WILDLAND FIRE MANAGEMENT PLAN

BANDELIER NATIONAL MONUMENT

NEW MEXICO

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ADDENDUM TO THE JANUARY, 1997 FIRE MANAGEMENT PLAN
BANDELIER NATIONAL MONUMENT

The US Fish and Wildlife Service (USFWS) sent Bandelier National Monument (park) a letter on December 4, 1995 in response to a request for concurrence with the park's determination (through a Biological Assessment) that the proposed Bandelier Fire Management Program "may affect, but is not likely to adversely affect" proposed, threatened, or endangered species. The species covered in this coorespondence were the "threatened Mexican spotted owl (Strix occidentalis lucida) (owl) and bald eagle (Haliaeetus leucocephalus), and the endangered southwestern willow flycatcher (Empidonas trailii extimus) and peregrine falcon (Falco peregrinus anatum). The USFWS concurred with the park's determination for three of these species, but not with the park's determination regarding the owl because the Bandelier FMP proposed activities was inconsistent with the Recovery Plan for the owl. Additional "communication regarding [USFWS] concerns" was requested for the owl.

The 1996 Dome Fire and receipt of substantive new elk impacts research fundings precluded our preparation of information to the USFWS to justify our proposed fire management actions on management ignited prescribed fires (MIPFs). An addendum to the 1995 BA will be prepared this fall (1997). However, in the interim the following actions will be taken (and constraints imposed) relative to the Bandelier Fire Management Plan:

1) The Prescribed Natural Fire component of the Bandelier FMP will be instituted as stated in the January 1997 FMP since the USFWS concurred with us that "lower intensity prescribed natural fire may have some short-term negative effects to owl habitat but much less than a catastrophic fire that would severely impact habitat conditions."

2) The MIPF component of the Bandelier FMP is hereby modifed so that no MIPFs will be ignited in occupied nesting habitat until we have provide enough evidence (through an addendum BA) to satisfy the USFWS that our finding of "may affect, but is not likely to adversely affect" if we implement the FMP is correct.

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I. Introduction and Policy Compliance

The Fire Management Plan is an implementation document that serves as an addendum to the park Resources Management Plan and meets requirements under the National Environmental Policy Act (NEPA) through an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI).

This document is also guided by NPS Fire Management Guideline (NPS-18, 1990), which requires that any area with vegetation capable of supporting fire will develop a Fire Management Plan. The Organic Act of the National Park Service (August 25, 1916, Section 102) provides the authority for implementation of this plan. Further, the Wilderness Act of 1964 (PL 88-577) and the National Parks and Recreation Act of 1978 were considered in the planning process.

Funding authorities for the fire management program are found in Section 102 of the general provisions of the Department of Interior's annual appropriations bill.

Presidential Proclamation No. 1322 of February 11, 1916 (39 Stat. 1764), which established Bandelier National Monument, stated that "...certain prehistoric aboriginal ruins...are of such unusual ethnological, scientific and educational interest...that the public interest would be promoted by preserving these relics of a vanished people, with as much land as may be necessary for the proper protection thereof...".

The significance of Bandelier lies in its superb combination of cultural, natural and wilderness values. In official recognition of these values, President Ford signed legislation in October 1976, creating a 23,267 ac (9,423 ha) Bandelier Wilderness.

According to recent studies, major park vegetative communities in the southwest evolved with fires of natural origin (Weaver 1951, Caprio et al 1989, Allen 1989, Swetnam 1990, Swetnam and Lynch 1993). Consequently, a forest structure consisting of small, even-aged groups within a larger, uneven-aged mosaic was maintained by fire within the ponderosa pine and mixed conifer cover type. Piñon-juniper woodlands within the monument were historically open with relatively dense grasses, herbs, and organic litter; hence, soils were protected. Higher elevation montane grasslands and open meadow areas were also created and maintained predominately from periodic surface fires.

II. Goal and Management Objectives

This Fire Management Plan prescribes actions necessary to implement Servicewide fire management policies (NPS-18 1990) and to achieve park resource management objectives. The park's primary resource management goal is:

> . . . to preserve, protect, and manage the park's cultural and natural resources within naturally functioning ecosystems, consistent with cultural resource preservation (NPS 1995)

Bandelier National Monument's fire management objectives support this goal, and they are: (1) to allow prescribed natural fires to function in fire-dependent ecosystems; (2) to use fire to meet management objectives; (3) to protect life, property, and park resources from the effects of unwanted fire; and (4) to prevent adverse impacts from fire suppression.

The following fire management strategies should maximize opportunities to achieve these four objectives.

