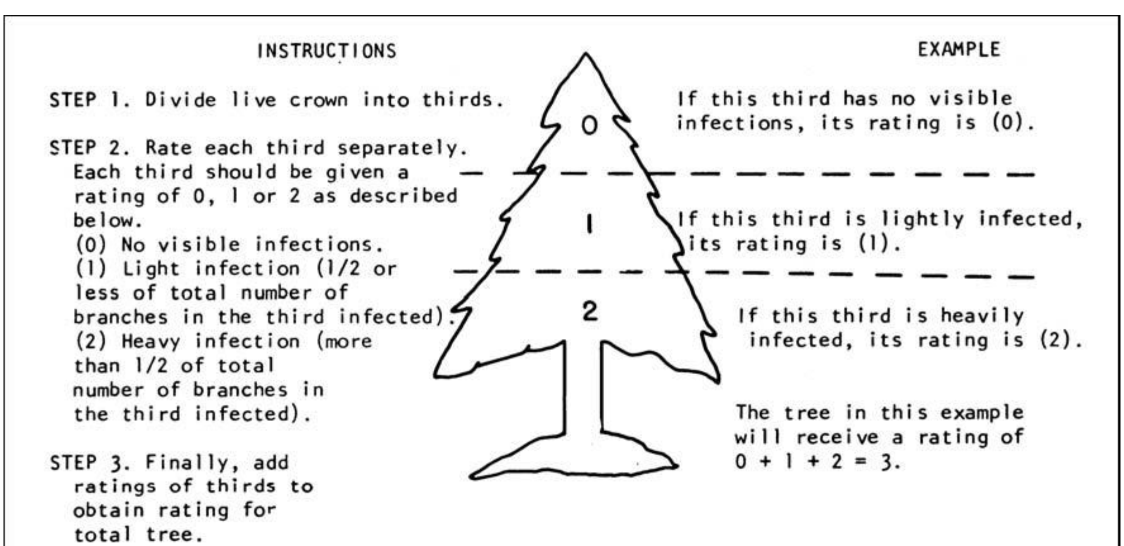
Trees in both photos are about the same age.

The high stand density in Unit One is reflected in the average growth rate of the trees. Tree diameter growth over the last 10 years averaged just over three quarters of an inch; or .076 inches per year from 1990 through 2000. The current rate of growth is much less than it was 30 and more years ago. Tree rings from earlier dates show growth rates approaching 2 inches in 10 years, more than double the current rate. As the trees have grown in size and number they have filled the available growing space, which has led to a gradual reduction in growth and vigor. Growth generally slows down as trees age but the average tree age in Unit One indicates that the stand has not yet fully matured. Ponderosa pines typically mature around age 120. This indicates that the decline in growth is more attributable to overstocking as opposed to age.

Unit One has a site index of 55, which is fair based on the full range of ponderosa pine growing sites; but is among the better sites found along the front range of Colorado. Site index is a measure of site quality with respect to tree growth for a given species. It is calculated based on the height and age of dominant trees. Trees grow taller on better sites and tend to be shorter on poor sites. Within a specific time frame, (usually 100 years) the height achieved by dominant trees is used as a basis for measuring site quality.

Dwarf mistletoe infections can be found on trees throughout the stand. The overall Hawksworth's rating (see below) for the stand is between 1 and 2. Individual tree ratings of 4 and 5 are common within clusters of trees with higher than average rates of infection, or mistletoe "hot-spots." Many of the "hot-spots" are near roads or in areas frequently seen and used by park visitors, giving the impression that this parasitic plant is rampant throughout the stand. A more thorough walk through the stand will show that this is indeed, not the case. Mistletoe infections are present at low levels in most of the stand. While this may sound like "good news" it should be taken as a "warning shot." Dwarf mistletoe has infected younger pines and will probably kill them before they reach maturity. The spread of this parasite poses a real threat to the long-term viability and aesthetic quality of this stand. It should not be ignored.

The 6-class dwarf mistletoe rating system (Frank G. Hawksworth 1961)

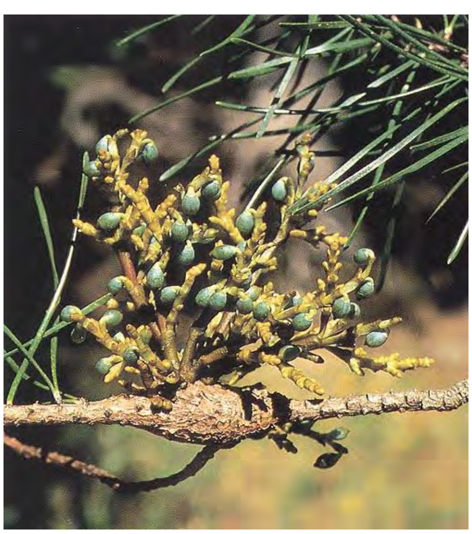


Regenerating trees, or seedlings and saplings less than five inches in diameter, are plentiful but are not distributed evenly throughout the stand. The number of regenerating trees (all species) averages about 700 per acre. Over half of the regeneration is ponderosa pine but Douglas-fir and white fir are common. While young trees can be found throughout the stand, many pines are clustered in dense thickets. These thickets are typically located in small openings where full sunlight reaches the forest floor. Where the parent trees above these thickets are infected with dwarf mistletoe, many of the saplings have become infected as well.

Left: Thicket of young ponderosa pines growing in a small opening.

Below: A young ponderosa pine with a dwarf mistletoe infection. (photo center)

Below: Close-up view of a mistletoe infection. (Photo by D.L. Nickrent)



Surface vegetation in Unit One is variable. Grass cover is present over much of the unit but becomes sparse or absent under dense tree cover where light cannot penetrate to the forest floor. In these areas, a thin layer of dead needles may be all that covers the forest floor. A wide variety of flowering plants and forbs are also found throughout most of the unit. Species include spring beauty, asters, kinnikinnik, pasque flower and others. A more comprehensive list of flowers and forbs in the park is listed on the reverse side of the Pueblo Mountain Park trail map provided by the Mountain Park Environmental Center.

Gamble oak is the dominant shrub species. Its distribution within the unit is variable, ranging from small individual shrubs to broad, dense thickets with heights of about 15 feet. Dead and diseased oak stems are common within the denser thickets. Other oak thickets have well developed stems with little or no lower branches. These small groups of oaks look more like small trees than shrubs. Other common brush species include mountain mahogany and current.

Left: typical ground cover in heavily shaded areas. Below: grass and oak dominated ground cover, typical of most of Unit One.

most

Below left: dead oak showing diseased stem. Below right: group of oak with well developed, tree like, stems.

Mountain pine beetles (MPB) have killed many ponderosa pines in Unit One. Trees killed by MPB can be found throughout the unit. At some small, isolated sites mortality among mature trees (not seedling and saplings) is nearly one hundred percent.

The standing dead trees killed by MPB don't pose a threat of spreading MPB to adjacent healthy trees. MPB leave their host tree just prior to host mortality. Once a tree has died it is no longer suitable habitat for MPB. The dead tree or "snag" can be infested with other, secondary insects, which often become a food source for birds. Larger dead trees can provide valuable habitat for cavity nesting birds. Woodpeckers favor larger snags for hollowing out nesting sites. Snags play a vital role in the overall forest ecosystem but too many snags present real and/or potential problems.

Dead trees killed by MPB

Besides the obvious eye-sore of large groups of dead trees, snags can pose a safety hazard. The vast majority of dead trees fall down or break off within five to ten years of dying. Dead trees killed by MPB Snags close to roads, parking areas, picnic sites, buildings or anywhere where people tend to be, pose a threat to human life and property values. Several broken, fallen and leaning trees close to roads and picnic sites were noted in Unit One.

Nearly 300 live trees in Unit One are infested with mountain pine beetle. The map on the following page shows the general locations and numbers of infested trees found. Each infested tree was marked with yellow or orange ribbon. These trees contained live MPB in at least one of its various forms. (egg, larva, pupa, callow adult, and adult.) The live MPB brood in these trees will almost certainly kill their hosts, fly to other healthy trees and begin their life cycle again. If left alone, the next generation of adult beetles will disperse in mass between the middle of July and early September, 2002, leaving their dead or dying parent beetles behind. If the survival rate among the currently developing larva is good, enough adults could emerge to infest two to three times the current number of infested trees. If brood survival is poor, the spread ratio may be nearer to 1:1.

The current stand conditions, particularly the average age, tree diameter and basal area in Unit One, are favorable to the development and spread of MPB. It is impossible to eliminate the impacts of MPB within the park simply because all ponderosa pine forests (healthy and unhealthy) have mountain pine beetle in them. It is possible to manage the impacts of MPB to minimize their effects on park values. Additional discussion is provided in the "Recommendations" section of this plan.

OBJECTIVES:

The purpose of this plan is to guide the City of Pueblo Parks and Recreation Department toward the achievement of the following goals:

1. Reduce the immediate and potential impact of mountain pine beetle infestation.
2. Reduce the destructive potential of wildfire within the park.
3. Maintain or enhance the aesthetic and recreational values of the park.
4. Provide for long-term forest health.

The Pueblo City Parks and Recreation Department identified these objectives during meetings and site visits to the park. Mountain pine beetle has, and is currently causing significant mortality among the park's ponderosa pines. Dense tree cover and undergrowth provide ample fuel for wildfires. Dead and dried trees, killed by mountain pine beetle add to the destructive potential of wildfires and detract from the park's aesthetic and recreational values. The value of the park as an amenity of the City of Pueblo is largely dependent upon the health of the park's forest, therefore; it must be maintained.

When looking only at the large yellow-barks, it is possible to picture Pueblo Mountain Park looking somewhat similar to Pueblo City Park; with wide spacing between trees and grass dominated ground cover. Unmanaged stands of ponderosa pine can in fact develop in this manner. Where fire regimes are shorter, frequent burning will favor the development of grasses and eliminate most small trees and brush. Large pines with thicker bark can survive the hot, fast moving grass fires. Variations in the spread pattern of fire would leave some areas unburned where small trees, if present, would survive and perhaps grow large enough to survive the next fire. While it is speculative to suggest that the forest around Beulah developed exactly this way and resembled a modern day city park; it is certain that fire played a much greater roll in the development and maintenance of the forest in the Beulah area prior to European settlement. It seems likely that natural fires would thin stands of trees and limit the growth of brush species.

Over time, in the absence of disturbance or management, small trees and brush would become more prevalent. Grass would gradually become less dominant as it is shaded out by taller vegetation. This condition is very similar to what is currently found in Pueblo Mountain Park.

Yellow-bark in center of photo is much larger and significantly older than trees in background. The large, full crown also indicates that it is still in reasonably good health.

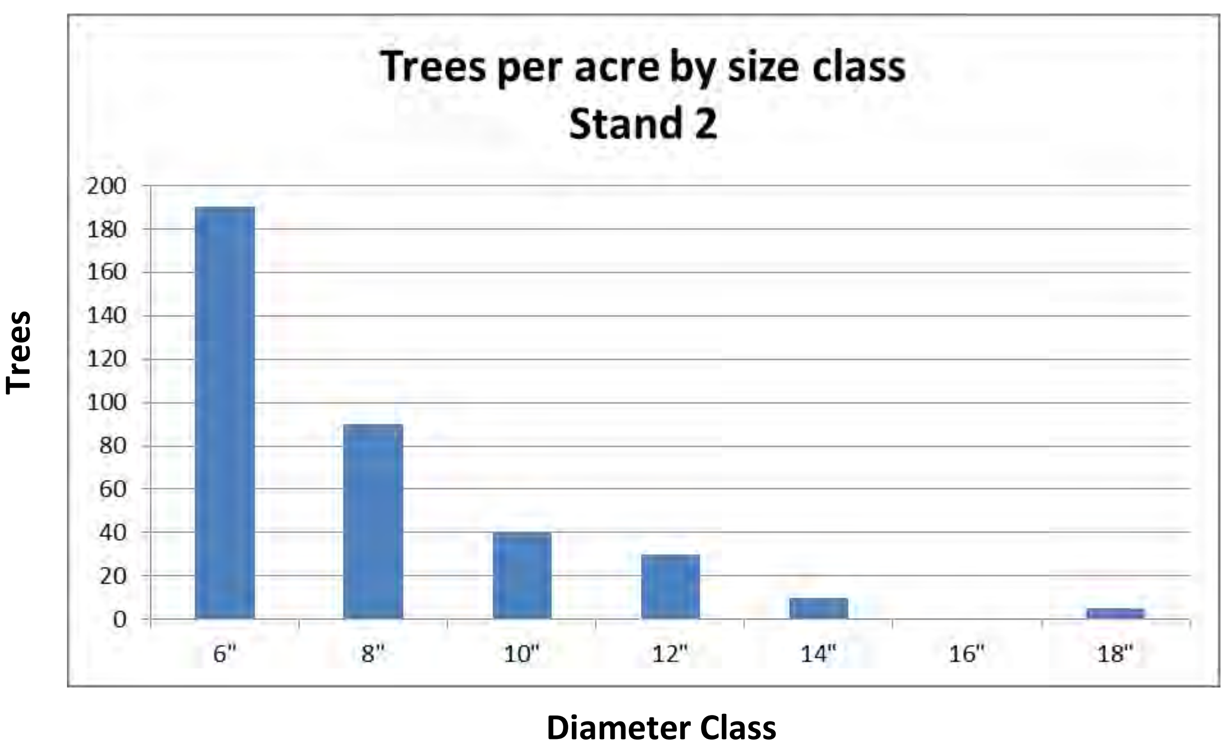
Yellow-barks at center and far left of photo. The crown of the tree at center is small and thinning (more sky can be seen through the crown) indicating it is in decline.

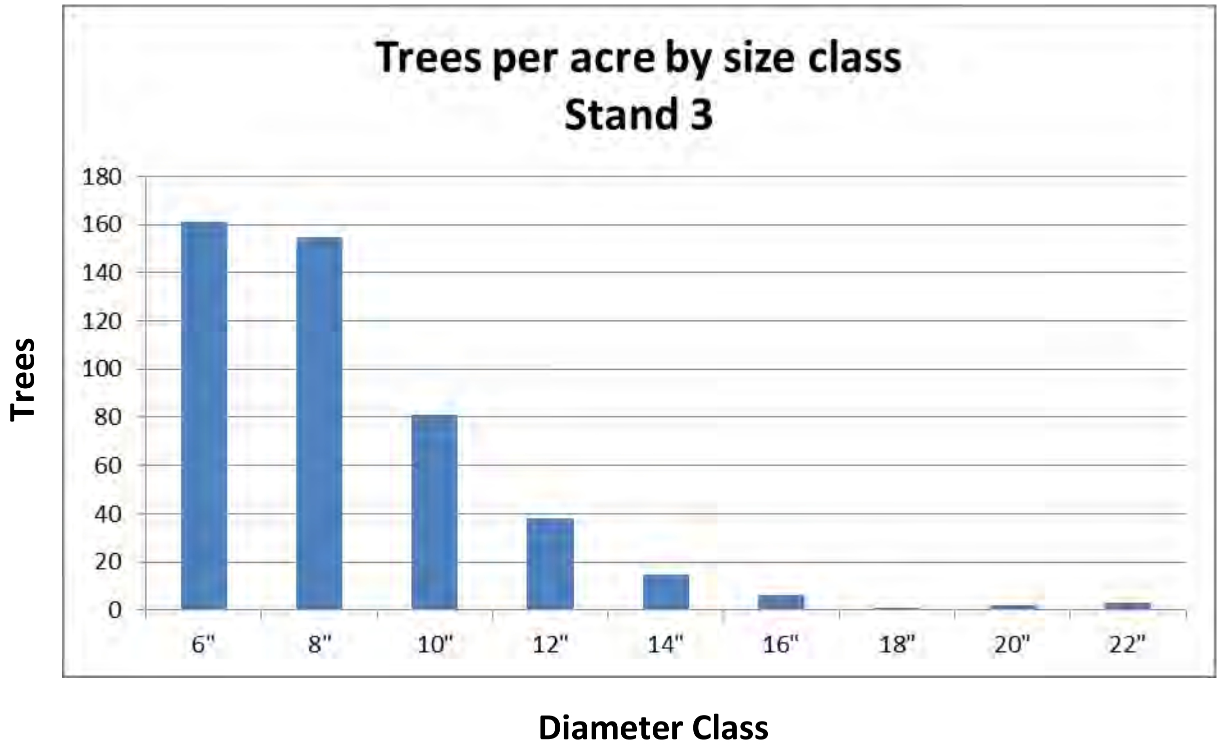
Units Two, Three and Four

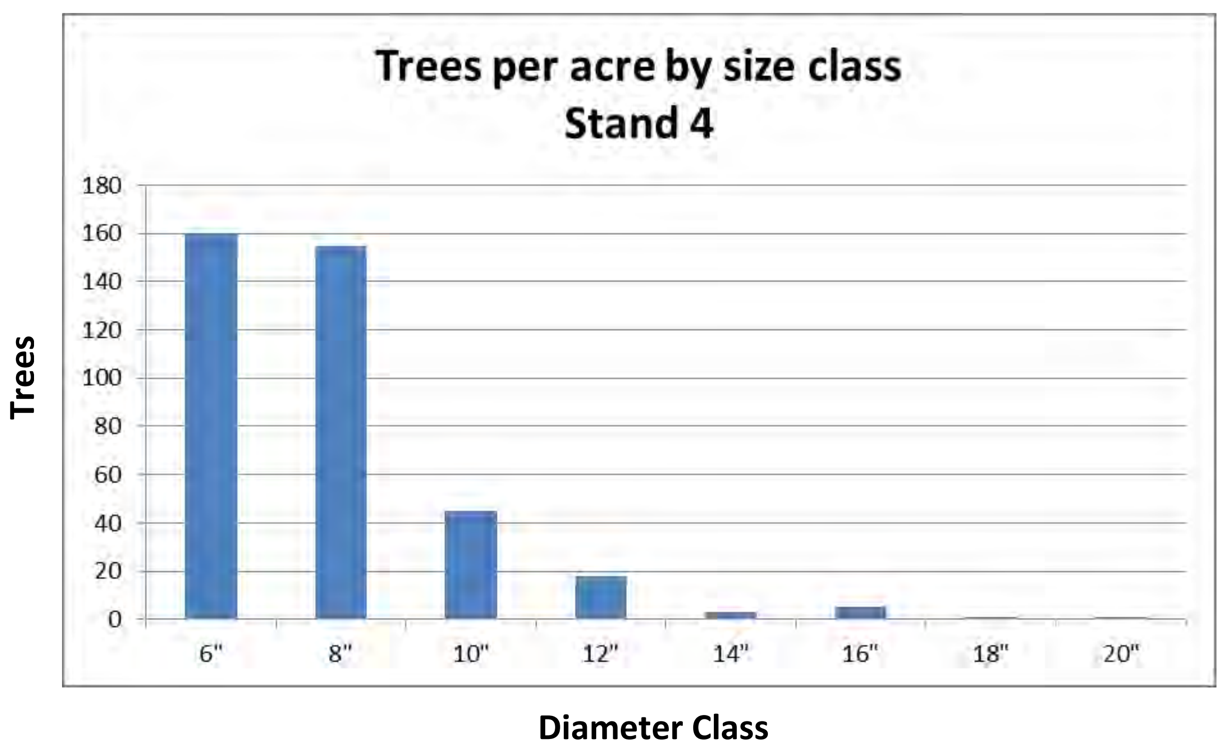
Management units Two, Three and Four have similar characteristics and could be considered a single management unit. They are differentiated geographically and by small variations in stand structure. These units comprise the majority of the forested land in the western portion of the park and collectively cover about 110 acres. Units Three and Four are very irregular in shape and at times are difficult to distinguish between adjacent mountain shrub units. Units Two and Four extend down slope into Unit One. Steep slopes are a common element in all three units, as is the relative inaccessibility, except by foot or horseback.

Douglas-fir is the dominant tree species in these three units. Lesser tree species include ponderosa and pinyon pine, white fir, rocky mountain and one seed juniper. The average tree in Unit Two is only eight inches in diameter and 30 feet tall. The stand average tree in Unit Four is about the same at 7.9 inches in diameter and 34 feet tall. The trees in Unit Three are slightly larger averaging nearly 9 inches in diameter and 46 feet in height. The average number of trees per acre are similar pattern in Units Two and Four averaging 374 and 389 respectively, while Unit Three has 461 trees per acre.

The following graphs illustrate that smaller trees dominate these stands and larger trees are in a small minority.



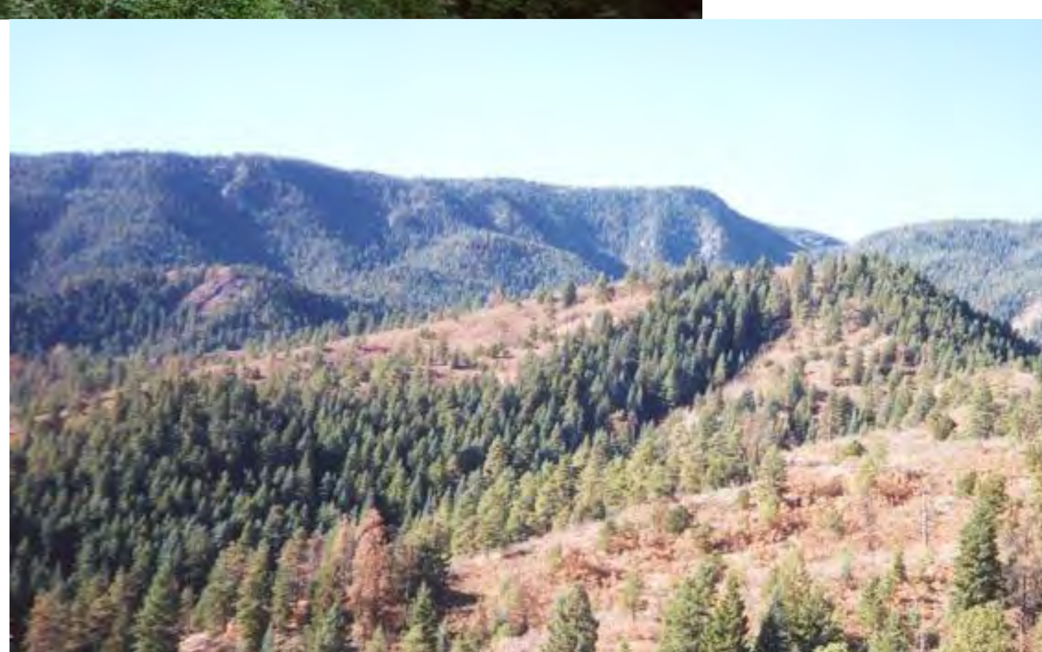

Trees per acre by size class
Stand 3
Trees
180
160
140
120
100
80
60
40
20
0
6"
8"
10"
12"
14"
16"
18"
20"
22"
Diameter Class


Trees per acre by size class
Stand 4
Trees
180
160
140
120
100
80
60
40
20
0
6"
8"
10"
12"
14"
16"
18"
20"
Diameter Class

The average age of the trees in these three stands is fairly uniform ranging from 105 years in Unit Two to 127 years in Unit Four. Within all three stands are a few large, old trees similar to those discussed in Unit One. All three of these units are overstocked, especially Unit Three. Basal areas within Units Two and Four are around 130 square feet per acre. Unit Three has a basal area of 193. Unit Three also has a higher site index of 50 compared to the other two units which each have a site index of 40.

The current growth rate of the trees in all three units is fairly slow. Diameter growth over the past ten years ranged from just under ½ inch in Unit Four to nearly ¾ of an inch in Unit Two. Growth in Unit Three was just over .7 inches during the last ten years. It is a little surprising that given the high stand density in Unit Three, the growth rate there was not the lowest of the three units. The low rate of growth in Unit Two is at least partially attributable to a dryer site. The unit is flanked on either side by dryer mountain shrub-lands. A steep, drainage splits the mountain shrub-land and on the northern facing side of this drainage, cooler temperatures likely allow for additional soil moisture. It is here where the Douglas-firs that make up Unit Two grow.

Unit Two grows on a northern aspect within a drainage. Unit Eight can be seen in front and on the ridge behind the unit. Unit Three can be seen to the right of West Peak.



Unit Four; from the west side of Devil's Canyon, looking eastward toward the hay meadows.

Unit Three: Very high stand density and moderate to high accumulation of dead and down woody debris. There is virtually no live ground cover at this photo point. (Photo has been enlarged and computer enhanced to compensate for low light).

Surface vegetation is still sparse under tree crowns with less closure.

Signs of mountain pine beetle activity were noted among the small ponderosa pine population. Some pines have been killed and others unsuccessfully attacked. No currently infested pines were detected. Western Spruce Budworm, a defoliating insect common is stands of Douglas-fir and White fir was fortunately not detected. Active populations in Custer County are being monitored and treated. Should budworm become active in southwestern Pueblo County, The western forest stands in Pueblo Mountain Park would be at risk.

Dwarf mistletoe can found in all three units wherever ponderosa pines are found. The overall level of infection is low. A similar looking infliction is found on both Douglas-fir and white fir trees in these three units. Fir broom rust is present at very low levels and is very spotty in distribution. The rust fungi cause growth deformations in infected branches, which gives the branch a dense broom like appearance, similar to the deformations caused by dwarf mistletoe. Unlike dwarf mistletoe, which can literally plant itself on a host tree, the spores of rust fungi depend on an opening in the trees defenses (such as an open wound) to become established. Rust fungi are generally ignored and seldom do they have serious adverse impacts on the health of a tree. Their main impact is cosmetic in the form of deformed branches or "witches brooms."

Fir broom rust in a white fir tree. Witches broom is in center of photo.

Seedlings and saplings consist predominantly of Douglas-fir. White fir and rocky mountain juniper were also counted in a few sample plots. A few ponderosa pine seedlings are present and were noted but none appeared within the sample plots. Regenerating trees in Unit Two average about 200 per acre. Higher average numbers were found in Units Three and Four. Each unit averaged 500 seedlings and saplings per acre. Many of the saplings in these units (particularly three and four) appear suppressed by the dense parent overstory. The branches of younger conifers typically extend all the way down to the ground. As they mature, some species including Douglas-fir self prune and loose lower limbs. Many of the saplings in these units have already shed lower limbs and have small, thin crowns; an indicator of suppressed growth.

Surface vegetation in within these three units is sparse due to shading from the dense tree cover above. Many sample plots had only a few scattered blades of grass and nothing else. Small openings in the tree canopy allow isolated patches of grass, forbs and shrubs to become established. Ground cover occasionally became more abundant within isolated areas where the tree crown canopy was more open. Shrubs include oak, mountain mahogany, chokecherry and current. Rocky mountain maple and alder shrubs were also found towards the bottom of Devil's Canyon. Kinnikinnik, Oregon grape, pussy toes and a variety of grasses were also noted.

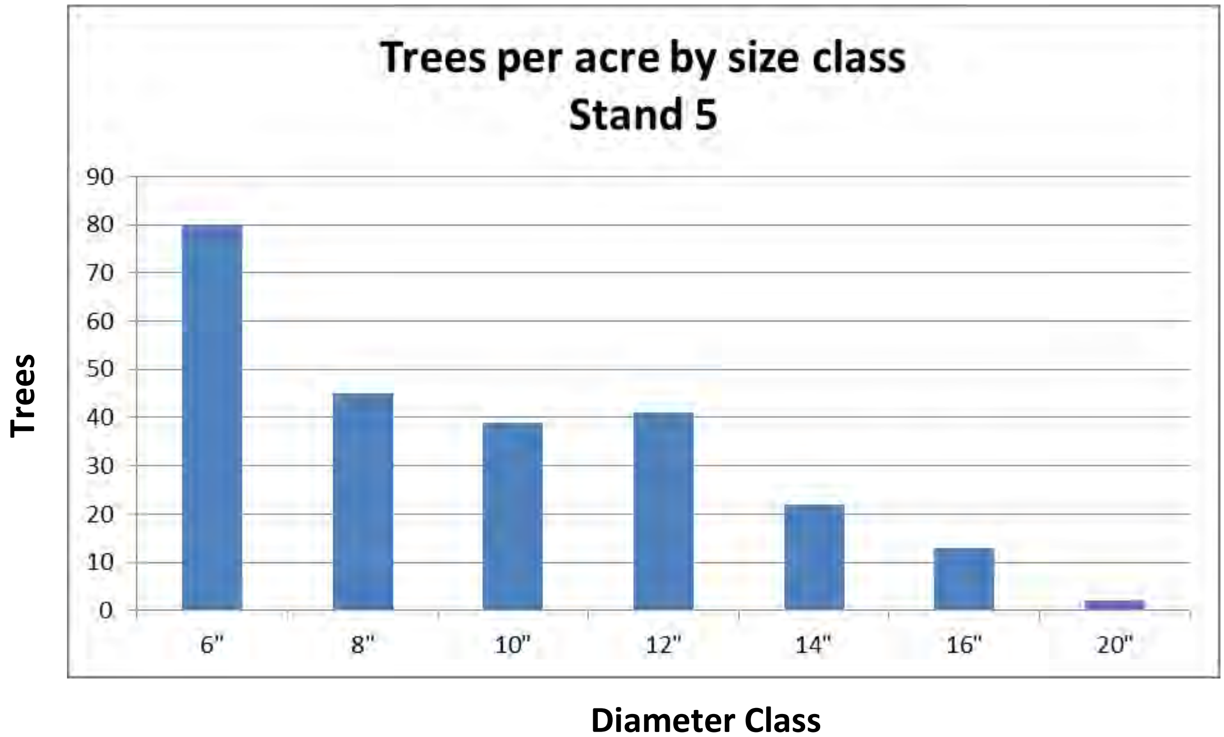
Pussy toes, a low growing perennial, is fairly common in the Douglas fir dominated stands of the park. They reportedly seldom if ever produce blooms in these stands due to low light conditions

Unit Five

Unit Five is generally located in the northwest corner of the park but includes a narrow strip of trees that extends east along the northern boundary. This unit of about 80 acres is irregular in shape and has several fingers and pockets that mingle with the mountain shrubs of Unit Six. Unit Five is a mixed conifer stand consisting primarily of ponderosa pine and Douglas-fir. White fir, piñion pine and juniper (sp.) are also found in the unit. There are slightly more ponderosa pines than fir. The lower portions of Unit Five near the large meadow are dominated by ponderosa pine and firs are present only in small numbers. Douglas-fir becomes more prevalent in the higher portions of the unit, sometimes forming small pure groups.

The trees average nearly ten inches in diameter and about 45 feet in height. There is a good distribution of trees by size class as shown by the graph on the following page. There are about 240 trees per acre covering about 130 square feet of basal area. This stand is just reaching maturity with an average age of 117 years.

Tree diameter growth over the past ten years averaged just 0.6 inches. The slower rate of growth is reflective of the higher stocking level.



Mountain pine beetles have been active within Unit Five as indicated by trees killed by MPB or attacked but not successfully infested. No currently infested trees were found in the unit. Dwarf mistletoe is also present in the pines but the overall level of infection is low. Broom rust was observed in both Douglas-fir and White fir at several sample plots.

Regenerating trees are numerous but not evenly distributed throughout the unit. No young trees were recorded at some locations while dense thickets were found at others. Throughout the entire unit, the number of regenerating trees per acre averaged about 600. Ponderosa pine is the species most frequently found, (appearing in 6 of the 13 sample plots) followed by white fir and Douglas-fir. Rocky Mountain juniper was also found at two sample plots. Although pine was found most frequently, white fir was present in the greatest numbers. Pine and Douglas-fir were found in roughly equal numbers.

The dense tree cover in Unit Five provides ample shade, favoring the establishment of fir. White fir is particularly tolerant of shaded conditions, and in fact, can be difficult to establish in bright, open areas. Douglas-fir is intermediate with regard to shade tolerance while ponderosa pine is intolerant, favoring sites with full sunlight.

Heavy shading by the tree canopy is also reflected in the relatively sparse surface vegetation. Oak brush and grasses are the dominant ground cover in localized areas where small openings or reduced tree density allow for more light penetration. Ground cover, particularly brush, is abundant in these areas.

Unit Five: Sparse ground cover except for young trees. One young pine in the foreground and numerous fir seedling in background.

Unit Five: Photo taken near edge of unit bordering Unit Six. Oak brush can be seen in background. Trees at right and center, foreground have been killed by MPB.

Units Six, Seven and Eight

Units Six, Seven and Eight are mountain shrub-lands. These units tend to dominate ridge tops, east and southeast facing slopes of the higher (western) portion of the park. Oak brush is the dominant shrub found within these units but mountain mahogany, big sagebrush, bitterbrush and several species of cactus are also common. Brush and ground cover can be very dense and difficult to walk through. In other places it is more open grown with patches of exposed rock and soil.

These units are very irregular in shape with numerous fingers and pockets mingling with the forested units. Clear, distinct boundaries between these units and the forested units are often lacking. Generally there is a transition zone between the shrub-lands and adjacent forestlands. Also within the shrub-land units there are small, semi-isolated stands of trees. Tree species found within these units include ponderosa pine, pinyon pine, rocky mountain juniper, one-seed juniper and Douglas fir.

There are relatively few southerly aspects within these units where warmer and dryer conditions are more typical. Dry conditions limit the establishment and survival of trees and favor the proliferation of grasses, plants and shrubs better suited to dry conditions. Fire or other periodic disturbance helps maintain the shrub cover type. Most slopes within these units face eastward and are not exposed to direct sunlight during the hottest part of the day. The lack of tree cover is most likely due to unsuitable soils rather than available moisture.

Over time and in the absence of disturbance, these shrub-land units may slowly yield to natural succession and the increased establishment of trees. The process appears to have already begun. Ponderosa and pinyon pines have made advances into the shrub-lands. The two juniper species and Douglas fir are also readily found within these units.

Ponderosa and pinyon pine encroachment into Unit Eight.

Juniper and pinyon pine encroachment into shrub-lands.

Most of the trees within these units are young seedlings, saplings or pole sized trees. These are generally scattered throughout the units but are also found in small groups. Unit Six contains about 200 seedlings and saplings per acre on average. Fir species accounted for about half of the trees sampled followed by ponderosa pine, pinyon pine and juniper. Only Douglas-fir and ponderosa pine seedlings were found in Unit Seven. They number about 40 and 20 trees per acre respectively. Unit Seven also contained a relatively high number of mature trees with respect to the total area of the unit. Unit Eight has the highest average number of seedlings and saplings per acre. There are about 170 ponderosa and pinyon pines per acre and about 130 Douglas-fir and white fir per acre. Fairly dense groupings of ponderosa pine saplings accounted for the higher average number of trees per acre. These denser groupings are typically found in closer proximity to the mature trees of the forested units where there is a more abundant seed source. Dwarf mistletoe infections in the young ponderosas are also more prevalent in the denser groupings, where they are nearer to infected, mature pines.

More mature trees are also present in all of these units. They are found primarily within transition zones with other forested units but are also found within isolated, interior pockets. Mountain pine beetle have killed many of the mature ponderosa pines. The beetles are another disturbance force that helps limit conifer invasion by killing existing trees and thereby reducing the available seed source for further invasion.

Left: Unit Eight looking eastward along the Mace Trail near the lookout point train junction.

Above: Unit Eight from Mace Trail looking south. Portions of Unit One are in foreground and Unit Two in far background.

Left: Unit Six, southerly exposures like this have sparse cover and more exposed rock and soil.

Unit Seven: Narrow strips of brush-lands are flanked by parts of Unit Three. Note mature tree cover in Unit Seven at photo center. Portion of Unit Seven to the left is barely visible beyond the tree tops of Unit Three.

Water, Riparian and Wetland Features

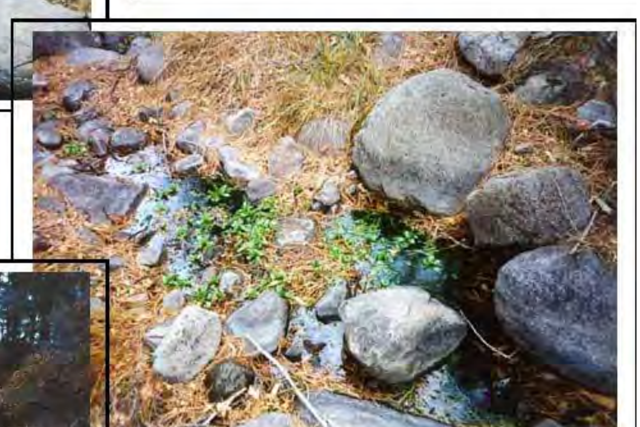
There are four creeks that flow through Pueblo Mountain Park. All the creeks are small in terms of flow volume and the flow of water is intermittent throughout the year. Two creeks (Squirrel Creek and Game Gulch) have only short sections within the Park boundaries. Squirrel Creek enters the park near the northwest corner of the park and quickly exits across the northern boundary. Game Gulch enters the park from the south and flows out of the Park near the Park's main entrance.

South Creek is perhaps the main water feature within the park. It also enters the Park from the south and flows through the recreationally developed, eastern portion of the Park before leaving. A small pond, built into and fed by this creek provides an additional riparian feature for recreation and wildlife.

Water in South Creek flows primarily in the spring and early summer months and the volume of water is low. There is little habitat value for fish on account of the interrupted flow of water. The creek provides water for non-aquatic species of wildlife for at least part of the year. Small animals, aquatic insects, dragonflies and wasps can be sustained into the late summer and fall by water trapped in small pools after the water has stopped flowing.

Left: Dry bed of South Creek. Rocks provide an indication of higher flows.

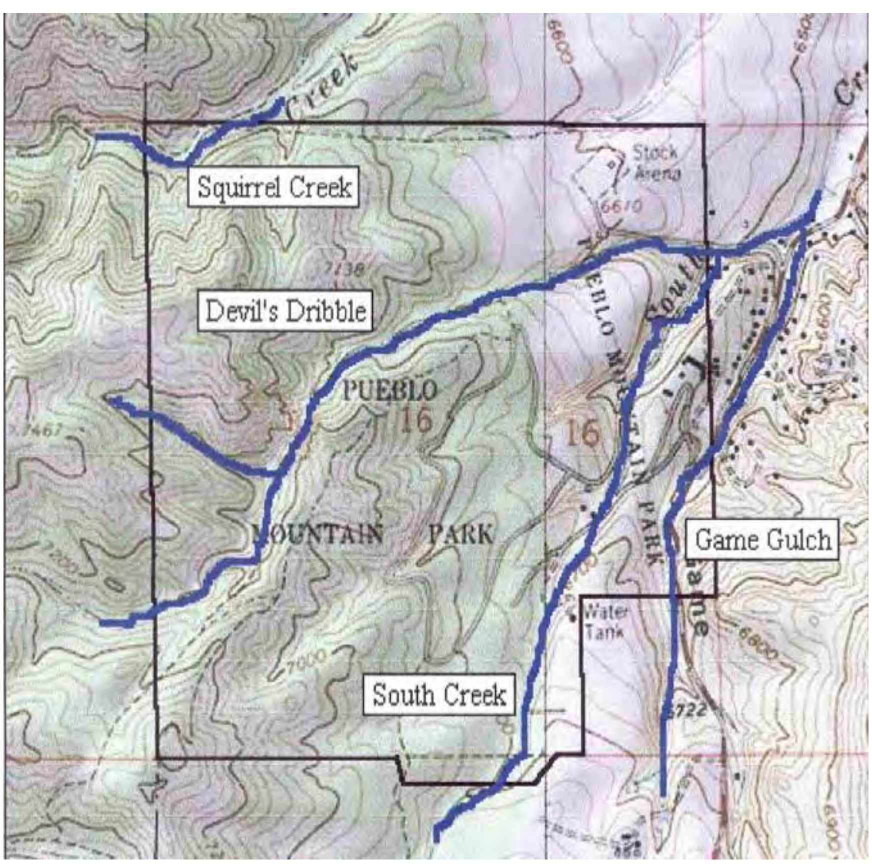
Below: Small pools of water remain in the creek after flow has been terminated. Note aquatic vegetation in the middle of the pools.



Left: Small pond in South Creek is drained annually. Note cattails at left of photo.