Objective 1: Allow prescribed natural fires to function in fire-dependent ecosystems:

- Permit prescribed natural (lightning-caused) fires in areas where fire dependency has been scientifically proven and the fuel load and vegetative composition are within the range of natural variability
- Permit prescribed natural fires within constraints of policy (NPS-18) and the Environmental Assessment, Fire Management Plan

Objective 2: Use prescribed fire to meet management objectives:

- Create and/or maintain defensible prescribed natural fire boundaries
- Where applicable, restore fuel loads and plant community structure and composition to ranges of natural variability comparable to pre-Anglo settlement using a predetermined regimen of management-ignited prescribed fires
- Minimize the occurrence of unnaturally intense fires through reduction of hazard fuels by management-ignited prescribed fires
- Avoid prescribed fires which would reduce air quality in densely populated areas for extended periods (beyond two weeks)
- Train park staff and cooperators to conduct safe, objective-oriented prescribed fires consistent with NPS-18 requirements

- Provide opportunities for public understanding of fire ecology principles, smoke management, and prescribed fire program objectives
- Monitor and evaluate the effectiveness of the prescribed fire management program

Objective 3: Protect life, property, and park resources from the effects of unwanted fire:

- Conduct all fire management activities commensurate with applicable laws, policies, and regulations.
- Suppress all unwanted fires (declared wildfires) in the park and in the interagency mutual aid zone
- Cooperate extensively with adjacent land management owners through Memoranda of Understanding to facilitate safe and prompt suppression of wildfires
- Suppress all wildfires with minimum cost, environmental and cultural resource impacts
- Use prescribed fire and/or mechanically treat the park's developed zones to simulate the effects of lightning-caused fires and to reduce the threat of unwanted fire
- Prevent unplanned human-caused ignitions through a cooperative fire prevention program
- Provide for the safety of park visitors, neighbors, and employees during all phases of wildland fire management operations
- Provide opportunities for public understanding of the wildland urban intermix problem

Objective 4: Prevent adverse impacts from fire suppression:

- Use minimum impact fire suppression techniques and rehabilitate disturbed areas to protect natural, cultural, wilderness, and scenic resources from adverse impacts attributable to fire suppression activities
- Suppress unwanted fires commensurate with values at risk
- Ensure that a resource advisor is present on all major suppression actions
- Engender understanding among firefighters about the impacts of fire suppression on sensitive park resources
- Avoid the use of non-native seed to rehabilitate sites disturbed by wildfires or their suppression

III. Description of Monument

The monument's Resources Management Plan (1995) and Statement for Management (1988) contain broad physical descriptions of the monument's environment.

Bandelier National Monument is located in north-central New Mexico on the east slopes of the Jemez Mountains (see Figure 1) in an area called the Pajarito plateau. Bandelier is bounded by the Baca Land and Cattle Company to the northwest, (13% of the total boundary), the Cañada de Cochiti Grant to the south (10%), the Santa Fe National Forest to the west and east (46%) and the Department of Energy to the north (31%).

A. Climate

Bandelier lies in an area defined as semi-arid continental climate, but with a great deal of variability which is largely elevation-dependent. According to Allen (1989), annual precipitation within the monument, ranges from approximately 12 in (30 cm) at lowest elevations along the Rio Grande to near 35 in (90 cm) on the top of Cerro Grande. Mean annual precipitation at the monument fire tower, elevation 6,600 ft (2012 m) is 16 in (40.7 cm). Periods of dryness can range from late April through the end of June, ending with an average two-month "monsoon" through August. Sixty percent of the annual precipitation falls between June and September, with thunderstorms reported for fifty eight percent of the days in July and August.