Devil's Dribble flows (dribbles) through the bottom of Devil's Canyon. The creek is fed primarily by two collecting drainages or draws on the west side of the canyon but other draws on both sides of the canyon also lead into the canyon bottom. The flow of water is very low in all but the wettest of years according to Dave Van Manon of the M.P.E.C. No flowing water was observed in the drainage during the inventory, however; the ground was wet within the creek bed. Where the canyon bottom is composed of solid rock, sub-surface flow is forced to the surface but quickly disappears into the ground where rock fractures or soil is found.

Water is forced to the surface in the canyon bottom where solid rock blocks sub-surface flow.



Pueblo Mountain Park Riparian Area Map

Fauna and Flora

The species of wildlife inhabiting or using the park as part of their habitat are too numerous to list. Abert's Squirrel, Black Bear, Mountain Lion, Turkey, and Mule Deer are among the primary species found in the area according to Ryan Swigman, District Wildlife Manager with the Colorado Division of Wildlife (DOW). There are no threatened or endangered wildlife species known to inhabit or use the park. While the park provides habitat to a wide variety of wildlife, none of the habitat is considered critical. Critical summer or winter range is identified throughout the state, for various species, as areas of particular importance to specific wildlife populations.

DOW Habitat Biologist, Kevin Kasmeric indicated that the high stand density or basal area found in most of the park's forest, limited it's habitat value. The dense tree cover provides good wildlife cover but also limits the amount of browse and forage available to eat. Elk forage was specifically identified as lacking in much of the park. Elk are common in the mountains and foothills of Colorado, primarily west of Interstate 25, but are uncommon in the park. Browse for deer is also limited in denser forest stands. Mr. Kasmeric recommended reducing the basal area of the forests in the park to make general improvements to the overall habitat.

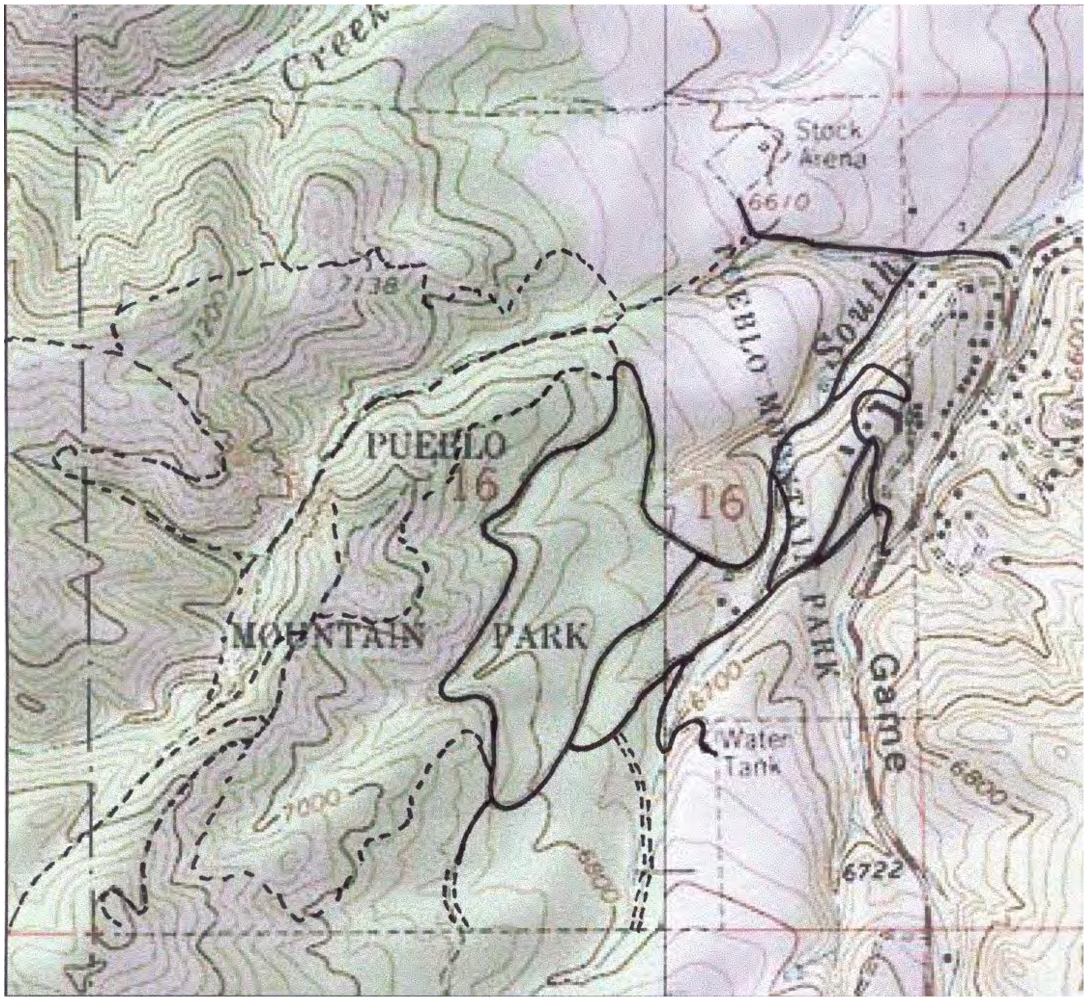
A cursory botanical survey of the park was conducted in the late fall of 2001 by Dr. Tass Kelso of the Colorado College Biology Department. A complete copy of Dr. Kelso's preliminary survey is shown in Appendix 3. The initial survey identified six primary plant communities and indicated that additional, yet to be identified, sub-communities likely exist.

From the preliminary survey Dr. Kelso was able to conclude that the park contains a wide variety of plant species and may contain a number of species and plant communities considered sensitive and of conservation concern by the Colorado Natural Heritage Foundation. A few species considered rare or uncommon in Colorado were identified in the preliminary survey. The preliminary survey did not reveal any threatened or endangered plant species protected by the Endangered Species Act.

Dr. Kelso's summary comments indicate that there is much more to be discovered and learned about the general biology of western Pueblo County including the park. The Natural Heritage Foundation is planning a more in depth survey of the park's biota; the results of that survey should be incorporated in the management of the park.

The presence and abundance of noxious weeds should also be further explored during the biotic survey. A small number of Musk thistles were found during the forest inventory in the southeast corner of the park. The site had burned in the recent past and the weeds most likely invaded the disturbed site. Non-native weed species are generally prolific and can replace native species. Control of noxious weeds is important to maintain native species diversity and protect wildlife habitat.

Roads and Trails



____ Main Roads = = = Secondary Roads ----- Trails

Access within the eastern half of the park is provided by a system of primary and secondary roads. The primary roads are well maintained and provide easy, vehicle access to park amenities and trail heads. The main entrance to the park is located near the eastern boundary, at about the mid point of section 16. There is a secondary entrance to the north, which passes through a residential area. Both access roads lead to Highway 78.

There are no roads in the western half of the park. A network of trails provides the only access to this area. All of the trails are generally narrow and allow for foot or horseback travel only. Steep grades and hairpin turns are common. Soil erosion, caused by poor drainage and/or heavy traffic, is occurring at some locations.

Park Amenities

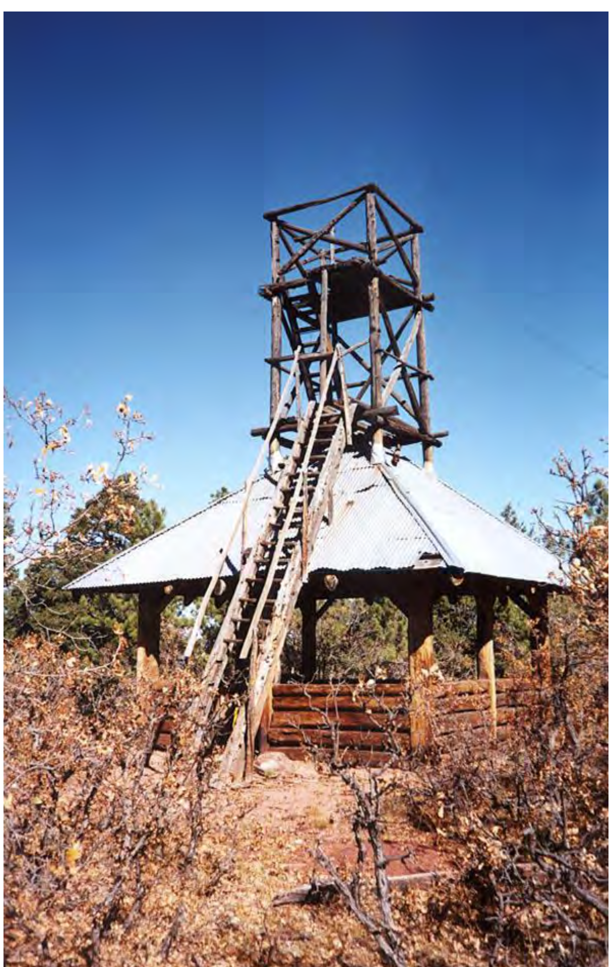
Most of the park’s amenities, buildings and other features are located in the eastern portion of the park where vehicle access is provided. The list of features includes: (From north to south)

Horse/stock arena.
Numerous archery ranges.
Horseshoe Lodge, small playground area and the pavilion.
Baseball diamond, scorers building, group picnic area and large playground.
Mountain Park Environmental Center, Park Headquarters and maintenance facilities.

Numerous picnic sites are also found throughout the park, near primary roads.

In the western portion of the park there are two features found along the trail system. An old lookout tower (commonly called the fire tower) stands atop West Peak (a.k.a. fire tower hill) and would provide a panoramic view of the entire park if repaired. Currently the stairs leading up to the platform are missing or are in disrepair and the platform itself has questionable structural integrity. A small pavilion is build directly under the tower and provides a shady resting place for hikers.

Lookout point consists of a steel rail built into the rock above Devils Canyon. The railing is situated on the edge of the canyon’s eastern rim and provides a safe viewing platform of the canyon below.



Left: The lookout tower and pavilion on top of West Peak.

Above: Lookout Point overlooks Devil’s Canyon.

Right: Playground behind horseshoe lodge. The lodge is the white building in the background.

Left: Historic Pavilion

Right: Baseball diamond. Stone and concrete bleachers are in the background. The stone and log scorers booth sits above the bleachers.

Below Left: Mountain Park Environmental Center.

Below Right: Park Headquarters and maintenance center

Wildfire Hazards and Risks

Wildfire is a natural component of forests. Fires along the front range of the Rocky Mountains occur frequently but have not been allowed to burn naturally since the region was settled. Left alone, most of these fires would have consumed down and dead woody debris, small trees and shrubs, but would have left much of the forest intact. Frequent, low intensity fires serve to thin and clean a forest, preventing the buildup of forest fuels. Fire suppression can and has lead to a gradual increase of forest fuels (all live and dead vegetation) available to burn. When fires escape control efforts, the unnaturally high fuel load can lead to conflagrations that consume or kill everything in the path of the fire. Homes, improvements and other values (aesthetics, recreational, wildlife) held by people are also at risk of being lost.

The forest structure of Unit One is conducive to the start and spread of wildfire. There is enough surface fuel on the forest floor (grass, forbs, pine needles) to carry a fire across the landscape. At some locations, there is ample ladder fuel (shrubs, oak brush, small trees) to carry a fire up into the crowns of the pine overstory. The crown layer of the pines is contiguous and dense enough for fire to spread through the tree tops, especially if wind is driving the flames. The heavier use of this unit by park visitors increases the likelihood of accidental ignitions in addition to natural starts caused by lightening.

Units Two, Three and Four have heavy fuel loadings in the form of trees and large woody debris but smaller surface fuels are less abundant. The relative sparseness of surface fuels reduces the chances of an ignition source resulting in a wildfire. It is analogous to lighting a campfire without the use of kindling. Lighting the fire would be difficult but given the right set of circumstances, (very dry wood on a hot, windy day) successful ignition is possible. A successful ignition in these units burning under the conditions mentioned above could be very destructive given the abundance and continuity of the fuel available.

Unit Five is similar in fuel loading and arrangement to Unit One except for surface fuels. Surface fuels are less abundant than in Unit One but more plentiful than in Units Two, Three and Four.

Unit Six has an abundance of small and medium size fuels (grass and mixed brush species) and some large fuels (trees) to fuel a hot fast burning fire. Brush species carry fire well due to the combination of both fine and medium sized fuels provided by leaves and woody stems. Where brush is dense fire would carry well through this unit, however; the vegetation (fuel) lacks continuity throughout the unit. Patches of bare ground or rock would limit both the rate of spread and the amount of heat produced. Ignition in an area with separated fuels is less likely to spread and the fire would likely burn itself out.

Brush is more abundant and continuous in Units Seven and Eight. Ignitions are more likely to carry through these units. Fire burning in these units would likely be very hot, fast spreading and resistant to suppression efforts.

Fuels are only one of three primary factors that affect the behavior of fire. Topography and weather also play key roles. Topographic factors are fixed and do not change. Weather factors are the most variable and cannot be planned for or influenced. The topography of Unit One will not contribute significantly to fire behavior. The steeper slopes found on the remaining units would have a significant effect on fire behavior. As slope increases, so does a fire's rate of spread. As heat from the flaming front rises upslope, it preheats and dries fuels above, making them easier to ignite.

The extensive road system in Unit One provides good access for responding fire fighters and pre-constructed control lines that would help contain a fire in that area. Close proximity to the Beulah fire department should reduce the response time by fire fighters and help contain fires while they are still small.

Response time to fires in Units Two through Eight could be very long depending on the proximity of the fire to the nearest road. Fires in these units have a greater chance to grow larger before any suppression effort can be made. The lack of vehicle access all but eliminates response with fire engines. Suppression efforts will have to be conducted with hand crews and/or aircraft. The trail system could be use by hand crews to help contain fires but the trails themselves will not contain a fire. Unless the trails and/or constructed control lines are supported by additional fire fighting tactics, fire will most likely spread across trails and hand dug control lines.

Water supply for fire fighting within the park is limited. When full, the pond in Unit One could be used as a draft source for fire engines. Small, portable pumps could be used to aid with filling tanks or charging hoses. According to officials at the Beulah Volunteer Fire Department, there are two, one-and-a-half to two inch taps located near the horseshoe lodge and pavilion. The exact size, thread type and flow rate of these taps are unknown. There are two fire hydrants located near the park. One is located across Highway 78, near the park entrance and another in on a private road behind the horseshoe lodge. These hydrants, supplied by six inch water mains, are part of the Pine Drive Water District. In most cases, water from these hydrants would have to be shuttled into the park with fire engines and/or water tenders (trucks with large tanks.) Maintaining a flow of water at a fire will be limited by factors such as the number of engines / tenders available and the round trip time between deliveries.

A large fire in Unit One (spreading through tree crowns) would place much of the park's infrastructure at risk. The heavy fuel loads around these structures are capable of generating intense heat that could easily ignite the buildings. While many structures are built primarily of stone, stucco or other non-flammable materials, all have combustible materials vulnerable to ignition sources other than direct flame impingement. Small gaps between logs in roof structures, open windows and accumulations of dead needles on rooftops and around buildings are only a few of the "Achilles heals". Burning embers blown into or in contact with structures are also a threat.

There is little infrastructure at risk in the higher units but infrastructure is not the only value at risk in Pueblo Mountain Park. A large fire *anywhere* in the park could have significant and long lasting impacts on aesthetic and recreational values. These values would not be lost or destroyed by fire, (the Yellowstone Park fires of 1988 didn't destroyed that park's values.) but they would be changed. There is consensus among the public and the Pueblo Parks and Recreation Department that the potential impacts or changes brought by wildfire are undesirable.

Overall there is a high wildfire hazard within the park. Dense and continuous fuels are present throughout most of the park. Steep slopes that exacerbate fire behavior and limit access are present in the western half of the park. Water supply for fire fighting purposes is limited, especially in the western half of the park. The values at risk are greater in the eastern half of the park, which is used more and contains most of the park's infrastructure, however; slopes, water supply and access are more favorable.

RECOMMENDATIONS:

Unit one

Defensible space thinning should be implemented around buildings and amenities in Unit One. General thinning, sanitation and improvement cutting should be implemented throughout the unit.

A defensible space is an area around a structure where fuel loads and arrangement have been modified to limit wildfire intensity (BTU output) and rate of spread. The space also provides fire fighters a safe working area to defend a structure in the event of a wildfire. Creating a defensible space does not eliminate the possibility of fire burning within it. Defensible space still contains fuel, (grasses, flowering plants, shrubs and trees) but the modified arrangement and reduced fuel loading lowers the fires destructive potential and resistance to control efforts.

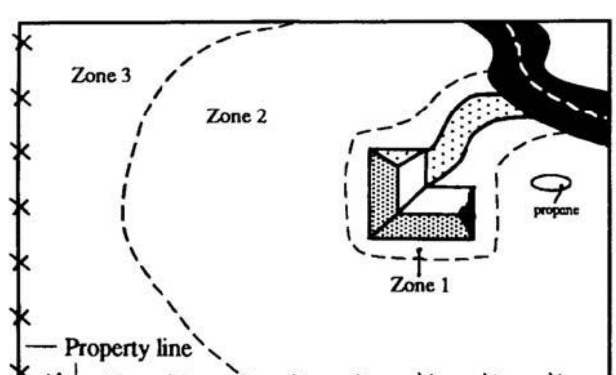
The buildings and infrastructure that should be prioritized for defensible space are:

- Water storage tank building at the southeast corner of the park.
- Park headquarters and maintenance facilities, including the MPEC building.
- Historic Pavilion.
- Horseshoe Lodge
- Ball park area, including the large picnic area and playground.

The trees adjacent to the road leading to the water storage building should be thinned to the same standards as those used for defensible space. The narrow access road to the building must be protected as well, to assure fire fighters access to the building.

A defensible space is broken down into three zones with different standards of fuel modification applied to each zone. From the outer zone (zone 3) to the inner zone (zone 1) the level or amount of fuel modification should increase so that less fuel and wider spacing between fuels is left closer to the structure.

The recommended standards for zones 1 and 2 are discussed below. Zone 3 is an area of regular forest management which will be discussed later.



Zone 1 extends 15 feet from the drip line or edge of the structure, deck or other attached projection. Preferably, the area within 3-5 feet of the structure is kept free of vegetation or flammable material. Decorative rock makes an attractive ground cover and will stop a creeping fire from reaching the foundation. Widely spaced foundation plantings are acceptable if the structure has noncombustible siding such as masonry or stucco. Foundation plantings should not be placed directly below windows or other openings and should be isolated from other fuels such as grass, with gravel mulch or stone / masonry borders.

The remainder of zone 1 may be landscaped with low growing vegetation such as grass, flowerbeds and a few small, widely spaced shrubs. Trees are not recommended within this zone. In addition to increasing fire hazards, trees too close to structures leads to other problems. Painting or other maintenance is complicated; branches rubbing on the structure could be damaged or damage the structure. If a tree is maintained within this zone it should be at the outer edge. The lower third of the limbs should be pruned up to a height of 10 feet if the tree is tall enough. The tree should also be considered part of the structure and zone 1 should extend around it.

Zone 2 is a larger area of fuel modification that transitions the denser surrounding forest (zone 3) to the relatively sparse zone 1. The size and shape of this zone is dependent on slope. The combined distance of zones 1 and 2 from the edge of the structure should not be less than 70 feet. The chart at right shows how the total distance of these zones should increase with increased slope. The example given shows that the distance above and to the sides of a structure situated on a 20% slope should be 90 feet. The zone should extend 105 feet below the structure. The size of this zone can be increased beyond the recommended minimum distance if desired.

Zone 2 is the most important of the three zones and is where most fuel modifications are made. Trees within this zone must be thinned to a wide spacing. The average space between tree crowns should be 10 feet. The spacing between tree trunks will be greater and will vary in distance.