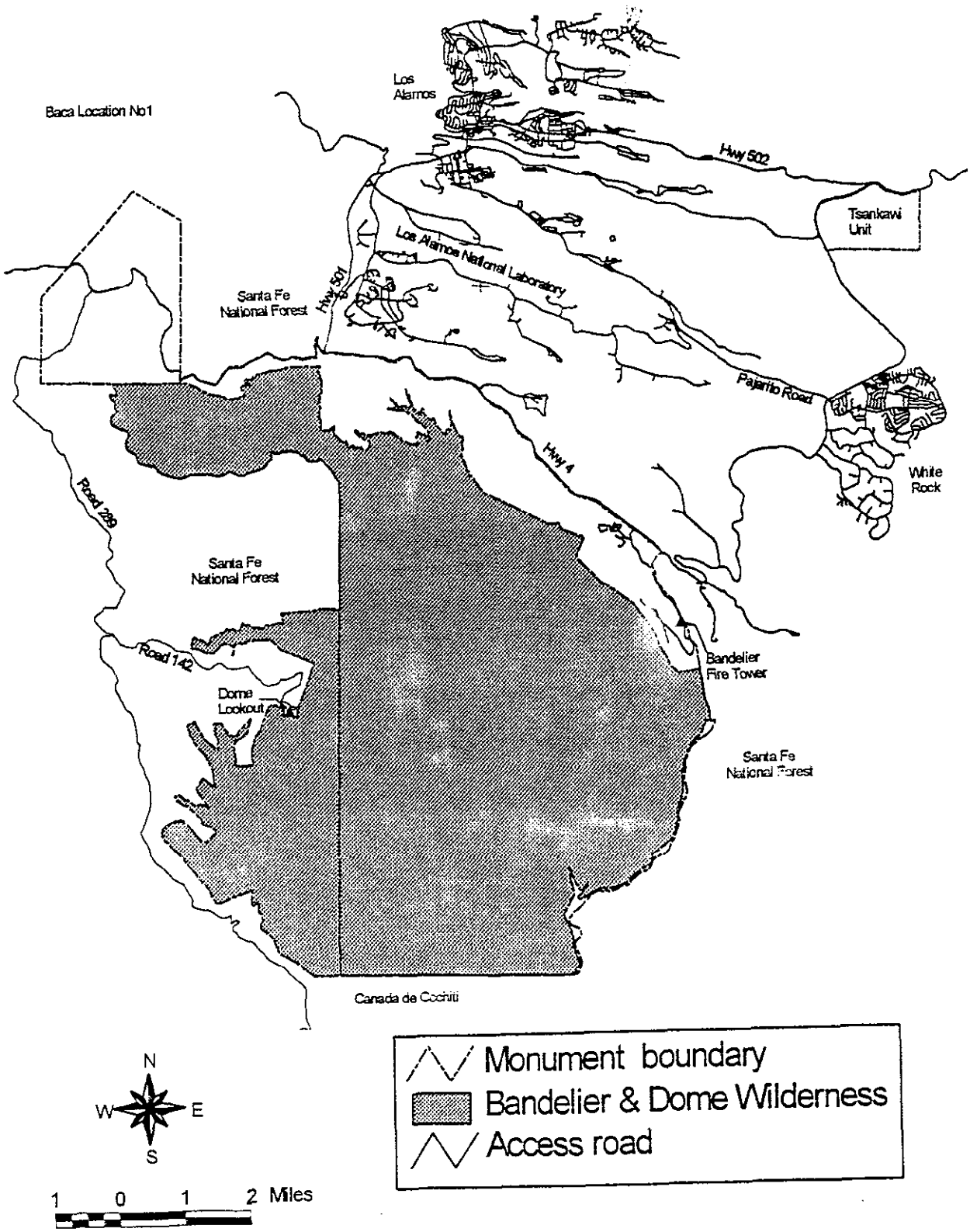
Cyclonic storms in winter result in snow at all elevations. The growing season in Los Alamos averages five months (May 6-October 16)(Allen 1989). Wide fluctuations in precipitation during the year are common. The warmest month is July (mean temperature 82°F (28°C) and January the coldest, with a mean temperature of 28°F (-1.6°C).

B. Topography, Geology and Soils

Bandelier National Monument is situated on the Pajarito plateau, which comprises the east flank of the Jemez Mountains, a large caldera system which erupted over one million years ago. The gently sloping plateau is composed primarily of ash tuff, and is cut by three major canyons within the monument: Frijoles, Alamo, and Capulin. Portions of Medio and Sanchez canyons are located in the southern end of the monument. The eastern margin of this massive tuff formation is the Cerros del Rio basalt in which the Rio Grande flows through White Rock Canyon.

Figure 1.

Bandelier National Monument and Vicinity



Common soil parent materials in the Jemez mountains range from rhyolites and andesites at higher elevations to tuff and pumice at low elevations and basalt at the Rio Grande River (Allen, 1989). Common soils include Entisols, Inceptisols, Alfisols, Mollisols, and Aridosols in and around the monument.

C. Vegetation

There are difficulties in defining monument vegetative patterns as related to fire susceptibility, fire behavior potential, modeling of fuels (see Chapter IV), and prediction of fire effects. Species composition changes both within and along elevational and moisture gradients and aspect; in other words, a relatively uniform compositional "mix" will not necessarily be maintained from stand to stand within a particular cover classification. The following is a broad description of the general vegetative complex as described by Allen (1989).

From the eastern boundary at the Rio Grande River 5300 ft (1616 m) and passing upward, juniper grasslands occur to approximately 6233 ft (1900 m); piñon-juniper woodland to 6890 ft (2100 m); ponderosa pine (Pinus ponderosa) forest 6890 to 7500 ft (2100-2300 m); mixed conifer forest consisting of ponderosa pine, Douglas fir (Pseudotsuga menziesii), white fir (Abies concolor), aspen (Populus tremuloides), and limber pine (Pinus flexilis) from 7500 to 9500 ft (2300-2900 m) and finally spruce-fir forest of Engelmann spruce (Picea engelmanii) and corkbark fir (Abies lasiocarpa var. arizonica) occurring on the north slopes above 9500 ft (2900 m) (Allen, 1989).

The following is a discussion of major landscape areas, cover types, fire history and potential fire behavior.

1. Cerro Grande Area

The Jemez montane grasslands, of which the extensive grassland on Cerro Grande is representative, is a unique ecosystem worthy of preservation. Recent investigation of this region shows that this native grass/forb community is being encroached upon rapidly, primarily by ponderosa pine and Douglas fir.

Among the primary factors contributing to the establishment and maintenance of these grasslands are (1) periodic fire; (2) animal grazing activity; (3) southerly exposure; (4) soil drought due to wind blown transfer of winter snows which creates xeric conditions favoring grasses over trees; (5) deep "A" horizon soils typical of grasslands; and (6) grassland competition against tree seedling establishment.

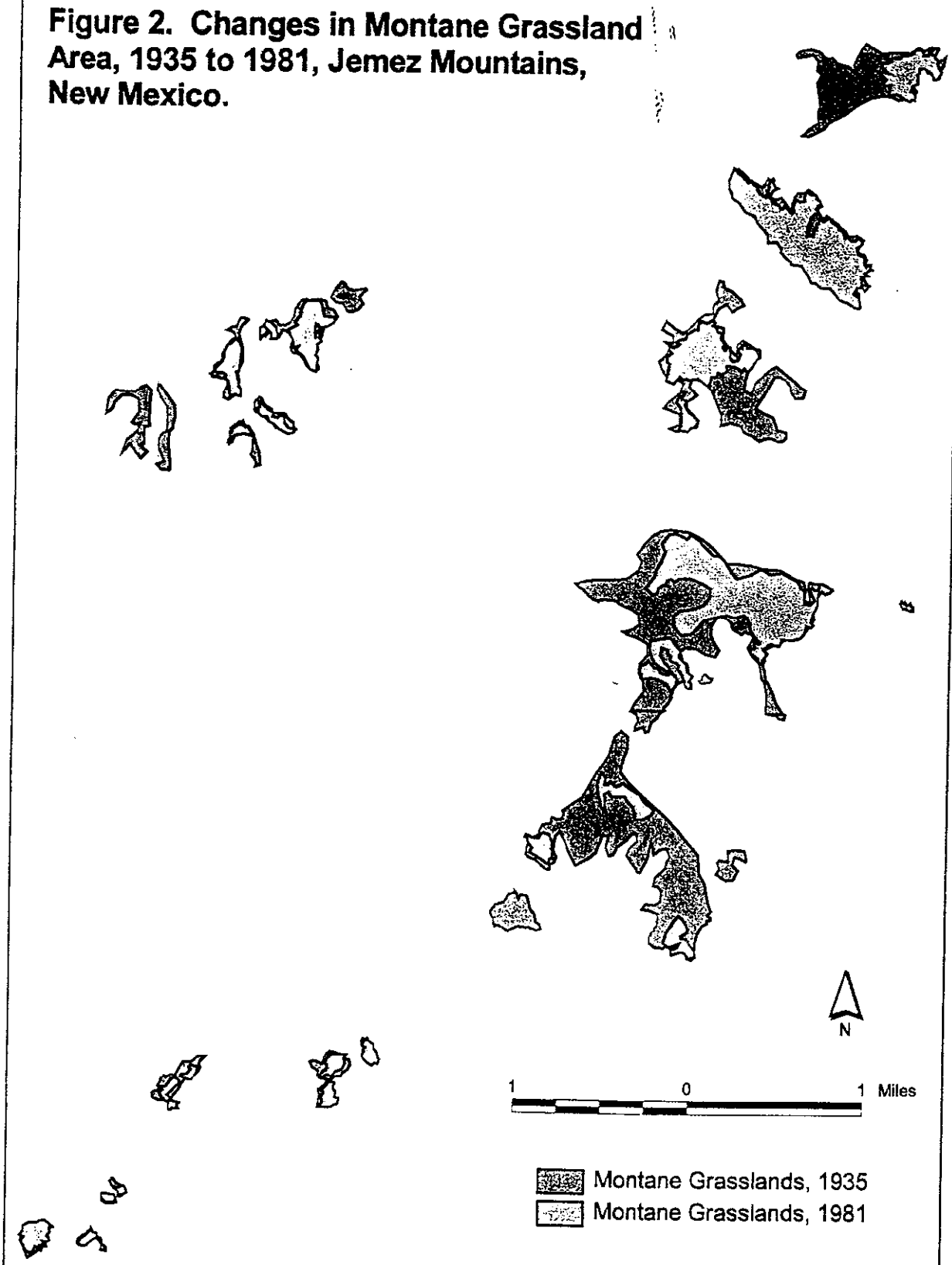
Several of these factors have been altered with time to the extent that presently we are observing a rapid site conversion around the Cerro Grande summit. Hundreds of increment cores from representative sized trees in this area support the premise that aggressive tree invasion began in the late 1910's and continued, with fluctuations, through the present time. It is generally acknowledged that fire is probably the most influential force acting against tree encroachment on grasslands. Tree invasion has also been affected by grazing of domestic livestock in the Cerro Grande area. The rather abrupt replacement of sheep by cattle prior to the 1920's coincides with the beginning of coniferous invasion. All the montane grasslands were seriously degraded due to over grazing by sheep, drought tolerant conifers more easily gained a foot hold when lower numbers of cattle replaced the sheep. Figure 3 illustrates the reduction in montane grassland area between 1935 and 1981. The east face of Cerro Grande is characterized by ponderosa pine as a dominant overstory species, with denser midstory Douglas fir, pine and oakbrush (Quercus gambelii) at midslope and extending into the Frijoles drainage; understory consists of forbs (wildflowers) shrubs and grasses dominated by Thurber fescue (Festuca thurberi).