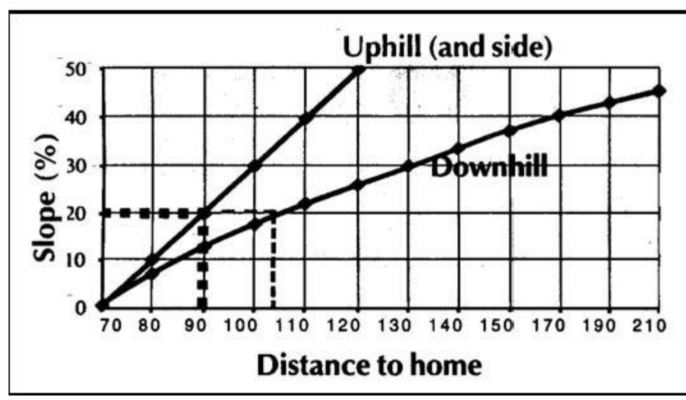
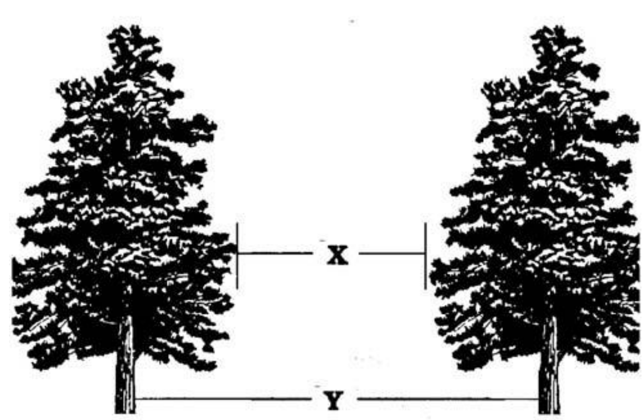


Figure at right shows spacing between tree crowns, “X” compared to spacing between tree trunks, “Y”. Tree spacing should be measured from the outer edge of tree crowns and not the tree trunks.



Because this zone is also a transitional area between zones 1 and 3, the spacing between trees should be greater at the interior, near the border with zone 1 and gradually decrease as it approaches zone 3. The gradual increase in forest density will make the defensible space more aesthetically pleasing and blend it into the surrounding forest.

To help prevent fire from spreading upwards into the crowns of trees, ladder fuel such as lower limbs or brush should be removed near trees to be maintained. Lower limbs should be pruned to a height of 10 feet. Brush or small trees growing under or near mature trees can carry a fire burning in grass into the crowns of mature trees. Removing them removes this rung of the fuel ladder and helps limit the fire to surface fuels. Small trees and shrubs may remain in the landscape as long as they are separated from other vegetation. If groupings of shrubs are desired, the total width of the group (as measured by the collective crown) should be no wider than the average width of mature trees. The same spacing guideline applied to tree crowns should be applied to groups of shrubs.

Surface fuels should also be reduced by removing, wood debris over one inch in diameter. Grass should be mowed or cut with a weed trimmer to a height of eight inches or less. Keeping grass short is especially important in the late summer and fall when it is cured and dry.

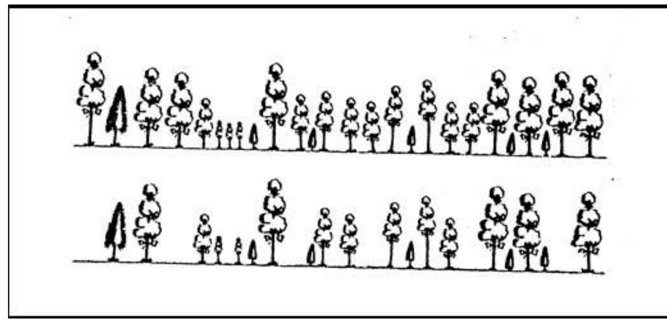
Firewood (if used) is typically stored within zone 2. Firewood should never be stored under decks, on porches or anywhere within zone 1. Stacks of firewood should be kept at least 30 feet away from structures, preferably on the uphill side of the house. Should the stack of wood start to burn the high heat output will mostly rise up and away from the structure. Stack firewood in open areas, away from trees or other vegetation. Propane tanks should also be isolated from surrounding vegetation. A concrete or gravel pad under and immediately around the tank is recommended. Do not screen propane tanks with trees, shrubs or other combustible material. An artistic paint job on the propane tank will help blend it in with the surrounding landscape.

The last zone of a defensible space (zone 3) should extend to the boundary of a given property. In this zone traditional forest management practices are recommended to meet multiple objectives. A reduced wildfire hazard is usually achieved in managed forests, regardless if it was an objective or not.

The forest stand in Unit One should be selectively cut and thinned to reduce wildfire hazards, safety hazards, damaging insects and disease. Thinning will improve the aesthetic value of the park by reducing the number of diseased, damaged, defective or suppressed trees and accentuating trees that are healthy and most attractive. Thinning will improve growing conditions for trees that remain be reducing the level of competition for water, soil nutrients, sunlight and growing space. Wildlife habitat could be improved by providing more light and room for the growth of ground cover species.

Various silvicultural practices or cutting methods are recommended to achieve the specified objectives. Selective harvesting is recommended to reduce the current stand density. Stocking levels will remain variable with some parts of the unit higher than others but an overall average basal area of 80 square feet per acre should be used as a guide. Thinning should include trees in all size and age classes and conversely trees maintained should be of various sizes and ages.

Figure at right illustrates selective harvesting or thinning using individual tree selection.



Group selection cuts should be interspersed with the overall thinning where dwarf mistletoe infections are rated 3 or higher on the Hawksworth scale. Group selection is a type of thinning where groups of trees are removed and other groups maintained, as opposed to individual tree selection. This practice is commonly used in forests that have a grouped or patchy structure but can also be used in forests with more

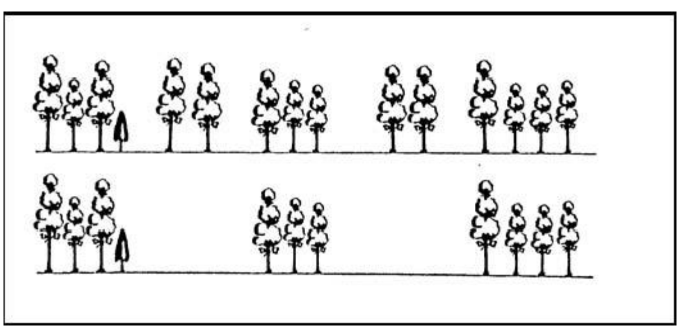


Figure at left illustrates selective harvesting or thinning using the group selection method.

Sanitation cutting is needed to remove pines infested with mountain pine beetle (MPB) and to remove dead, standing trees (snags) near picnic areas and roads. Currently infested pines should be cut and removed (or treated) prior to July 1, 2002 if possible. This will greatly reduce the number of adult MPB available to infest more pines next summer and fall. Trees already killed by MPB constitute a serious hazard. Not only in terms of wildfire but more immediately, as a safety hazard to park visitors. Most dead trees fall over or break within 10 years. Falling trees pose an obvious hazard to lives and property when they share space with people, and valued objects. Larger snags also make excellent habitat for cavity nesting birds. It is important to maintain some large snags (2-4 per acre) in the park, however; snags should not be maintained near picnic areas, roads or other locations frequented by people.

Sanitation cutting and removal or treatment of MPB infested trees will reduce future losses of pines to MPB in the short term. Immature beetles continue to live within cut trees and will eventually emerge from the trees unless further treatment is applied to the infested logs. Untreated logs or wood can be moved to areas where host species (ponderosa, lodgepole and limber pines) are not found and the beetles can be allowed to emerge. So called "safe sites" should be a mile or more away from host trees.

The most common methods of treatment include peeling the bark, chipping or milling. Chemical treatment of infested wood is no longer feasible. The only chemical pesticide labeled for treating MPB infested logs or wood (Lindane) is no longer produced in the United States and existing supplies have become scarce. Exposing infested logs to direct, unfiltered (by trees or tall brush) sunlight has also been shown to kill developing MPB larva and pupa. The exacting procedures required to make solar treatment successful has led to mixed results in many applications. This method should still be considered if other, less demanding, alternatives are unfeasible.

Chipping infested trees or removing them to a safe site would likely be the most expedient and applicable methods to use in Pueblo Mountain Park. Peeling bark is labor intensive and solar treatments are demanding but either method could be used to treat trees that are inaccessible. Controls should be placed on contractors or other parties removing MPB infested wood to assure proper treatment or storage at a suitable site and prevent spreading MPB. Once beetles have emerged from the wood or the wood has been treated, it is safe to use in areas with host species.

Treating or removing infested trees does not deter other beetles from flying into the area and infesting more trees. Creating and maintaining forest conditions less favorable to MPB is the only long-term control strategy. MPB are most successful (most damaging) in dense stands of mature pines. The table below shows the relative risk of MPB damage based on three primary stand factors that have a demonstrated correlation to MPB outbreaks.

Risk	Average Age	Average DBH	Average Basal Area
Low	< 60 years	< 7 inches	< 80 sq. ft. / acre
Moderate	60 to 80 years	7 to 8 inches	80 to 120 sq. ft. / acre
High	> 80 years	> 8inches	> 120 sq. ft. / acre

Elevation and latitude also have a demonstrated correlation to MPB outbreaks. These factors cannot be changed and in the case of Pueblo Mountain Park both fall into the "high" risk category. Unit One is also in the "high" risk category for each of the factors listed in the table.

Reducing the stand density in Unit One will lower the overall risk of MPB outbreaks. The Average diameter and age of the trees will not be lowered appreciably by thinning (and maintaining) trees from all age classes. The risk rating for these two categories will remain high. The reduction of stand density will improve growing conditions for the remaining trees and should increase their vigor and growth rate. Healthy, vigorous trees are more difficult for MPB to successfully infest. Vigorous trees typically produced more pitch or sap when attacked by beetles and frequently expel or "pitch-out" the attacking insects.

Maintaining a lower stand density will allow more light to reach the forest floor, (particularly in the small, group selection cuts) which favors the growth of ponderosa pine seedlings and saplings. Increasing the mix of younger and smaller trees will eventually lead to a reduction of average age and diameter. Because small, young trees are rarely attacked by MPB, increasing their numbers and mix within the stand will serve to maintain tree cover in the certain eventuality of future MPB epidemics.

Future MPB epidemics are inevitable and pine trees will be infested and killed in the park for as long as there are large pine trees. This fact should be understood and accepted. The objective of reducing MPB impacts is feasible and prudent. An objective to totally eliminate MPB is neither.

As discussed earlier, lowering stand density and increasing spacing between trees lowers wildfire hazards by reducing and separating the fuel available. The greater the spacing between trees the less likely fire is to spread through tree crowns. When ladder fuels are separated from mature trees, the ability of fire to spread vertically is reduced. The most likely path for a fire to follow in these circumstances is along the forest floor, where it does the least damage (and can provide the most benefit) and is easiest to control.

Thinning trees to improve forest stand conditions can have the adverse effect of increasing short-term wildfire hazards. While tree trunks are typically removed from the forest, treetops and limbs (slash) are often cut into small pieces and scattered on the ground or put into small piles. This creates a huge increase of surface level fuel, which is the primary carrier of fire.

Slashed that is lopped and scattered leaves a uniform layer of fuel on the surface that increases the wildfire hazard for several years. Once the dead pine needles drop off (after about 2 to 3 years) the increased hazard diminishes. The hazard is further reduced as twigs and small limbs break down and become incorporated in the organic layer of the soil. Allowing the slash to decompose helps build soil and maintain site quality. Removing all cut organic matter could have adverse long-term impacts on soil quality.

Piling slash breaks the uniformity of the increased fuel load and results in a smaller increase in the wildfire hazard <u>if the piles are created away from standing trees</u>. The concentrations of dry fuel will burn hotter than lopped and scattered slash, so it is important that they be isolated from other fuels. Piled slash does not decompose rapidly and can remain visible for decades unless chipped or burned under controlled conditions. Most of the benefits of nutrient recycling are lost when slash is piled. Chipping the slash and spreading the chips evenly throughout cutting areas is more expensive and time consuming than either piling or lopping and scattering, however; it is recommended as the primary means of slash disposal in the park. As chips, the additional fuel load does not significantly increase the wildfire hazard. Wood chips are less offensive aesthetically and decompose more rapidly allowing nutrients and organic material can be recycled in the soil. With the exception of zones 1 and 2 of defensible space areas, either of the other two slash treatments are viable alternatives and may be used when chipping is deemed infeasible.

The use of fire should be considered as a future management tool. The current stand conditions would make the use of prescribed fire difficult and somewhat risky. After fuels have been reduced and separated by thinning and slash has been treated or allowed to break down, fire could be reintroduced into the park. Access roads lend themselves to the application of prescribed fire as pre-constructed control lines. The gentler slopes will help to maintain control of fire and moderate its behavior. While it is premature to explore the use of fire in greater detail, (in light of the scope of work that needs to be accomplished beforehand) the possibility of using prescribed fire to maintain desired forest conditions should be recognized.

Units Two through Four

Thinning is recommended within units Two through Four to reduce the average basal area of those units to no more than 100 square feet per acre. Thinning should be focused on the overabundance of trees in the smaller size classes but trees in any size classes may be cut depending on their condition and quality. The residual stand should maintain trees in all size classes. Trees with larger crowns, good form and free of rust fungi should be targeted for retention.

Reducing the basal area in these units will improve growing conditions for the residual stand and should increase the average growth rate. Opening these forest stands will better allow for the growth of surface vegetation, which would improve the habitat value for wildlife. Currently there is virtually no food available for wildlife in these units.

Thinning would also reduce the long-term wildfire hazards in these units but as discussed earlier, would increase hazards in the short-term. Unlike Unit One, chipping is not feasible in these three units due to poor access and steep slopes. Lopping and scattering or piling slash are the only practical alternatives.

Unit Five

Thinning and selective harvesting are recommended in Unit Five to reduce the stand density to Basal area 80 or 100. Where ponderosa pine is dominant the basal area should be reduced to about 80 square feet per acre. Individual tree and group selection cutting should both be utilized to reduce the stand density and remove small groups of trees with higher mistletoe infection ratings or groups of trees killed by MPB.

Where Douglas fir trees dominate, a general thinning should be applied to reduce the stand density to at least basal area 100. As in Units Two through Four most of the trees cut should be in the smaller diameter classes.

Thinning Unit 5 will produce similar benefits as discussed earlier that are consistent with the stated objectives. It will also create short-term impacts, particularly increased wildfire hazards as has also been discussed. Slash disposal options will be limited by poor access and steep terrain.

Units Six, Seven and Eight

No silvicultural treatments are recommended for these units at this time, however; a defensible space is recommended around the observation tower on top of West Peak which is located between Units Three and Eight. This tower and hikers pavilion would be at serious risk in the event of fire. It is located atop West Peak and surrounded by heavy, dense fuels. Any fire in the vicinity could spread rapidly, uphill toward the tower. Given the added exposure of downhill slopes on all sides, the size of the defensible space should be larger than usual. There are no uphill or side slopes, which require shorter defensible space distances. All sides of the defensible space should extend to the calculated downhill distance of approximately 150 feet.

Trail Restoration

Trail restoration and drainage work is recommended on the lower portions of Mace trail and Tower trail. Mace trail in particular has been severely eroded from the trailhead up, about ¼ mile. Log or stone waterbars constructed across steeper sections of trails would channel water off the trail and reduce erosion. Waterbars should extend all the way across the trail at an angle of about 20 degrees from perpendicular. The outflow of water should be well clear of the trail to prevent it from draining back onto the trail.

Wood chips from forest management projects could be placed on the trails to reduce further soil compaction and damage to tree roots. The chips would slow the flow of any water on the trail and thus reduce erosion.

IMPLEMENTATION:

Implementation of this plan will take many years. As time progresses, adjustments and updates of this plan will be necessary. Work plans should be developed and implemented annually by City Parks and Recreation staff. Annual work plans should set specific tasks to be completed each year. The tasks should be consistent with the objectives of this plan. Annual accomplishments should be measurable and evaluated upon completion. Units of measurement may vary depending on the task(s) to be completed. Possible units of measurements include:

Number of MPB infested trees treated.
Number of picnic areas improved by removal of hazard trees.
Number of defensible space areas created.
Number of acres thinned to recommended stocking level.
Number of acres of slash treated.

Tasks should be prioritized and implemented as time, staffing and funding allows but some accomplishment should be made annually. Park's staff will ultimately determine the prioritization of tasks. Suggested priorities are listed below in order of importance.

Treat trees currently infested with MPB by July 1, 2002.
Remove standing dead trees, which pose a safety hazard to the public.
Create defensible space areas around infrastructure.
Begin implementing forest management in Unit One.

Because of poor access to Units Two through Five, management activities in these units should be given lower priority. Activity in these units may be deferred indefinitely.

Annual achievement of tasks will require further planning, hard work and financing. The City of Pueblo will need to commit human and financial resources toward the achievement of annual goals. Additional seasonal staff members assigned to Pueblo Mountain Park would assure progress toward the achievement of goals. Adjusting the work plans of existing Park's staff to include priorities at the mountain park would also lead to steady accomplishments.

Other tools and resources are available to help implement annual work plans. Private contractors may be used to implement tasks of larger scope such as the creation of defensible space or placing acreage under management. They have the skills, experience and equipment needed to do the work quickly and efficiently. The commodity value of the trees thinned should also be utilized to the extent possible to help finance work projects. The value of the wood is low and the timber market is currently depressed but opportunities to sell wood products should be constantly explored. Even if wood is sold at a low price, traded in exchange for other services or given away, costs would be reduced by not having to dispose of or chip useable wood.

The general public and volunteers could make significant contributions to the completion of tasks smaller in scope. Public firewood sales would aid in the removal of standing dead trees, which pose safety hazards as well as provide financial support. Standing trees should be cut and limbed by park staff or contractors to avoid accidents or injuries caused by unskilled persons felling large trees. The public should be allowed to cut the downed trees into firewood and haul it away.

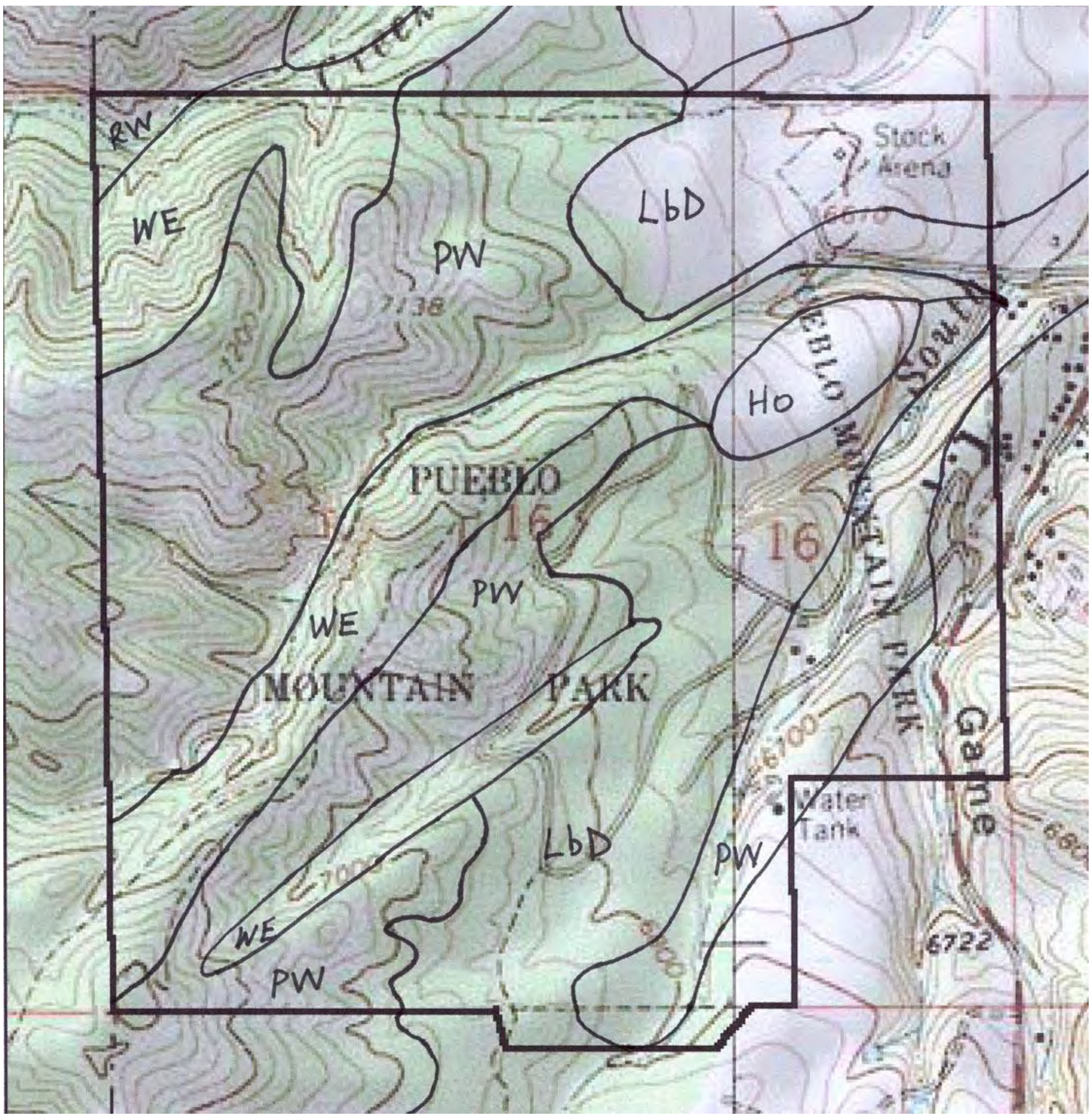
Volunteer groups such as local Boy Scout troops, Volunteers for Outdoor Colorado or other local groups could make significant contributions to the management of the park. The Mountain Park Environmental Center, through its educational programs could make small but significant contributions as well. Educational programs could be designed to include “hands on” activities, which both teach environmental concepts and accomplish results on the ground.