The west aspect consists of ponderosa pine dominating the upper slopes, with stringers of aspen with grass-forb understory. On the lower slopes, oakbrush patches grade in with ponderosa. Some mixed conifer stringers extend upward following the east fork (headwaters). Cerro Grande is a vital ecological complex. As habitat for turkey and blue grouse, a variety of rodents and many other small and large animals, and a population of raptors, the need to restore and maintain a healthy ground cover remains critical to keeping the necessary balance.

Historical fires evidently ran upslope (or backed downslope in some cases) to the ridgecrest where normally they slowed or ceased spread in the spruce stands which occupy the north aspect of Cerro Grande. An eleven year mean fire interval occurred prior to 1900. Due to the absence of periodic fire on Cerro Grande in the 20th Century, conifer establishment and density has increased unimpeded. Needle cast and dense shading have contributed to the overall decline in vigor of the native grasses in the forest understory. The meadows of the lower Cerro Grande are thought to be more mesic in character. Since the advent of aggressive suppression policies following the turn of the century, there has been a serious encroachment of conifer species on the once moist meadows. This has resulted in depletion of soil moisture by the transpiration of trees, enhancing the drying of these meadows and further encouraging tree invasion.

That portion of forested flats below Cerro Grande covers the mesatop bounded on the north by State Route 4, the flats on the west and east sides of Upper Frijoles Canyon to the park boundaries, and on the east by the NW-SE trending drainage which bisects Apache Mesa. This area consists of mixed conifer (Douglas & white fir, ponderosa pine, limber pine) and aspen overstory, with fir-pine midstory

Figure 2. Changes in Montane Grassland Area, 1935 to 1981, Jemez Mountains, New Mexico.



and understory. The ground cover is grass dominated, with forbs scattered about. There is also a remnant old growth snag population in the overstory which serves as habitat for a variety of bird and rodent species. Records indicate this area was harvested between 30 and 60 years ago. This activity left resultant heavy loadings of rotted logs (primarily Douglas fir) often exceeding 40 in (1 m) in diameter. The absence of fire since the turn of the century has created a severe fire problem due to high crown-fire potential, along with negative effects on herbaceous species occupying the understory due to blockage of sunlight, water transpiration, and heavy needle litter buildup.

2. Frijoles Canyon Area

Located within Frijoles Canyon, this area extends from the headwaters to Lower Frijoles Falls.

The vegetation is rich, varied and relatively dense; mixed conifer dominates the overstory and much of the mid-story, with several hardwood species occurring in patches near the streamside. Dense shrubs, forbs, and grasses occur along with heavy litter and branchwood which contribute to the surface fuel strata.

The lower reaches of this unit were treated with prescribed fire, and consequently some leftover burned woody debris remains. The upper inner-canyon areas have not been burned largely since the 1977 La Mesa Fire. Fire history chronologies for canyon wall portions of this area are incomplete; however, Allen (1989) reports that fires typically spread down into the canyon bottom from adjacent mesatops, resulting in widespread fires with a mean fire interval of 11 years. The last major fire to burn through Upper Frijoles Canyon was 1893.

The fuel loadings in this area are such that extreme fireline intensities with high energy release could result; and under severe wildfire conditions, extreme resistance to control could be expected once a fire front reaches the steep slopes (40-60%) on either canyon wall. The canyon area below Upper Crossing consists of mixed-conifer overstory with cottonwood, boxelder and alder dominating the midstory along the streamcourse.

Grasses, forbs and low shrubs constitute the live understory vegetation. Dead/down fuels are a complex of branchwood, large logs, needle, leaf and herbaceous litter with areas of duff extending to 6-8 in (15-20 cm) below litter surface. Surface fuels can accumulate in the canyon bottom comparatively faster than the adjacent mesatops due to the high productivity of the riparian environment.

3. Burnt-Escobas Mesas, mesas south to the monument boundary

This area is described as largely ponderosa pine-gambel oak with some piñon-juniper woodland on the eastern-most extent. Much of this unit was moderately to severely burned over during the 1977 La Mesa Fire and/or the 1996 Dome Fire. Therefore many areas are in the process of recovery through primary successional vegetative establishment. Grasslands, oak shrubfields, and ponderosa pine savannahs now dominate much of the [La Mesa fire] area. The Dome fire, which burned 4,779 acres of Bandelier landscape, included several areas of severe burn intensity where all surface vegetation was consumed on the higher slopes just west of upper Capulin Canyon.

Large ungulate grazing has had a significant impact on fire's ability to carry on the surface. There are locations which contain remnant arrays of large, often pitchy downed fuels.

The phenomenon of allelopathy, the chemical inhibition of one plant by another, is a means of restricting establishment of potential competitors (Evans, 1988). Foliage and competition from piñon and juniper prevent understory herbaceous growth in wide areas of the monument. Without this herbaceous component, fire's ability to spread is severely restricted.

4. Canyon bottoms of Lummis, Alamo, and Capulin; Portions of Medio, Sanchez, and Whiterock Canyons

Canyon bottom vegetation for nearly the entire length of Capulin Canyon was affected to differing degrees by the 1996 Dome fire. Ground fuels in upper Capulin were heavy, contributing in several locations to high intensity fire and loss of both ground fuels and standing live midstory and overstory. In the more xeric areas, vegetation and fuels were more discontinuous and therefore were subjected to light surface fire. Capulin Canyon bottom will pass through several years of successional vegetative phases. However, the rate of overall vegetational recovery will be largely dependent on moisture availability from both streamflow and precipitation patterns.

Whiterock Canyon hosts largely riverine vegetation: New Mexico Olive (Forestiera neomexicana), juniper (Juniperus sp.), and sagebrush (Salvia sp.), and herbaceous ground cover. Although fire does not play a distinct role in shaping vegetation, this area can support fire when large amounts of floodwater debris and drowned plants occur near river level.

5. Tsankawi area

This 800-acre detached section of the monument supports primarily piñon-juniper association with scattered ponderosa pine in the arroyo bottoms. Light, patchy ground fuels separated by rock outcroppings will result in limited spread low intensity fire, likely to burn only under the driest and windiest of conditions.

D. Fauna

Bandelier supports habitat for a wide variety of animal species, including approximately 1000 known arthropods, 5 amphibians, 14 reptiles, 44 mammals including 5 species of bats.

About 115 bird species and 90 species of ants have been recorded in and around the park area (Allen, 1989). A species list of fauna is located in Appendix L.

There is also habitat within the park which supports a variety of listed threatened and endangered species.
The state listed endangered (& Federal Category 2, under review for listing) Jemez Mountains salamander (Plethodon neomexicana) may occupy habitat within the park. Bandelier also supports habitat for the bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus), (endangered), and the Mexican spotted owl (Strix occidentalis lucida), (threatened), (Allen, 1989). The southwestern willow flycatcher, Empidonax trailii estimus, is listed as endangered.

E. Cultural Resources

There are 31 historic structures and more than 300 pieces of handmade Pueblo Revival furniture dating to the Civilian Conservation Corps (CCC) era among the historic resources of the monument. The structures represent the most complete assemblage of CCC architecture in the country and as a Historic District, achieved National Landmark status on May 28, 1987. An estimated 6,000 archaeological sites ranging from simple lithic scatters to complex structural sites representing several periods are found within the monument. These sites date largely from 1100-1600 A.D., and comprise one of the largest concentrations of sites in the National Park System. A four-year field survey has been completed which sampled approximately forty percent of the monument land area. In addition, survey work associated with the rehabilitation of the 1996 Dome fire resulted in additional site recordings, and are listed in the monument GIS.

The monument contains a historic orchard planted by Judge Abbot in 1913, and is located just west of the ruins at Tyuonyi. Management objectives for the orchard

are to maintain genetic strains (to the extent possible) and the overall historic features of the area.

The 4,234 ac (1,714 ha) Cañada de Cochiti Grant located on the monument's southern boundary, has been authorized for addition to the monument. This tract contains the remains of a hispanic village established circa 1728, as well as several earlier Ancestral Puebloan sites.

F. Air Quality

Bandelier's 23,267 ac (9423 ha) Wilderness is protected under Class I Air Quality Standards as directed by the Clean Air Act and Amendments (1972, 1977, and 1990). As such, the monument must maintain the highest levels of protection from pollutants and visibility degradation.

Protection of visibility in Class I areas such as the Bandelier Wilderness is an important aspect of the PSD (Prevention of Significant Deterioration) section of the Act. The Act also sets a broad goal to prevent any future impairment of visibility. Although prescribed fire is defined as a "temporary" source of air pollution, state and local laws may apply under the general category of "open controlled burning". Specific New Mexico State air quality guidelines for prescribed fire smoke and smoke management procedures are contained in the Air Quality/Smoke Management Guidelines (Chapter VIII). For reference, see the Memorandum of Understanding, New Mexico Smoke Management (rev. 1997), Appendix F.

G. Water Resources

Natural water within the monument is limited largely to springs, seeps and perennial and intermittent streams. Several old stock ponds occur in the 1977 acquisition tract, within the upper Frijoles drainage. These ponds are designated for removal and reclamation in the 1995 Resources Management Plan.

Frijoles Creek is a perennial second-order stream which flows in its entirety within the monument. It can provide water for fire management operations anywhere along its length; summer flow varies from 3-15 cubic ft/sec (cfs). Alamo Creek can be intermittent over its total length, depending on summer precipitation amounts. As such, it cannot be counted on to provide a consistent source of water for wildland fire operations. Capulin Creek will remain an unstable and variable flow watercourse for several years due to the effects of the Dome fire. Other canyons (i.e., Medio and Sanchez) within the monument carry only storm runoff, mainly during July and August.