Small thickets of ponderosa pine regeneration need to be thinned as well as larger trees. The saplings can easily be thinned with a small bow saw and carried by a child. The concepts outlined in this plan could be shared with others who are interested in and care about the park. Allowing students and/or volunteers to do this and other light tasks would provide learning opportunities and a sense of empowerment.

Funding and services provided by the City of Pueblo, MPEC and other volunteer groups could be augmented with grants or cost share programs. The National Fire Plan (NFP) provides grants to help fund wildfire hazard reduction projects. Projects funded in the recent past included defensible space creation, fuels reduction projects, educational programs, and programs designed to help organize and increase the preparedness level of local communities and first responders. Great Outdoors Colorado (GOCO) is another possible funding source for park projects.

The National Fire Plan is a relatively new program; 2002 is the second year that funding has been provided for local on-the-ground projects. Hopefully congressional funding for this program will continue into the foreseeable future. Grant proposals have been solicited between October and early December for projects to be implemented the following calendar year. Successful applicants are typically notified to proceed with projects by February and have until the end of the federal fiscal year (September 30) to complete the work. While it is too late to apply for a grant for implementation in 2002, park managers should begin developing work plans for 2003 as well as 2002 and plan on applying for a NFP grant in October of 2002. NFP grants are administered by the Colorado State Forest Service. Additional information about these grants may be obtained from the CSFS Canon City District Office, at the telephone number shown on the cover of this plan.

Appendix 1 – Soil Map and Descriptions
From NRCS Soil Survey of Pueblo Area, Colorado; June 1979
Map reproduced by CSFS 2002



PW – Pinata–Wetmore association. This association is in the foothills and mountains in the western part of the survey area. It is made up of about 40 percent Pinata very stony loam and 35 percent Wetmore stony sandy loam. The areas are irregularly shaped and cover as much as 1,500 acres. The Pinata soil is at the base of sandstone scarps and on hogbacks. The Wetmore soil is on mountainsides over granite.

The Pinata soil in this association has the profile described as representative of the Pinata series, but in places the subsoil extends to a depth of 60 inches. The slope is 25 to 40 percent. The Wetmore soil has a profile similar to the one described as representative of the Wetmore series, but the subsoil is sandy clay loam. Also, it is on southern exposures, is drier, and has a different plant cover. The slope is 30 to 60 percent.

Included with these soils in mapping are areas of stony fine-loamy soils that are moderately deep over granite bedrock. These soils make up about 10 percent of the acreage. Also included are areas of soils that are similar to Nederland soils but have an average annual soil temperature of about 45 degrees F. These soils make up about 5 percent of the acreage. Other areas included are Larkson soils that make up about 10 percent.

Runoff is medium, and the hazard of erosion is slight. This soil has potential for recreation use and for wildlife habitat if it is well managed. The native vegetation is mainly ponderosa pine, Gambel oak, mountain mahogany, and bluegrass. Capability unit VIIs-4, non-irrigated; Pinata soil in woodland suitability group 6x2; Wetmore soil in woodland suitability group 6x1; not in a range site.

WE – Wetmore-Mortenson association. This association is in the western part of the survey area on mountainsides that generally face north. About 40 percent of this association is made up of Wetmore gravelly course sand loam, 30 percent is Mortenson very stony fine sandy loam, 20 percent is a soil that is similar to this Wetmore soil but has a 10 to 15 inch layer of weathered granite over the gard granite, and 10 percent consists of other soils. The slope is 25 to 70 percent. The Wetmore soil formed in material weathered from granite and schist, and the Mortenson soil formed in material weathered from sandstone, but small areas of each soil occur with the other and are underlain by either granite and schist or sandstone

The Wetmore soil has the profile described as representative of the Wetmore series, but in places it is finer textured. The Mortenson soil also has the profile described as representative of its series, but in places the subsurface layer is thinner.

Included with these soils in mapping are areas of a deep, grayish-brown loamy soil that has slopes of 10 to 25 percent. It is on footslopes at the base of mountainsides along the sides of areas, 100 to 300 feet wide, of a very dark brown, deep, loamy soil that occupies drainageways. The soil included in drainageways has slopes of 3 to 10 percent.

Runoff is medium, and the hazard of erosion is slight. If they are well managed, these soils have medium potential for wood products. The native vegetation is white fir, Douglas-fir, ponderosa pine, and an understory of shrubs and grasses. Capability unit VIIs-4, non-irrigated; woodland suitability group 5x1; range site not assigned.

LbD – Larkson loam, 6 to 12 percent slopes. This soil is on loess-thickened, east facing dip slopes of sandstone upland plains in the western part of the survey area. The areas are irregular in shape and cover as much as 700 acres. This soil has a profile similar to the one described as representative of the series, but there are no stones in the surface layer and no cobbles and gravel in the substratum. Also, in places, the surface layer is as much as 7 inches thick, especially in spaces between trees where the grass is more dense.

Included with this soil in mapping are areas of Vamer soils and Rock outcrop that make up about 10 percent of the acreage and areas of Holderness silt loam that make up about 5 percent.

Runoff is medium, and the hazard of erosion is moderate. This soil has high potential for timber, recreation and wildlife habitat. The native vegetation is ponderosa pine. Capability unit IVe-3, non-irrigated; woodland group 5r1; range site not assigned.

Ho – Holderness silt loam, 3 to 9 percent slopes. This soil is on foothills in the western part of the survey area. The slop is mostly more that 5 percent. The areas are irregular in shape and cover as much as 600 acres. This soil has the profile described as representative of the series, but in small swales the surface layer is somewhat thicker.

Included with this soil in mapping are areas of Nunn soils at lower elevations and on exposures that have a higher average annual soil temperature. These areas make up about 10 percent of the acreage. Also included are areas of Stroupe soils that make up about 5 percent of the acreage.

Runoff is moderate or rapid, and the hazard of erosion is high. Gully erosion is common. This soil is suited to pasture and grazing. The native grasses are mainly bluegrass and wheatgrass. Capability unit IVe-3, non-irrigated, Loamy Park range site.

Appendix 2 –Forest Inventory Data Summary

The tables on the following pages summarize the forest inventory data collected in each of the 5 management units. Readers may find the following definitions and guide useful in interpreting the data. Some of the data has been interpreted and presented in graph form in the main body of the plan. The graphs showing the number of trees by diameter class for each stand came from this data. All data is expressed on a PER ACRE basis and does not account for actual acreage of the stand.

Terms:
DBH – Diameter at Breast Height, (4.5 feet) is where tree diameters are measured.
STEMS – The number of trees.
CUVOL – Volume of wood measured in solid cubic feet.
SCRIB – Volume of wood measured in usable board feet (1 board foot = 1'x 1'x 1").
BA – Basal Area (square feet per acre occupied by tree trunks).
HT – Height
BAF – Basal Area Factor (relates to the type of prism used to conduct the inventory).

The tables show the number of trees, (STEMS) the cubic foot volume (CUVOL) and the board foot volume (SCRIB) broken down into two inch diameter classes and 10 foot height classes. The first line of data shows the number of trees in the six inch diameter class broken out by height classes. The total number of trees in the six inch diameter class, regardless of height, is shown in the far right column. The next two rows of data show the cubic foot volume and the board foot volume of trees in the six inch diameter class broken out by height classes and the total volumes for the diameter class shown in the far right column. This process is repeated for each diameter class present in the stand.

Some rows of data may show zero stems present but have positive values in the corresponding rows for volumes. The program used to generate these tables does not show fractions of trees per acre or 1 tree for every two or three acres, but it does account for the per acre volume of these trees.

At the bottom of the tables, below the "TOTAL" line, STEMS, CUVOL and SCRIB are totaled according to height classes regardless of tree diameter. The first column of numbers below the "TOTAL" line (three zeros) are only place holders where the diameter classes are usually shown. The figures in the far right column show the total STEMS, CUVOL and SCRIB for all trees.

Summarized data is shown below the table, including the statistical error calculated for the inventory. For planning purposes the statistical error should not exceed 20% within one standard deviation.

PROGRAM RMCRUZ5 15:11:51 11-05-2001
STAND: PMP STAND 1

PER ACRE STAND SUMMARY
ALL SPECIES

HEIGHT CLASS

DBH		20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	6	23	10	2	0	0	3	0	0	0	0	0	38
CUVOL	6	27	20	8	0	0	14	0	0	0	0	0	69
SCRIB	6	0	0	0	0	0	0	0	0	0	0	0	0
STEMS	8	7	6	7	3	2	0	0	0	0	0	0	24
CUVOL	8	15	22	30	21	11	0	0	0	0	0	0	98
SCRIB	8	53	52	53	45	21	0	0	0	0	0	0	223
STEMS	10	1	6	9	7	7	3	0	0	0	0	0	33
CUVOL	10	4	36	79	69	95	40	0	0	0	0	0	323
SCRIB	10	7	75	217	218	346	158	0	0	0	0	0	1021
STEMS	12	0	1	3	12	10	5	0	0	0	0	0	30
CUVOL	12	0	7	40	172	168	108	0	0	0	0	0	494
SCRIB	12	0	22	142	657	682	466	0	0	0	0	0	1967
STEMS	14	0	0	1	3	9	5	0	0	0	0	0	17
CUVOL	14	0	7	8	62	216	127	0	0	0	0	0	420
SCRIB	14	0	25	33	261	955	576	0	0	0	0	0	1850
STEMS	16	0	0	1	3	6	4	0	0	0	0	0	14
CUVOL	16	0	0	17	81	198	152	16	0	0	0	0	464
SCRIB	16	0	0	75	368	920	716	76	0	0	0	0	2154
STEMS	18	0	0	1	1	3	3	1	0	0	0	0	9
CUVOL	18	0	0	26	42	107	157	48	0	0	0	0	379
SCRIB	18	0	0	115	195	510	762	231	0	0	0	0	1812
STEMS	20	0	0	0	0	0	2	0	0	0	0	0	2
CUVOL	20	0	0	0	0	0	112	15	0	0	0	0	128
SCRIB	20	0	0	0	0	0	556	77	0	0	0	0	632
STEMS	22	0	0	0	0	0	1	0	0	0	0	0	2
CUVOL	22	0	0	0	0	25	70	31	0	0	0	0	127
SCRIB	22	0	0	0	0	123	352	156	0	0	0	0	631
STEMS	24	0	0	0	0	0	1	0	0	0	0	0	1
CUVOL	24	0	0	0	0	0	42	16	0	0	0	0	58
SCRIB	24	0	0	0	0	0	214	82	0	0	0	0	296
STEMS	26	0	0	0	0	0	0	0	0	0	0	0	0
CUVOL	26	0	0	0	0	25	14	0	0	0	0	0	40

SCRIB	26	0	0	0	0	129	73	0	0	0	0	0	203
STEMS	28	0	0	0	0	0	0	0	0	0	0	0	0
CUVOL	28	0	0	0	0	0	0	17	0	0	0	0	17
SCRIB	28	0	0	0	0	0	0	88	0	0	0	0	88

TOTAL---

STEMS	0	31	22	24	28	36	26	2	0	0	0	0	170
CUVOL	0	46	91	208	446	845	839	142	0	0	0	0	2618
SCRIB	0	61	174	634	1742	3685	3874	708	0	0	0	0	10878

STAND: PMP STAND 1

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
170	123	11.5	55	97

CRUISE SUMMARY

BAF USED= 20 POINTS SAMPLED= 39 AVG. # TREES/PT.= 6.1

LIMIT OF ERROR AT 1 STANDARD DEVIATION = 6 PERCENT

PROGRAM RMCRUZ5 15:25:47 11-05-2001

STAND: PMP STAND 2

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											
	DBH	20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	6	171	22	0	0	0	0	0	0	0	0	0	192
CUVOL	6	169	37	0	0	0	0	0	0	0	0	0	206
SCRIB	6	0	0	0	0	0	0	0	0	0	0	0	0
STEMS	8	0	95	0	0	0	0	0	0	0	0	0	95
CUVOL	8	0	310	0	0	0	0	0	0	0	0	0	310
SCRIB	8	0	403	0	0	0	0	0	0	0	0	0	403
STEMS	10	0	19	0	23	0	0	0	0	0	0	0	42
CUVOL	10	0	106	0	177	0	0	0	0	0	0	0	283
SCRIB	10	0	219	0	582	0	0	0	0	0	0	0	801
STEMS	12	6	12	13	0	0	0	0	0	0	0	0	32
CUVOL	12	48	111	155	0	0	0	0	0	0	0	0	314
SCRIB	12	155	388	583	0	0	0	0	0	0	0	0	1126
STEMS	14	0	5	0	5	0	0	0	0	0	0	0	10
CUVOL	14	0	59	0	105	0	0	0	0	0	0	0	164
SCRIB	14	0	220	0	442	0	0	0	0	0	0	0	662
STEMS	18	0	3	0	0	0	0	0	0	0	0	0	3
CUVOL	18	0	61	0	0	0	0	0	0	0	0	0	61
SCRIB	18	0	256	0	0	0	0	0	0	0	0	0	256
TOTAL---													
STEMS	0	177	157	13	27	0	0	0	0	0	0	0	374
CUVOL	0	217	686	155	281	0	0	0	0	0	0	0	1339
SCRIB	0	155	1485	583	1024	0	0	0	0	0	0	0	3248

STAND: PMP STAND 2

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
374	130	8.0	30	105

CRUISE SUMMARY

BAF USE= 20 POINTS SAMPLED= 4 AVG. # TREES/PT.= 6.5

LIMIT OF ERROR AT 1 STANDARD DEVIATION = 16 PERCENT

PROGRAM RMCRUZ5 15:27:27 11-05-2001

STAND: PMP STAND 3

PER ACRE STAND SUMMARY
ALL SPECIES

HEIGHT CLASS

	DBH	23	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	6	41	73	25	15	8	0	0	0	0	0	0	161
CUVOL	6	39	134	72	69	37	0	0	0	0	0	0	350
SCRIB	6	0	16	74	159	89	0	0	0	0	0	0	338
STEMS	8	6	33	96	19	0	0	0	0	0	0	0	155
CUVOL	8	14	117	496	138	0	0	0	0	0	0	0	765
SCRIB	8	0	170	1206	433	0	0	0	0	0	0	0	1809
STEMS	10	0	3	34	37	7	0	0	0	0	0	0	81
CUVOL	10	0	21	256	398	88	0	0	0	0	0	0	762
SCRIB	10	0	66	784	1462	333	0	0	0	0	0	0	2645
STEMS	12	0	0	7	17	14	0	0	0	0	0	0	38
CUVOL	12	0	0	92	264	259	0	0	0	0	0	0	615
SCRIB	12	0	0	352	1055	1068	0	0	0	0	0	0	2475
STEMS	14	0	0	4	4	4	3	0	0	0	0	0	14
CUVOL	14	0	0	63	79	94	105	0	0	0	0	0	340
SCRIB	14	0	0	257	333	404	463	0	0	0	0	0	1458
STEMS	16	0	0	0	3	1	1	0	0	0	0	0	5
CUVOL	16	0	0	0	81	45	53	0	0	0	0	0	179
SCRIB	16	0	0	0	362	203	245	0	0	0	0	0	809
STEMS	18	0	0	0	0	1	0	0	0	0	0	0	1
CUVOL	18	0	0	0	0	48	0	0	0	0	0	0	48
SCRIB	18	0	0	0	0	226	0	0	0	0	0	0	226
STEMS	20	0	1	0	0	1	1	0	0	0	0	0	2
CUVOL	20	0	26	0	0	43	53	0	0	0	0	0	122
SCRIB	20	0	117	0	0	206	259	0	0	0	0	0	582
STEMS	22	0	0	1	0	1	1	0	0	0	0	0	2
CUVOL	22	0	0	31	0	45	54	0	0	0	0	0	130
SCRIB	22	0	0	143	0	227	270	0	0	0	0	0	639
STEMS	30	0	0	0	0	0	0	0	0	0	0	0	0
CUVOL	30	0	0	0	0	0	0	53	0	0	0	0	53
SCRIB	30	0	0	0	0	0	0	310	0	0	0	0	310

TOTAL---

STEMS	0	47	110	167	95	36	6	0	0	0	0	0	461

CUVOL	0	53	298	1010	1029	658	264	53	0	0	0	0	3365
SCRIB	0	0	369	2817	3803	2755	1237	310	0	0	0	0	11291

STAND: PMP STAND 3

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
461	193	8.8	46	114

CRUISE SUMMARY

BAF USE= 20 POINTS SAMPLED= 11 AVG. # TREES/PT.= 9.6

LIMIT OF ERROR AT 1 STANDARD DEVIATION= 7 PERCENT

PROGRAM RMCRUZ5 16:03:46 11-05-2001
STAND: PMP STAND 4

PER ACRE STAND SUMMARY ALL SPECIES

		HEIGHT CLASS											
	DBH	20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	6	65	95	0	0	0	0	0	0	0	0	0	160
CUVOL	6	45	181	0	0	0	0	0	0	0	0	0	226
SCRIB	6	0	13	0	0	0	0	0	0	0	0	0	13
STEMS	8	53	36	66	0	0	0	0	0	0	0	0	155
CUVOL	8	110	143	263	0	0	0	0	0	0	0	0	516
SCRIB	8	121	271	506	0	0	0	0	0	0	0	0	899
STEMS	10	20	14	6	6	0	0	0	0	0	0	0	46
CUVOL	10	84	77	49	63	0	0	0	0	0	0	0	274
SCRIB	10	178	206	169	229	0	0	0	0	0	0	0	782
STEMS	12	0	0	9	9	0	0	0	0	0	0	0	17
CUVOL	12	0	0	112	144	0	0	0	0	0	0	0	256
SCRIB	12	0	0	434	584	0	0	0	0	0	0	0	1019
STEMS	14	0	0	3	0	0	0	0	0	0	0	0	3
CUVOL	14	0	0	54	0	0	0	0	0	0	0	0	54
SCRIB	14	0	0	223	0	0	0	0	0	0	0	0	223
STEMS	16	0	0	5	0	0	0	0	0	0	0	0	5
CUVOL	16	0	0	112	0	0	0	0	0	0	0	0	112
SCRIB	16	0	0	479	0	0	0	0	0	0	0	0	479
STEMS	18	0	0	0	2	0	0	0	0	0	0	0	2
CUVOL	18	0	0	0	77	0	0	0	0	0	0	0	77
SCRIB	18	0	0	0	355	0	0	0	0	0	0	0	355
STEMS	20	0	0	0	0	2	0	0	0	0	0	0	2
CUVOL	20	0	0	0	0	79	0	0	0	0	0	0	79
SCRIB	20	0	0	0	0	374	0	0	0	0	0	0	374
TOTAL													
STEMS	0	138	145	88	17	2	0	0	0	0	0	0	389
CUVOL	0	240	401	591	284	79	0	0	0	0	0	0	1595
SCRIB	0	299	490	1811	1168	374	0	0	0	0	0	0	4143