H. Human Uses

The following section briefly describes the evolution of human use of the Bandelier area, with the intention of characterizing how these uses contributed to shaping many of today's vegetative communities. These communities in turn defined fuels mosaics and attendant fire behavior patterns.

The early (or archaic) period began approximately 7500 years ago, and is thought to mark the beginnings of human agricultural activity in the area, replacing or supplementing hunting and gathering. The Ancestral Puebloan peoples began settlement on the Pajarito Plateau about 1100 AD, with population increases on the plateau during the 13th century.

One of the many human uses which had a major effect on the vegetative structure of the area was domestic livestock grazing, which occurred between 1860 and 1932, with particularly heavy grazing in the late 1880's (Allen, 1989.)

Fire history and other studies have shown (Swetnam, 1989 and Allen. 1989) that land use patterns from the 1890's forward, combined with a policy of total fire suppression beginning in the 1910's, constituted an alteration of the ecosystem unparalleled in human history of this region. See Chapter IV for further discussion.

The Santa Fe National Forest began administering the newly created Bandelier National Monument in 1916, promoting multiple-use of the monument's natural resources. In 1932, the monument was transferred to the National Park Service, and all resource use-based activities ceased at that time.

Another significant influence was the beginning of the Department of Energy's Los Alamos Scientific Laboratory in 1943. The growth and development of this facility to the present has greatly increased the potential for wildfires originating on monument lands to threaten highly sensitive technical areas.

A review of total monument visitation trends reveals a annual increase for the last decade of just over 10% per year. The 1993 total visitation was 367,478; 1994 visitation totaled 430,978 (with a slight decline to 396,517 in 1995). If this increase in monument visitation continues, there is a higher probability of human-caused ignitions particularly in and around developed areas.

IV. The Historic Role of Fire in Bandelier and the Jemez Mountains

The following sections describe how Bandelier's ecosystems were affected by fire; through its former natural presence, its more recent absence, and from suppression activities.

A. Fire History

There is no conclusive scientific evidence that puebloan cultures of this region utilized fire in hunting or other activities; however, one historical (Komarek, 1969) account suggests that these early peoples recognized lightning fires as a "natural force" which enhanced wildlife habitat and often checked outbreaks of insects and disease.

The southwestern United States has led the nation in average number of lightning fires each year. This vigorous fire regime ensues from an annual cycle of a variably wet cool season, a normally arid foresummer, and isolated lightning storms ushering the onset of the summer monsoonal rains. Lightning fires begin in the early spring and peak in late June to early July and decrease significantly as the summer rainy season progresses. Local surface burns are recorded as fire scars in tree rings, which allows simultaneous evaluation along with climatic patterns (Swetnam and Betancourt, 1990).

In terms of monument fire history, Caprio, et al (1989) reports that the Frijoles watershed has an active fire event record, the study points out that fire was a common occurrence throughout the watershed prior to 1900. Also of note is the notion that fires could occur commonly in different parts of the Frijoles watershed within the same year. Allen (1989) reports that for this entire watershed, the mean fire interval (i.e., a fire occurring somewhere on the study area) pre-1900 for all sampled cross-sections combined, ranged from 4 to 13 years. Extensive fires burned across the sample area in 1684, 1709, 1725, 1737, 1773, 1814, 1822, and 1842. Most of these watershed-wide type fires diminished after 1851, except one which occurred in 1899. The average frequency for all fire history studies for all sample areas (ponderosa pine-mixed conifer overstory type) is one fire in 10 years during the 18th and 19th centuries. The pattern for the 20th century is a different story entirely.

Seasonality of past fires is also important. According to Allen (1989), dormant season (i.e., late September-April) scars represented 33% of the total scars recorded (figure 3). Following this is 45% for May-June (18% early-earlywood,