STAND: PMP STAND 4

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
389	133	7.9	34	127

CRUISE SUMMARY

BAF USED= 20 POINTS SAMPLED= 6 AVG. # TREES/PT.= 6.7

LIMIT OF ERROR AT 1 STANDARD DEVIATION= 13 PERCENT

PROGRAM RMCRUZ5 15:32:38 11-05-2001

STAND: PMP STAND 5

PER ACRE STAND SUMMARY ALL SPECIES

HEIGHT CLASS

	DBH	20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	6	65	15	0	0	0	0	0	0	0	0	0	80
CUVOL	6	53	31	0	0	0	0	0	0	0	0	0	83
SCRIB	6	0	0	0	0	0	0	0	0	0	0	0	0
STEMS	8	14	12	14	5	0	0	0	0	0	0	0	45
CUVOL	8	32	47	74	27	0	0	0	0	0	0	0	180
SCRIB	8	22	72	149	68	0	0	0	0	0	0	0	312
STEMS	10	12	11	3	8	5	0	0	0	0	0	0	39
CUVOL	10	53	65	25	87	67	0	0	0	0	0	0	297
SCRIB	10	112	157	74	306	251	0	0	0	0	0	0	900
STEMS	12	0	14	9	16	2	0	0	0	0	0	0	41
CUVOL	12	0	138	95	257	34	0	0	0	0	0	0	523
SCRIB	12	0	483	318	1026	132	0	0	0	0	0	0	1960
STEMS	14	1	0	3	4	9	4	0	0	0	0	0	22
CUVOL	14	15	0	50	95	228	126	0	0	0	0	0	514
SCRIB	14	54	0	204	405	987	570	0	0	0	0	0	2220
STEMS	16	1	2	5	1	1	2	0	0	0	0	0	13
CUVOL	16	12	39	100	33	42	87	0	0	0	0	0	313
SCRIB	16	45	154	421	144	188	414	0	0	0	0	0	1367
STEMS	20	0	0	0	0	1	0	1	0	0	0	0	1
CUVOL	20	0	0	0	0	40	0	50	0	0	0	0	90
SCRIB	20	0	0	0	0	190	0	253	0	0	0	0	443
STEMS	30	0	0	0	0	0	0	0	0	0	0	0	0
CUVOL	30	0	0	0	0	0	0	0	51	0	0	0	51
SCRIB	30	0	0	0	0	0	0	0	296	0	0	0	296
STEMS	34	0	0	0	0	0	0	0	0	0	0	0	0
CUVOL	34	0	0	0	0	0	0	46	0	0	0	0	46
SCRIB	34	0	0	0	0	0	0	275	0	0	0	0	275
TOTAL													
STEMS	0	94	55	33	35	18	7	1	0	0	0	0	242
CUVOL	0	164	320	343	499	410	214	95	51	0	0	0	2096
SCRIB	0	233	867	1167	1950	1748	984	528	296	0	0	0	7771

STAND: PMP STAND 5

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
242	129	9.9	43	117

CRUISE SUMMARY: BAF USED= 20 POINTS SAMPLED= 13 AVG. # TREES/PT.= 6.5

LIMIT OF ERROR AT 1 STANDARD DEVIATION= 5 PERCENT

Appendix 3 – Pueblo Mountain Park: Botanical Overview and Comments

Dr. Tass Kelso
Dept. of Biology
Colorado College

Our botanical survey of PMC was undertaken late in the growing season, so should be considered a preliminary overview only. However, it is clear from even this somewhat cursory look that the vegetation and flora of the Park is rich, diverse, and probably contains a number of plant species and communities considered by the Colorado Natural Heritage Program to be sensitive and of conservation concern. We identified six primary plant communities: the Canyon Shrub Community, the Riparian community, the Ponderosa Pine-grassland Community, a Mixed Ponderosa Pine-Gambel Oak Community, a Cool Conifer Community (primarily Douglas Fir), and a Mixed Oak Community. A more detailed analysis would undoubtedly provide additional subcommunities.

I. The Canyon Shrub Community. This community type occurs in the Devil's Canyon area, and is quite mixed in its species composition. The orientation of the canyon is SW-NE, so cool north- facing slopes and warmer south-facing slopes provide very different habitat types. Although the rocky face section of the canyon is relatively limited, it provides excellent for a number of unusual plant species, including orchids, ferns and mosses. The moisture available in the canyon bottom, at least seasonally, makes the plant diversity there extremely high. This canyon should be a high priority for species and community assessment in the next growing season.

II. The Riparian Community. This community type occurs along the stream drainage south of the Environmental Center, and runs throughout the eastern sector of the Park. We were able to do only a brief survey of the plants there, but found in a short time the quite rare species *Agustache foeniculum* (hyssop; 2 other locations known in Colorado), and the somewhat unusual to uncommon species *Lysimachia cilitata* (yellow loosestrife), and *Corylus cornuta* (hazelnut). All three of these species are eastern relictual elements, indicative of cool moist conditions and atypical habitats in Colorado. Their presence strongly suggests that this riparian corridor may be a rich source of other disjunct species, and it, too, diserves a detailed plant survey next season, both for species and for communities of conservation interest.

III. Much of the Park consists of Ponderosa Pine forest, with an understory of miscellaneous grasses and shrubs, including *Muhlenbergia montana* (mountain muhly), *Bouteloua spp*. (grama grass) and *Symphoricarpos* (snowberry). Some regions are subirrigated, and appear to have a diverse herbaceous component as well. Most of the regional Ponderosa Pine forests are considerably less diverse than this, and relatively few, with the exception of those in the Black Forest region north of Colorado Springs, contain consistent grass understory. This aspects suggests a regionally diagnostic component, and the possible presence of some of the rare species currently known only from the Black Forest.

IV. Mixed Ponderosa Pine-Gambel Oak Community. This community occurs on more open slopes, particularly on the lower south-facing areas of the western foothills. We were unable to survey this community in much detail; it does not appear to be as plant species rich as some of the other communities, but would provide excellent nesting and migratory bird habitat.

V. Cool Conifer (Douglas Fir) Community Steep north facing slopes are dominated by Douglas Fir (*Pseudotsuga menziesii*) forests, with additional components of White Fir (*Abies concolor*) and occasional Colorado Blue Spruce (*Picea pungens*). There is little understory here, but we found large colonies of *Goodyera oblengofolia* (rattlesnake orchid) to be present. Although not a rare orchid, its presence suggests the likelihood of other orchid species of conservation concern, including *Goodyera repens*, since the two congeners often grow together in the Pikes Peak region.

VI. Mixed Oak Community Ridgetops and upper south-facing slopes are composed of an interesting mix of oak species. The oak thickets here are a hybrid mix of Gambel Oak (*Quercus gambellii*) and the hybrid *Quercus undulata*, in an introgressed series that spans the range of leaf shape and size. These hot, dry habitats are likely sites for other species representing a southwestern biogeographic component, such as species from the Mesa De Maya region and New Mexico.

<u>Summary Comments</u> The western side of Pueblo County where the Wet Mountain front meets the plains is very poorly known biologically. The dramatic topography, presence of cool moist habitats, and in some canyons, continual running water, plus the remoteness of much of the front suggests a high probability of a flora that is rich, diverse, and undoubtedly full of surprises, including the presence of rare species. The Pueblo Mountain Park represents considerable botanical diversity, and provides a regional ecological microcosm. It deserves full attention as a site for biological surveys in all taxa, so that assessement and conservation of its resident and migratory biota may be incorporated into appropriate management plans.

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Appendix D – Attachment 2

Pueblo Mountain Park

Protocol for Burning Slash Piles (Updated 9/30/16)

BACKGROUND:

As part of its efforts to regain a healthy forest environment in the Pueblo Mountain Park, work is being done to reduce natural fuels in the park. In general, larger diameter (3 inch +) wood is cut and gathered for burning in the biomass boilers at Horseshoe Lodge. The smaller diameter wood, commonly called "slash" is piled at selected locations in the park for future burning. To minimize the size and duration of the resulting slash pile fires, the piles are kept to a maximum size of approximately 10' wide x 10' long x 5' high. The piles are covered with tarps to keep them dry. (9'x12' tarps are recommended.) The tarps are removed and the piles burned following a snow event that covers the area with <u>at least 6 inches of new snow</u>. This provides the opportunity to control the fires such that only the slash piles are burned. Piles of small diameter dry vegetation such as these will likely result in intense burning conditions, especially in the first 10-20 minutes following ignition. Flame lengths of 4-5 times the height of the slash pile should be expected, i.e. expect <u>20-25 foot flame lengths</u> from a 5' high slash pile in the early burning phase. Plan accordingly in terms of wind conditions, adjacent vegetation and overhanging branches.

WEATHER:

1. Prior to burning, check the weather forecast for the day and evaluate the conditions in the park. DO NOT BURN ON WINDY DAYS OR ON DAYS WHEN WINDS OVER 5 MPH ARE FORECAST. A light breeze is acceptable and actually helps complete the combustion process, but it increases the potential for scorching adjacent trees if the piles are too close. Fires should not be started on days when wind speeds (including gusts) of 5 mph or more exist or are predicted to occur, unless the piles to be burned are in large clearings.
2. If the winds pick up while burning slash piles, be prepared to dampen the fire activity by shoveling snow on the fire.

PERSONNEL:

1. Have personnel assigned to the task of burning slash piles sufficient to have them at the burning piles while there is still active flame. DO NOT LEAVE BURNING SLASH PILES UNATTENDED WHEN ACTIVE FLAME IS STILL PRESENT.
2. Personnel shall be adequately clothed for the conditions, including snow, cold and fire.

TOOLS:

Each person burning a slash pile shall be equipped with a long handled shovel for tending the fire and throwing snow on it, if needed to moderate flame length and heat output.

COMMUNICATIONS:

There shall be a communications link between personnel at the burn piles and Mountain Park Environmental Center (MPEC) staff at Horseshoe Lodge. That link may be via cell phone (if an adequate signal is available at the burn site) or MPEC portable radio.

NOTIFICATION OF AUTHORITIES:

1. THE PUEBLO COUNTY SHERIFF REQUIRES THAT ITS COMMUNICATIONS CENTER BE NOTIFIED OF ANY CONTROLLED BURNS IN UNINCORPORATED PUEBLO COUNTY. To facilitate that requirement, the Sheriff has set up a "Burn Line" to be called before controlled burns are started and after they have been put out. That telephone number is 583-BURN. Callers will be asked to identify themselves and where the controlled burn will be, and to give a phone number for the Communications Center to call if there are questions about the burn. It will be sufficient to give the MPEC phone number (485-4444) as a call back number, as long as someone is there to answer the phone. The burn line is to be called again once the controlled burns are out (no active flame) for the day.
2. The Pueblo Mountain Park is in the Beulah Fire Protection and Ambulance District's response area. The District asks that MPEC also contact it directly (485-2367) prior to starting a controlled burn. The caller should be sure to indicate that they are calling about a controlled burn, not an emergency.
   In the event the controlled burn gets out of control, personnel at the burn site should call for help from emergency responders. ALL REASONABLE EFFORTS SHOULD BE TAKEN TO AVOID THIS SITUATION, BUT IF THOSE EFFORTS FAIL, RESPONDERS SHOULD BE CALLED. THE BEST WAY TO ACCOMPLISH THAT IS TO CALL "911" AND STATE YOUR EMERGENCY.

In both cases, this notification is intended to alert the Communications Center and Fire District of controlled burns, and minimize the potential to send emergency responders to controlled burns that are still under control.

MOP UP:

Burn piles should be checked the following day. Ashes and embers that remain should be scattered in the surrounding snow or quenched in place by mixing snow in the ash/ember piles. To minimize the potential for root fires, check to ensure that there are no tree stumps that were hidden by the slash pile. If there were, pile snow on them to make sure that they do not re-ignite. These final actions minimize the potential of fire spreading beyond the slash pile site, spread nutrients beyond the burn pile and speed regrowth of vegetation.

Appendix E: Projects

Appendix E contains one project developed for this plan and an example of a project developed for an area in California.

Project Summary

Project Name: Air Curtain Destructor	**Priority:** __Low __Med __High
Number of Acres: N/A	**Estimated Cost:** ACD: $70,000 Adm: $17, 500
Project Type: ____ Mechanical ____RX Fire __X__ Other: Equipment Purchase	
Project Description	
Purchase an Air Curtain Destructor (ACD)	
Desired Results	
Purchase an ACD and have it in place prior to the start of the first fuel reduction project. Preferably, the unit could be purchased by a group of agencies and shared.	
Method	
The Core Team would name an agency or group who would assume the lead and complete a grant request or identify other ways to secure funding and purchase an ACD. Once the unit is purchased, the lead agency would schedule, arrange for the transportation of the unit to a suitable site at and coordinate the fuel treatment projects.	
Prescription	
The recommended model is a S-217, which can burn between 2-5 tons per hour. The unit is large enough to handle the quantity of materials produced but small enough to transport on a lowboy. A S-220 model is of similar size and treats 3-6 tons per hour would be more efficient, but may be more difficult to transport on mountainous roads. The target date to have the ACD in place and secure an air quality exemption from the Colorado Air Pollution Control Division.	
Remarks	
Information concerning ACDs can be obtained from: Air Burners, LLC; 4390 Cargo Way; Palm City, Florida 34990. Phone number is 772.220.7303. E-mail: info@airburners.com – www.airburners.com The regional distributor is: Lance Armstrong, DDI Equipment, Grand Junction, Colorado. Phone: 970.243.3422. Emissions data for the various sized units are available from Air Burners, LLC.	

Attachments:

□ Photographs

Model S-220 Air Curtain Destructor

An overview of a site. The run off in the foreground resulted when the operation was halted at the end of each day and the fire in the box was extinguished. The residue in the background was the result of a month's operation. The amount of run-off and residue produced is dependent on the operation schedule and operating procedures.

An Example of a Project Summary

Project Name: Create Fuel Break	**Priority:** __Low __Med _X_High
Number of Acres: 384	**Estimated Cost:** See Attachment
Project Type: __X__ Mechanical __X__RX Fire __X__ Other: ACD	
Project Description	
Create a shaded fuel break up to one-half mile wide in some locations to protect Yosemite West from a high intensity wildland fire. (Projects YW-001, YW-002, YW-003, YW-004, and YW-005).	
Desired Results	
It is the desire of the stakeholders to reduce the amount of hazardous fuels within and adjacent to the community, reduce and regulate fuel loading and modifying the vegetation structure and stand composition as necessary to protect life, property and resources. When fully implemented, the shaded fuel break in combination with increased defensible space around structures is expected to afford fire suppression personnel a ninety percent success rate when defending the community against a high-intensity wildland fire. The project will provide for safe and effective fire suppression actions while also considering the esthetic values important to the community and the commercial value of timber in the undeveloped, privately held areas to be treated. The landscape should take on an appearance of what may have existed naturally and historically. It should display a mosaic of complex vegetation patterns and type that would have evolved naturally with ecological and geological processes. There generally should be less continuous, uninterrupted vegetation types, more openings, a variety of seral stages and different plant communities in a random patchwork. The work completed by the community will enhace the fuels mitigation work completed by the National Park Service.	
Method	

Discussion: This project is based the on assumption that due to the location of community and the condition of the surrounding fuels, there is a high likelihood that Yosemite West is vulnerable to a wildland fire ignited on the surrounding lands. Intense wildland fires usually loft firebrands that can be carried by air currents for some distance (Commonly called *spotting distance*). Modeling using Behave Plus (Andrews 1986, Andrews et al. 2003) indicates that the spotting distance in the common fuel types in the area is between .5 and .8 miles. Depending on environmental conditions and other factors, the lofted embers can land on receptive fuels and ignite new fires (*spot fires*) in advance of the main fire.

Past history has shown that the ridge to the north of Indian Creek can be used to hold a fire threatening the community from the north. It is important to treat the lands between Indian Creek and the community to remove receptive fuels that could be ignited by windborne embers and contribute to a crown fire that would be difficult to control.

Henness Ridge will slow the advance of a wildland fire burning up slope in the canyon to the south of the ridge. However, spotting on the backside of a ridge (in this case, in the Indian Creek drainage) often occurs and spot fires can gain intensity and quickly burn up the slope as a crown fire.

The National Park Service has created a fuel break on the boundary between the park and the community and additional work is scheduled for the near future. This action should afford the community needed defensible space to the east and south along the boundary, **provided the community treat the fuels on vacant lands, and around existing structures.**

Goal: Mitigate the treat to Yosemite West from a wildland fire igniting on surrounding lands to the extent that fire suppression resources have a 90% probability of successfully defending the community.

Objective: On the east and south boundary between the park and the community, the work completed by the community will enhance the fuels mitigation work completed by the National Park Service.

Objective: The north facing slope of Indian Creek from the boundary of the Park west to the limit of the project should be treated so that any spot fires caused by windborne embers will burn as low intensity ground fires that can be controlled by suppression forces.

Objective: On lands to the south bordering the National Forest and to the west should be treated to the extent that a crown fire moving up the Indian Creek drainage cannot be sustained and fire suppression forces will be able to safely suppress the resulting surface fire or defend the community through the use of indirect suppression tactics.

Objective: Create an awareness in the community of the importance of creating defensible space around structures and reducing receptive fuels within and adjacent to the subdivision. There is a need to attain all these objectives, as failure to meet any one – including the treatment of fuels within the community – may compromise the effectiveness of the other actions and place the residents and structures of the community in jeopardy.

Method: This undertaking is composed of five project areas that have been identified for treatment. The first priority is the creation of a shaded fuel break approximately 300’ wide on the west and north sides of the sub-division (See attached map – Project WY-001). Treatment of the other areas will be completed incrementally on a funds available basis to strengthen the primary fuel break and improve the defensibility of the community from a high intensity wildland fire. When all the treatments are completed, the fuel break will tie in to the shaded fuel break created by the National Park Service on the south and east sides.

Depending on landownership, the project area may be logged prior to other treatment and the logs salvaged for commercial purposes. A professional forester recognized by the State of California and/or the American Society of Foresters, using the standars established for this project, should mark the trees to be cut for saw logs. The landowner will be responsible for finding a market for the logs and arranging for their removal in a timely manner. Skidding equipment and methods that do not cause a great deal of ground disturbance should be used to remove the logs in order to protect the ground cover and prevent silt laden run-off that could impact the water quality of the Merced River.

The methods to be used to thin the remaining stand will depend on the terrain and vegetation type. On slopes 40% or less, mechanical equipment such as a masticator should be used to reduce small trees and brush to surface fuels that can later be treated with prescribed fire, as needed.

It may be necessary to use chainsaws and other similar devices to cut small trees and brush on slopes greater than 40%, and to limb trees to reduce ladder fuels. The materials not utilized as saw logs or for other purposes would be hauled to a central area and burned in an Air Curtain Destructor or brought to a road and chipped. The chipped materials would be blown back into the forest wherever possible to provide for soil protection and to return nutrients to the soil. The residue from the ACD would be removed to an appropriate location.

With the exception of any logging activity, which will be completed at the discretion of the landowner, the thinning will be completed using contracted equipment and labor. It will also be necessary to issue a contract or complete an agreement for a loader with operator, and have them in place at the start of the fuel reduction project to load the ACD (Provided an ACD is used). A Bobcat, or other similar piece of equipment and a dump truck are required periodically to remove residue from the ACD and haul it to a disposal site. Based on the amount treated, only one load of residue a week should be generated. The residue can be stored on site and removed at the completion of the project.

The project areas may receive followed up treatment in the form of a low-intensity broadcast burn, or it may be necessary to burn piles of residue if it is determined that the fuel loading is too great. The use of prescribed fire should only be considered if an ACD is not available or if the residue constitutes an unusually heavy fuel load that would contribute to high fire intensities that may kill the remaining trees. This activity can be completed by a contractor or through an agreement with a governmental agency.

Prescription

The desired results are a forest composed of less continuous vegetation with more openings, a variety of seral stages and different plant communities in a random patchwork that will not support a crown fire. To achieve those results several things must be considered:

Species Composition: When selecting species to remove, preference should be given to the pine species, oak, and Douglas fir. In riparian areas, brush should be given preference. The historic stand composition was one composed of large pine, with Douglas fir and some oak. A few white fir and incense cedar would have been present. Oak brush and manzanita would have been present in dryer, more open sites.

Age Classes: The desire is to create a forest that is composed of uneven aged trees and brush. Older trees should be scattered through the stand to replicate what would have been present following a fairly intense wildland fire. These larger trees would have survived subsequent light under burns that would have killed groups of small trees. The result would have been an uneven aged stand with pockets of the same cohort scattered through the site.

Tree size: Trees, regardless of species, greater than 20” dbh (diameter of the tree 4’ from the ground) should be favored. **However**, in order to create an uneven-aged stand, trees of different cohorts should be left.

Stand Composition: Forested stand should be composed primarily of pine, Douglas fir, and oak with a limited number of incense cedar and white fir. Trees should be clumped and unevenly spaced through the stand in a random pattern with scattered small open areas. The result should be an uneven aged stand with pockets of the same cohort scattered through the site. Small patches (10 scare meters or less) of dog-hair pine can be left, provided the patches are over 150’ from the nearest structure. The clumping of white fir is not recommended unless the boles are limbed to eliminate fuel ladders.

Areas of brush that are currently occupying open areas should be allowed to remain unless the stand is highly decadent. However, there must be a transition area between brush fields and timbered areas to prevent the creation of fuel ladders.

Tree Spacing: Three elements generally must be present for the development of a surface supported (active) crown fire: 1) High wind speeds, 2) High crown bulk density and cover, and 3) low crown base height. There is little that can be done about the wind, but the other two elements can be manipulated to reduce the likelihood of an active crown fire. They key to preventing a wildland fire from reaching the tree canopies is removing smaller, understory trees and raising the height of lower branches of the larger trees. These two form ladder fuels that allow the fire to reach the crowns. The second element is determining tree spacing to further reduce crown bulk density. For slopes less than 40%, computer models suggest the spacing to be 22 feet between singe tree crowns or groups of trees. For slopes greater than 40%, the spacing should be 24 feet. Trees should be limbed 6 – 8 feet from the ground in undeveloped areas and 10 feet next to roads.

Trees should be spaced randomly. Groups of two to four larger trees (20” dbh) can be left but must be limbed to a height of 10 feet and living surface fuels, such as young trees and brush, removed. The creation of openings of one acre (.405 hectare) to two acres (.810 hectare) is encouraged.

It is not necessary to mark the trees to be left in the unit following thinning. It has been demonstrated that experienced operators, once given the standards, can thin the forest and remove the brush and undergrowth without further direction.

Limitations

Several historic railroad grades created and used during past logging operations must be protected from damage due to their historical significance. They should not be disturbed, if possible, and should be crossed at right angles, when it is safe to do so.

Adequate protection must be afforded water quality. Riparian areas and drainages should not be disturbed and vegetation should not be treated within 25’ of a watercourse.

A small amount of fugitive smoke is produced when the ACD is first ignited. Due care should be taken when locating a site for the unit so that the smoke from the start up and the emissions, dust and noise from the operation will not impact visitors and residents.

Remarks

□ It is important to note that this project is not a “cure-all”. History has shown that little can be done to halt or modify the rate and direction of spread of an independent crown fire. This type of crown fire is burning independently of the surface fire and burns with such a high intensity that it often creates its own environmental conditions.

- Fire investigators and others looked closely at what led to the loss of homes and outbuildings in Los Alamos, New Mexico as a result of the Cerro Grande Fire. Forest Service investigator Jack Cohen examined the area following the fire, and concluded that much of the fire burned “within several hundred yards or more of the Los Alamos residential area… as a surface fire – underburn… the tree canopy was scorched but not consumed. [His] examination suggests that the high ignitability of Los Alamos was principally due to vegetation, flammable shrubs, wood piles, etc. adjacent to, touching, and/or covering the homes… the high ignitability of most of the residential area allowed numerous simultaneous house fires that quickly overwhelmed the suppression forces” (Carle 2002). **Therefore, it is highly important that this project be completed in its entirety and in conjunction with the creation of defensible space around structures in the community.** When both projects are completed, the safety of firefighters and the public greatly improved.
- Depending on slope and aspect, surface fires may spread more quickly in open stands of timber than in closed stands of timber.

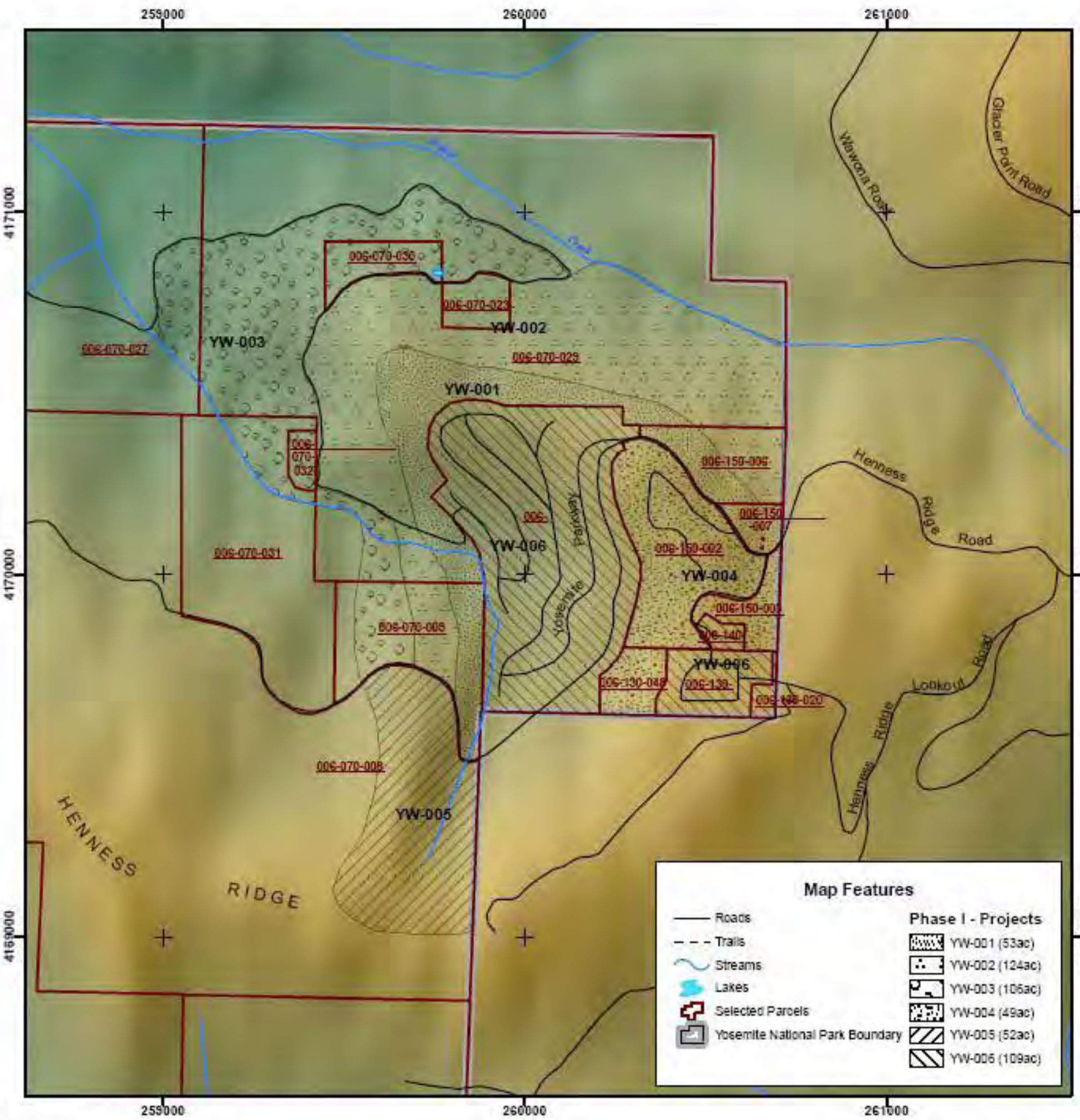
Attachments:

- Map of Projects
- Photographs
- Cost Estimates

Yosemite West
Community Wildfire
Protection Plan

Phase I
Projects/Parcels Map

Elevation Shaded Relief
USGS 7.5' Topographic Maps:
El Capitan and El Portal, CA



Map produced by:
Digital Mapping Solutions
Date: 01/11/05

Projection: UTM, Zone 11, NAD27
Accurate for display purposes only.

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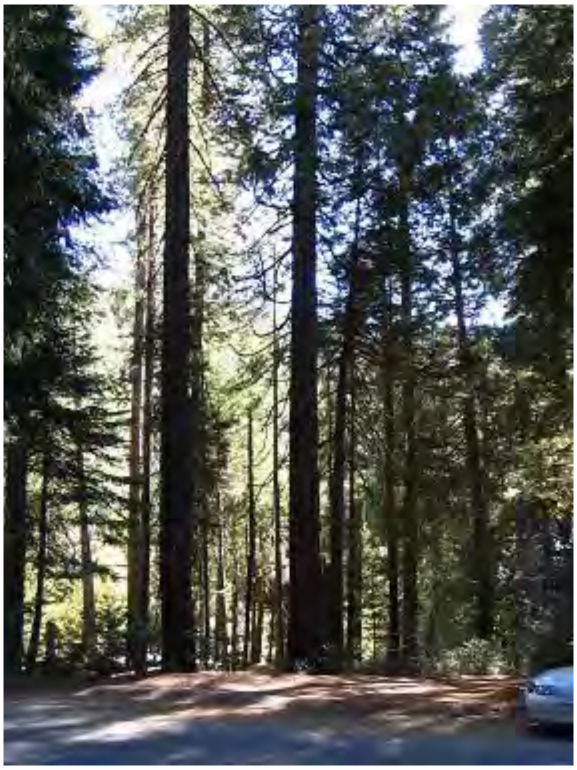
DIGITAL MAPPING SOLUTIONS

WILDLAND FIRE ASSOCIATES



The stand at the left is composed of at least three cohorts. The stand would be treated to remove the majority of the small fir trees that crowd the site. The two trees in the foreground would remain, as would some of the mid-range trees – depending on spacing. The dead tree in the right center of the stand may be left for wildlife.

The result would be a more open stand, similar to the stand below. Note that the stand below is an uneven aged stand with openings. There is adequate ground cover to protect the site from erosion and elements necessary for a healthy ecosystem, such as fallen trees, standing snags, forbs, and brush remain. The trees have been limbed and ladder fuels have been removed. Very little surface fuel remains to carry a fire.

Cost Estimates

Project	Treatment Method	Acres	Est. Cost	Remarks
YW-001	Masticator Thinning Chipping/Hauling* Project Admin[19] Prescribed Burn[20]	46 14 14 35	$18,400 $ 2,800 $ 6,650 $ 6,960 $34,810 $35,000 $ 8,750 $43,750	*If an ACD is used the materials could be hauled to the disposal site for the same estimated cost. Rx burn on western and northwestern boundary only where slope <40% and only if necessary.
YW-002	Masticator Thinning Pile burn/Hauling* Project Admin	52 72 72	$20,800 $14,400 $18,000 $13,300 $66,500	*Much of this unit has slopes >40%. Hand piling and burning may be appropriate. If an ACD is used, as much residue as possible should be disposed of in that manner.
YW-003	Masticator Thinning Pile burn/Hauling* Project Admin	78 28 28	$31,200 $ 5,600 $13,300 $12,525 $62,625	*If an ACD is used the materials could be hauled to the disposal site for the same estimated cost.
YW-004	Masticator Project Admin Prescribed Burn Project Admin	49 44	$19,600 $ 4,900 $25,500 $44,000 $11,000 $55,000	It may be necessary to hand thin approximately 5 acres. Based on the terrain and fuel loading in this unit, the use of an Rx burn to further reduce fuels may not be necessary.

[19] Project Administration includes a monitoring program that is intended to conduct representative sampling prior to treatment and post-treatment in Year 1, followed by follow-up monitoring in Year 3 and Year 5 or 6. At least one Brown's transect or equivalent should be randomly placed in each treatment area, and at least two randomly placed photo plots per project area should be established. [20] The estimated cost of conducting a prescribed burn is included for each project that this treatment may be required. The prescribed burn would be conducted after the fuels are cured, perhaps in Year 2 or 3. Whenever practical, an ACD should be used in lieu of prescribed fire. The rational is reduced emissions and reduced risk of an escape.

YW-005	Masticator Thinning Pile burn/Hauling	35 17 17 35	$14,000 $ 3,400 $ 4,250 <u>$ 5,410</u> $27,060 $35,000 <u>$ 8,750</u> $43,750	*If an ACD is used the materials could be hauled to the disposal site for the same estimated cost. It may be possible to jointly treat the unit with prescribed fire conducted jointly with the NPS.
YW-006	Chipping/Hauling* Project Admin.	109	$38,150 <u>$ 9,500</u> $47,650	Discussed in project titled: *Create Defensible Space in The Community and Improve and Establish a Safety Zone* *If an ACD is used the materials could be hauled to the disposal site and burned for half the estimated cost.

Appendix F: Tools

Fire Management Tech Tips

United States Department of Agriculture
Forest Service

Technology & Development Program

September 2002

5100 0251 1317—SDTDC

The Use of Air Curtain Destructors for Fuel Reduction

Alan R. Schapiro, Mechanical Engineer

Summary
The San Dimas Technology and Development Center (SDTDC) investigated the use of air curtain destructors (ACDs) as an efficient, environmentally friendly, and technically viable means of disposing of slash, wood, and other burnable waste materials. ACDs should be considered an additional alternative to current fuel reduction methods and disposal of road clearing debris such as pile burning, chipping, landfill disposal, and prescribed fire. SDTDC's research of the industry indicates that one company, Air Burners LLC, manufactures both self-contained and trench ACDs. Their self-contained ACDs are basically skid-mounted air curtain incineration systems including a refractory lined firebox that does not require any setup or teardown. Their trench burners are trailer-mounted air curtain incineration systems requiring a pit or earthen trench that functions as a firebox. Both types of burners can efficiently dispose of large quantities of forest waste products at very high temperatures with very little air emission. This safe and clean method of burning allows its operation nearly any time of year except when fire danger is too high. In addition to burning safely and cleanly, volume reductions of approximately 95 to 98 percent are achieved. The ash may be used as a soil amendment that can be spread on the forest floor.

Background
Use of ACDs for wildfire mitigation and fuel management is growing rapidly as an alternative to current fuel reduction methods. The use of prescribed fire as a means of slash removal is subject to weather conditions, and in some cases, prohibited in wildland urban interface areas. Leaving the slash on the forest floor to decompose is another traditional alternative. However, the slash may take many years to decompose, particularly in semiarid and cold environments. While decomposing, the material remains a considerable fire risk. This method can also increase the risk of unwanted insect outbreaks. Pile burning, another traditional alternative used to remove slash, is also subject to weather/burn conditions. Chipping, grinding, and mulching are other alternatives that still require a means of disposal and may prove to be very costly.

ACDs can be operated safely and practically year round for disposal of slash with only a few operating limitations such as fire conditions, required clearance from trees (or other fuel hazards), and maximum allowable wind conditions (figure 1). Volume reduction of slash is approximately 95 to 98 percent and the byproduct (ash) may be used as a soil amendment by spreading it on the forest floor.

Figure 1—Skid mounted ACD in full operation (no visible smoke).

For additional information, contact: Fire Management Program Leader, San Dimas Technology & Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198; Phone 909-599-1267; TDD: 909-599-2357; FAX: 909-592-2309
LotusNotes: MailroomWOSDTDC@FSNOTES - Intranet(website):http://fsweb.sdtdc.wo.fs.fed.us - Internet e-mail: mail room-wo-sdtdc@fs.fed. us

The ACDs manufactured by Air Burners LLC have been used worldwide for several types of applications. They are used in forest fuel management and wildfire mitigation efforts, in the construction industry to reduce debris from land clearing and demolition operations, and at landfill sites to maximize costly space by reducing wood waste and similar burnable waste streams. They are also used in disaster recovery for clearing the aftermath from storms or floods.

Description

The main operating principle of the ACD is the high velocity air (curtain) blown across and into the upper portion of the combustion chamber (figure 2). This powerful curtain of air has two effects. First, the high volume of air causes overoxygenation of the fire, and secondly the high velocity airflow over the combustion chamber entraps particulates (smoke), which then completes combustion in the combustion chamber, thus limiting emissions and smoke. The high turbulence along with increased combustion time and temperatures in excess of 1,800 °F results in complete combustion and significantly reduced air emissions. Reduced air emissions lower impact on nearby residents, smoke sensitive individuals, and decrease smoke-related inversions during fall and winter. In addition, the high temperatures and oxygen-rich environment burn everything from green fuels to red slash.

Equipment

Air Burners LLC manufactures two types of ACDs: self-contained skid-mounted firebox systems that do not require any setup or teardown; and trench burners that require setup and an earthen pit or trench which functions as the firebox.

Skid-Mounted Systems

The skid-mounted ACD as shown in figure 3, is a self-contained system that includes a refractory walled firebox, diesel engine power plant, mechanical drive system, blower fan, and fuel tank. These ACDs are engineered to be transportable by a lowboy or similar drop-deck trailer. The transportability increases the flexibility of bringing the ACD to the wood waste source, rather than hauling the waste to a fixed location for processing. These ACDs are ready for use as soon as they are offloaded at the jobsite. The refractory lined firebox allows for controlled burning without the need for an earthen pit or trench. The forward equipment deck shown in figure 3 supports the diesel engine, the fuel tank, the direct drive system to operate the fan, and the fan. An air nozzle manifold is mounted on one side of the firebox. The wood waste is loaded over the top of the ACD on the side opposite the manifold (figure 4).

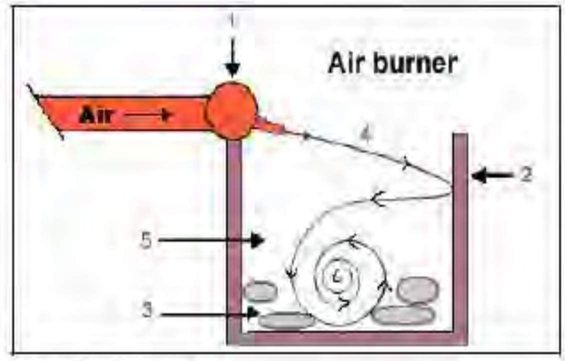


Figure 2—Air burner.

1. Air curtain burner manifold and nozzles directing high velocity air flow in refractory lined box or earthen trench.
2. Refractory lined wall for self contained ACD or earthen wall for trench ACD.
3. Waste material to be burned.
4. Air Flow forms a high velocity "curtain" over fire.
5. Continuous airflow over-oxygenates the fire, creating higher temperatures and thereby a more clean and complete burn.

Figure 3—Skid mounted ACD in full operation (no visible smoke).

Skid-mounted systems are designed and constructed to optimize the air curtain concept. High velocity air is blown across and down at an optimum angle into the pit creating the air curtain on top and a rotational turbulence within the firebox. The high velocity air creating the rotational turbulence provides an oxygen-enriched environment in the combustion zone that accelerates the combustion process (similar to the effect of fanning a fire). The temperature within the firebox is usually above 2,000 °F. The high velocity air

Figure 4—Loading fuel into ACD (full operation).

over the firebox creates an air curtain that traps unburned particulate until it is completely consumed. Nearly complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke.

Vertical refractory walls aid in the combustion process by retaining and reflecting the high temperatures generated within the firebox. The combustion process reduces the wood waste by approximately 98 percent, leaving about 2 percent in volume as residual ash. Twin refractory lined panel doors at the rear of the firebox allow for ash removal. The unit has no bottom and can be dragged on its skids with the rear door panels open for dumping ash.

The skids and durability of the unit allow it to be dragged around the site for repositioning or from site to site depending upon the terrain and distance to be moved. The ash may be left in place, disposed of, or used as a soil amendment by mixing it with the soil at the site or other locations.

Air Burners LLC manufactures several skid-mounted systems with burn rates ranging from 1 to 15 tons per hour. The larger units are more difficult to transport or move around the site. Due to their size, special permits are required for transporting over roads. Systems can be customized to meet specific needs. The standard units can also be leased.

Trench Burner Systems

The trench burner systems are trailer-mounted self-contained air curtain incineration systems consisting of a power plant, mechanical drive system, blower fan, and fuel tank (figure 5). All of the components are either mounted to or stored on the trailer. An earthen trench must be constructed since the trench burners do not contain a firebox. The manifold sections are assembled and placed along the trench edge. Carrier pipe sections are assembled to carry the air from the power plant to the manifold, thereby keeping the trailer-mounted components clear of damaging heat generated from the burning operations (figure 6). Burning operations can usually run until the ash in the trench needs to be removed or a new trench is needed. Air Burners LLC manufactures several trailer-mounted trench systems with burn rates ranging from 5 to 14 tons per hour. These units can also be leased.

Firebox vs Trench Burner

The self-contained firebox burners eliminate guesswork regarding the size of the fire area. These above-ground units avoid problems with the water table, rocks, and roots and allow for easier ash removal. The real minus for these units is their size. The smallest ACDs weigh over 20,000 pounds. So dragging it around in soft soil can be difficult. While the smaller units will fit on a

Figure 5—Trailer mounted trench burner system.

Figure 6—Trench burner.

standard equipment trailer, the larger units are oversized loads for most roads. So the logistics are more complicated than towing a trench burner.

The trench burner can be easily towed behind a truck to the jobsite. These units will handle more uneven terrain than the fireboxes and can be mobilized cuickly. The trench allows the operator to easily see the fire and load the pit without the need to raise the fuel up over the wall. The real minus for the trench burner is in the construction of the trench. The trench must be dug correctly or the efficiency of the ACD goes down, increasing emissions and decreasing thru-put (burn rate). If the trench is omitted or too shallow, the principle of the air curtain is lost. Ground and soil conditions become a big factor. A high water table can create flooding in the trench and cause trench walls to lose integrity if the soil is too soft. Additional safety factors also must be considered. Precautions must be taken to alert personnel to the pit's location to avoid inadvertently failing in or perching heavy loading equipment too near the edge of the pit causing the walls to collapse.

Operation

Skid-mounted or trench burner ACDs are simple, easy, and almost identical to operate. ACD operations follow three stages: startup, full operation, and burndown. For startup, the trench or firebox is partially loaded with layers of fine and easily burnable forest slash. An accelerant (typically diesel fuel) is applied over the layers and covered with heavier logs to just under the manifold. Fusees could be used for ignition. The fan is started once the heavier materials burn, and the fan speed is gradually increased to full capacity. Smoke will be produced during startup, but will decrease as the fan speed increases and the process approaches full operation. Startup burning takes about 1 hour and is complete when a base of hot coals and burning material is established. During full operation, slash is fed to the fire at a steady rate using a front-end loacer or an excavator with a bucket and thumb. The last stage, burndown, typically takes about 1 to 2 hours. The air is slowly decreased as the last load burns down. After burndown, hot coals may remain for several days under an insulating blanket of ash. The ash may be left in place, disposed of, or used as a soil amendment by mixing it with the soil onsite or at other locations.

Skid-mounted ACDs are designed to run for approximately 24 hours before the ash needs to be removed. Long burns are generally more efficient (having lower emissions) than shorter burns. The efficiency starts to drop once the ash pile reaches approximately 1/4 to 1/3 the depth of the firebox or pit.

For safe operation, the manufacturer recommends a 100-foot clearance around the AM Barring extremely high winds there is little chance of large embers escaping the trench or firebox and burning beyond the clear area. Very small embers can escape, but generally burn completely before they hit the ground. Having an engine and crew onsite further reduces the risk of fire. A patrol of the area may reduce the clear area requirements and burn condition limitations. ACDs should not be operated if the fire danger is too high or if people or animals are likely to fall into the pit or climb up on the box. Should conditions require shutdown, the fire could be extinguished in 10 to 20 minutes. Safety should always be the number one operational consideration.

U.S. Environmental Protection Agency regulations for New Source Performance Standards (NSPS) requires that ACDs operate below opacity limits of 35 percent during the initial 30-minute startup and 10 percent during operation (6-minute average), provided the material burned is restricted to 100 percent wood waste, clean lumber, and/or yard waste. Air Burner ACDs operate well below these limits in contrast to open burning which averages between 60 to 80 percent opacity.

SDTDC Evaluation

SDTDC is currently planning to operate a skid-mounted unit for evaluation purposes in Fall 2002 at a site within national forest lands. Data will be collected on aspects such as mobility, durability, and operability to develop Forest Service recommendations and standards for operation. This information will be published during FY 2003.

Conclusions

ACDs should be considered when evaluating alternatives to current fuel reduction methods in urban interface areas. ACDs may not be as cost competitive in areas where broadcast and pile burning are acceptable. Potential advantages to ACDs include:

- Produces lower smoke emissions compared to pile or broadcast burning.
- Burns a greater variety of materials from green fuel to red slash.
- Reduces fire risk and outbreak of insect problems.
- Operates with fewer restrictions on weather and burn conditions.

- Residents in urban interface areas are more willing to accept ACD use and remove wood waste and slash fuel hazards around their homes if offered free disposal

- The fire is contained and easily and quickly extinguished, if necessary.

Information
For further information regarding ACDs manufactured by Air Burners LLC, contact:
Brian O'Connor or Norbert Fuhrmann

Air Burners LLC
4390 Cargo Way
Palm City, FL 34990
888-566-3900 or 772-220-7303
www.airburners.com

Approximate English to Metric System Conversion Factors

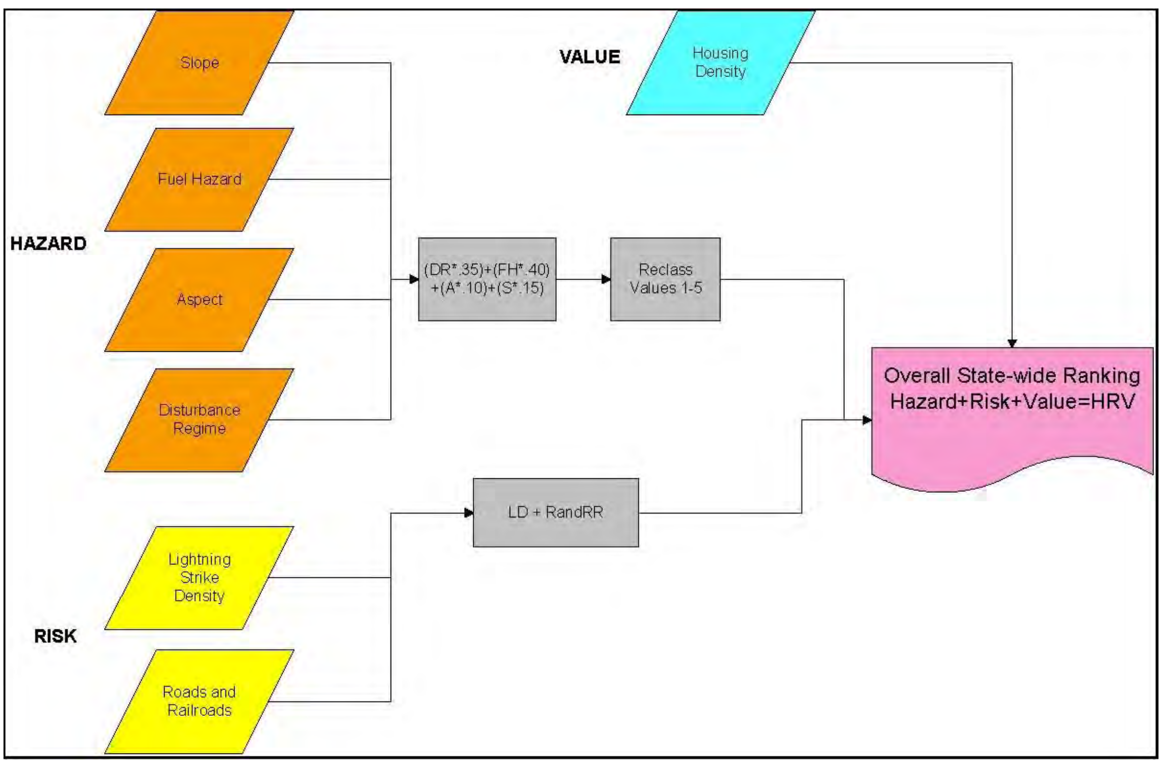
To Change	To	Multiply by
pounds	kilograms	0.454
tons	kilograms	907.2

Temperature Conversion of Units
°C = (°F - 32) /1.8

About the Author
Alan Schapiro, a licensed professional engineer in the State of California, obtained both a bachelor's degree in mechanical engineering and a master's degree in engineering from Cornell University. He has 20-plus years of engineering and project management experience in the development, design, startup, and operation of oil/gas, coal, nuclear, and alternate/renewable electric generation power plants. Alan is a project leader in the Fire and Aviation program responsible for air curtain destructor applications, fire engine development and testing, and foam proportioner testing. He also has responsibilities in other program areas such as engineering roads technology, forest management, and recreation.

Appendix G: Colorado Wildland Urban Interface Hazard Assessment Methodology

Colorado Wildland Urban Interface Hazard Assessment Methodology



Skip Edel
Colorado State Forest Service

April 29, 2002

Background

Geographic Information Systems (GIS) is a tool that allows for comparison and analysis of geographic phenomenon. Differing sets of data can be compared based on their spatial location information. In the mid-nineties, GIS was recognized as an ideal tool to use in determining wildfire hazard, by comparing values such as slope, vegetation, housing density, ignition history, and aspect throughout Colorado. GIS provided the tools to implement a state-wide analysis that was previously extremely difficult.

The Front Range Redzone Project was one of the first attempts to map the fire hazard along Colorado's Front Range, incorporating slope, aspect, and fuels. The project centered on the areas of highest housing density – the urban and suburban areas along the Front Range. This project started the Redzone concept in Colorado and provided a great educational tool to convey wildland fire danger. Due to the success of the Front Range Redzone project the scope was expanded to include the remaining forested lands in Colorado. This state level project was called the Midlevel Assessment. The Midlevel Assessment took a more detailed look at the state and included more accurate information on fuels, population growth, and distribution. Even this more detailed information lacked the resolution to accurately map population densities in the western portion of Colorado. Some portions of the Midlevel Assessment are used in this mapping effort, specifically the values for slope, aspect, and vegetation.

The Colorado Wildland Urban Interface Hazard Assessment builds on the work of earlier hazard methodologies and provides new and updated data to further enhance accuracy and scale. A better, more accurate housing density surface was created to assist in ranking the Wildland Urban Interface hazard. This assessment also includes all of the counties in Colorado, including the eastern plains counties, which were previously omitted .The final outputs are a Risk, Hazard, and Value (RHV) map displaying areas of concern that are at risk of catastrophic wildland fire.

This project is a joint effort of CSFS, USFS, BLM, NPS, and other interested parties.

Approach

The Colorado Wildland Urban Interface Hazard Assessment uses three main layers to determine fire danger, Risk, Hazard, and Values. The following lists include the data used to create each of the three layers.

1. Risk – Probability of Ignition
    a. Lightning Strike density
    b. Road buffer – 100 meter buffer of roads and railroads in Colorado.

2. Hazard – Vegetative and topological features affecting intensity and rate of spread
    a. Slope
    b. Aspect
    c. Fuels – Interpreted from CDOW GAP Vegetation information.

3. Values – Natural or man-made components of the ecosystem on which a value can be placed.
    a. Housing Density – Life and property

4. Non-flammable areas Mask – a mask was created to aid in the analysis for areas that will not carry fire such as rock and water areas. Urban areas were included in these non-flammable areas if there was not a significant source of vegetation to carry the fire. These areas show in the final assessment as a zero value for fire hazard.

Scale

The Colorado Wildland Urban Interface Hazard Assessment is meant to be used as a tool to compare fire hazard in various areas in Colorado and within counties. The data is not meant to be used to determine fire hazard at the subdivision or parcel level scale. The assessment data and process steps are provided to allow counties or subdivisions to substitute better, higher resolution data for comparing portions of small areas of counties, subdivisions, or individual parcels.

Process Outputs

One of the objectives to creating a Statewide Wildfire Hazard Assessment is to assist in prioritizing and planning mitigation projects. The other is to update the Redzone maps which have proved to be a useful communications tool.

The following maps are the Process Outputs and represent the combination of the Risk, Hazard, and Values layers:

Risk + Hazard + Value (housing density) = RHD

Redzone Map = buffered high values from the assessment showing high hazard areas.

GIS Process Steps

Data layers were collected or contracted for all of the layers stated above. Use National Elevation Dataset for the creation of the base 30 meter DEM layer. Create all grids based on this DEM layer with the same cell size and extent. Change any NO Data values to 0. The steps are as follows:

1. Risk

a. Lightning Strike – Determines areas of high lighting strike occurrence and corresponding rise in ignition potential. Only the positive polarity strikes are used to create the density surface.[21] Source: BLM lightning strike data. Create density surface and classify to:

Reclass Value	Density
4	High
3	Medium
2	Low
1	Very Low

b. Roads – Buffer existing roads by 100m and reclass the buffer areas to 1, all other areas will receive a value of 0.

c. Add the Lightning Strike and Roads grids together for the Risk Grid.

2. Hazard

a. Create Slope from 30m USGS DEM and reclassify the grid as described in NFPA 299, 1991, (slope in percent):

Slope %	Rating	Reclass Value
0-5	Mild	1
6-20	Moderate	2
21-40	Steep	3
41+	Extreme	4

b. Create Aspect from 30m USGS DEM and reclassify the grid as described in NFPA 299, 1991, (aspect in degrees):

Aspect°	Reclass Value
0-160 or 200-360	1
160-165 or 195-200	2
165-175 or 185-195	3
175-185	4

[21] Correlation between positive polarity strikes and wildfire ignition: "ArcGIS Extensions – Identifying Areas of High Risk to Wildfires" ESRI, 2002. "Lightning Ignition Efficiency" notes from John Calkins, ESRI, 2002. "Lightning Detection and Operation Systems in North America" Peter Brookhouse, Australian BrushfireConference, 1999.

c. GAP Vegetation codes were reviewed by CSFS, USFS, and BLM employees and ranked based on Fuel Hazard and Disturbance Regime. Fuel hazard represents a qualitative ranking based on flammability during an average burning day. Disturbance regime is also a qualitative ranking based on the average length of the return interval.
   i. Fuel Hazard – create grid for vegetation hazard rating and reclassify based on CDOW GAP VEG primary codes. Ratings based on values derived in Colorado Red Zone Analysis, "Colorado Fire Protection Assessment Report", "Colorado Mid-Level Wildfire Hazard Assessment Report", and CSFS District Forester evaluations (see Appendix A for codes). Fuel hazard represents a qualitative ranking based on flammability during an average burn day.
   ii. Disturbance Regime – CDOW GAP Vegetation Primary codes reclassified based on methodology used in the Colorado Red Zone Analysis, "Colorado Fire Protection Assessment Report", "Colorado Mid-Level Wildfire Hazard Assessment Report", and input from CSFS District Foresters (see Appendix A for codes). Disturbance regime is also a qualitative ranking based on the average length of the return interval.

d. Hazard = [Disturbance_Regime]*0.35 + [Fuel_Hazard]*0.40 + [Aspect]*0.10 + [Slope]*0.15

e. Classify Hazard grid to five equal intervals and reclass to values 1 (low) – 5 (high).

3. Values

a. Housing Density, Life and Property – Source: Dr. Dave Theobald, Colorado State University[22] and Dr. Brian Muller, University of Colorado Denver. Data was created using a combination of parcel data, well head location data, and Census information. Projections were also made for housing densities in 2010 and 2020 to allow for future risk projections.
   i. Create a density surface and classify as follows:

Houses per Acre	Reclass Value	Density Class
0-0.004	0	Public or Vacant
0.004-0.025	3	Ranchette
0.025-0.1	4	Low
0.1-0.5	5	Medium
0.5-1	4	High
1-9999	2	Urban

4. Non-flammable areas Mask – a mask was created to aid in the analysis for areas that will not carry fire such as rock and water areas. Urban areas were included in these non-flammable areas if there was not a significant source of vegetation to carry the fire. These areas show in the final assessment as a zero value for fire hazard. Values for the mask were derived from the DOW GAP vegetation information and used for Front Range urban areas. These areas were used to create "holes" in the state coverage masking out non-flammable areas.

[22] See Appendix B – "Mapping Housing Density for Prioritization of Urban/Forest Wildfire Hazards in Colorado", David M. Theobald and Mary Kneeland.

5. Combination of Hazard, Risk, and Value Layers – Grids were added together to create the final HRV grid showing areas in the state at high risk to catastrophic wildland fire in the interface. Values ranged from 2-15 and were coded for best display.

Appendix A – CDOW GAP Vegetation codes for Fuel Hazard and Disturbance Regime

PRIMARY	Description	Fuel Rank	Hazard	Disturbance Rank	Disturbance Regime
11001	Human Settlement type	0	none	0	n/a
21001	Dryland Crops type	1	low	4	short
21002	Irrigated Crop type	1	low	4	short
21003	Orchard/Horticulture type	1	low	4	short
21004	Confined Livestock Feeding type	0	none	0	n/a
31010	Tall-grass Prairie type	2	moderate	4	short
31013	Sand Dune Grassland Complex type	1	low	4	short
31020	Mid-grass Prairie type	2	moderate	4	short
31030	Short-grass Prairie type	1	low	4	short
31040	Foothill and Mountain Grasslands	1	low	4	short
32001	Mesic Upland Shrub type	2	moderate	4	short
32002	Xeric Upland Shrub type	2	moderate	4	short
32003	Deciduous oak type	4	very high	4	short
32005	Bitterbrush Shrub Steppe	2	moderate	4	short
32006	Mountain Big Sagebrush type	2	moderate	4	short
32007	Wyoming big sagebrush steppe type	2	moderate	4	short
32009	Big Sagebrush Shrubland type	2	moderate	4	short
32010	Desert Shrub type	1	low	4	short
32011	Saltbush Fans and Flats type	1	low	4	short
32012	Greasewood Fans and Flats type	2	moderate	4	short
32013	Sand Dune Complex Shrub type	1	low	4	short
32030	Disturbed Shrubland	1	low	4	short
41001	Aspen forest type	1	low	3	medium
42001	Spruce-fir type	3	high	1	very long
42002	Spruce-fir clearcut type	2	moderate	2	long
42003	Douglas fir Type	3	high	3	medium
42004	Lodgepole pine type	3	high	2	long
42007	Lodgepole pine clearcut type	2	moderate	2	long
42009	Limber pine type	2	moderate	3	medium
42010	Ponderosa pine type	3	high	4	short
42011	Blue spruce type	2	moderate	2	long
42012	White fir type	3	high	3	medium
42015	Juniper woodland type	3	high	3	medium
42016	Pinyon/Juniper woodland type	4	very high	3	medium
42017	Rocky Mountain Bristlecone pine type	1	low	1	very long
42018	Mixed Conifer type	3	high	3	medium
43000	Mixed Forest type	2	moderate	4	short
52001	Open Water type	0	none	0	n/a
61001	Forest dominated wetland/riparian type	1	low	3	medium
62001	Shrub-dominated Wetland/Riparian type	2	moderate	4	short
62002	Graminoid-and orfb-dominated wetland	1	low	4	short
70000	Barren land	0	none	0	n/a
71001	Unvegetated Playa type	0	none	0	n/a
71002	Bare soil (Non-playa)	0	none	0	n/a
73000	Sandy Areas other than beaches (Dune)	0	none	0	n/a
74001	Exposed Rock type	0	none	0	n/a

75001	Mining Operations	0	none	0	n/a
81001	Prostrate shrub tundra type	1	low	2	long
82001	Meadow Tundra Type Above Upper Tree	1	low	1	very long
82002	Subalpine meadow type	1	low	3	medium
83000	Bare Tundra	1	low	1	very long
85000	Mixed Tundra	1	low	2	long

Appendix H: Maps

1. Fire Protection Districts
2. Beulah Area Wildland Fire Mitigation Project
3. Predominant Vegetation
4. Fuel Hazard
5. Fire Return Interval Risk of Wildfire Ignition
6. Lightning Ignition Probability
7. Land Ownership
8. Structures
9. Assessed Valuation
10. Population Density
11. Wildland Urban Interface
12. Wildfire Hazard Areas
13. Communities at Risk
14. Evacuation Routes
15. 2000-2006 Local Mitigation Projects
16. 2000-2006 Federal Mitigation Projects
17. Proposed Mitigation Projects