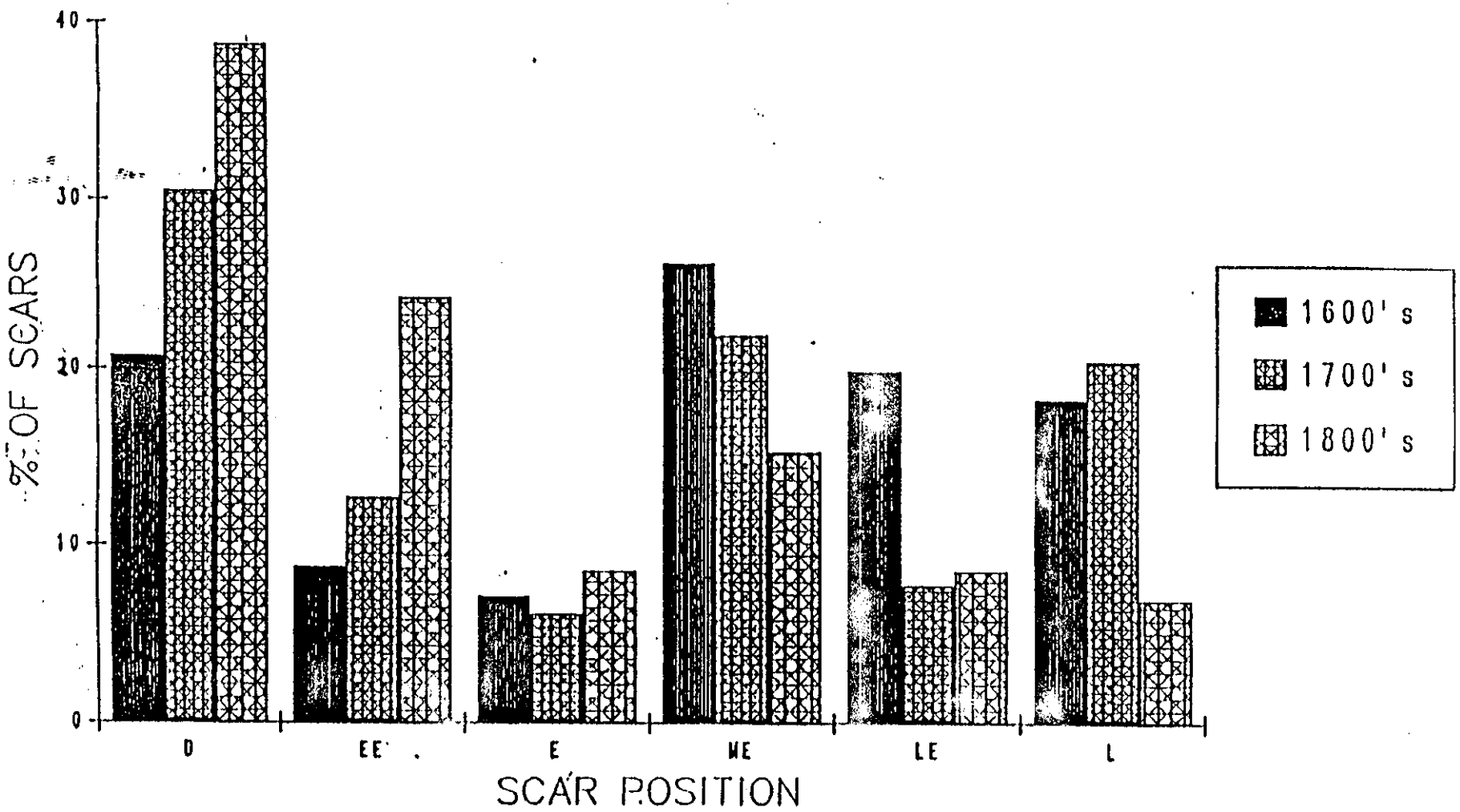
8% earlywood, 19% mid earlywood), and 22% in late-early and latewood. These percentages correspond somewhat closely to local seasonal lightning patterns (Figure 3).

As shown on Figure 4, fire occurrence was drastically reduced starting at the turn of the century. Likely the result of steadily increasing human settlement and activities requiring fire protection, this marked the beginning of simultaneous decline of "free burning" wildfires and consequent steady annual increase in forest debris (i.e., fuels) accumulations, even-aged forest structure, and decline of fire-dependent species.

Figure 5 displays current size-class distributions for the mixed conifer cover type at one location. This is illustrative of a stand structure severely altered due to the absence of stand regulating fire. Allen (1989) also discusses the increases in the density of local ponderosa pine forests. Figure 6 displays the size-class structure on a Research Natural Area on National Forest lands approximately 18-6 mi (30 km) west of the monument. Here, the two-tiered stand shows an old growth density of 45.5 stem/ac (100 stems/ha), with an understory thicket of stagnant saplings and poles which raises the total stand density to 9826 stem/ac (21,617 stems/ha). This condition sharply raises the potential for destructive, difficult to control crown fire. Such was the case in 1977 when the monument's ponderosa pine zone was suddenly and severely altered by the La Mesa fire. Changes in stand densities noted above largely led to this devastating fire, a largely unnatural crown-type fire which took out much of Bandelier's extremely overstocked ponderosa forest with in a few days. Total fuel load in the fire area ranged from 16-25 ton/acre (35,840-56,000 kg/ha), which is considered moderate to high for this forest type. However, current fuels complexes weigh in at 25-45 tons/acre (56,000-100,800 kg/ha) within the higher elevation mixed conifer forest.

Another such event leading to vegetative cover alteration of over 16,000 acres of Santa Fe National Forest and Bandelier National Monument was the Dome fire in 1996. A human-caused start in late April, this fire occurred in high fire severity conditions resulting from an unusually dry and windy early spring. Although crownfire behavior was the rule over the upper Capulin watershed on National Forest lands, the monument by contrast was affected by lower to moderate fire intensities not unlike many management-ignited prescribed fires. This was mainly due to changes in vegetative composition and structure, however.

Figure 3 Relative scar position by century for all fire scars, 1600-1899.



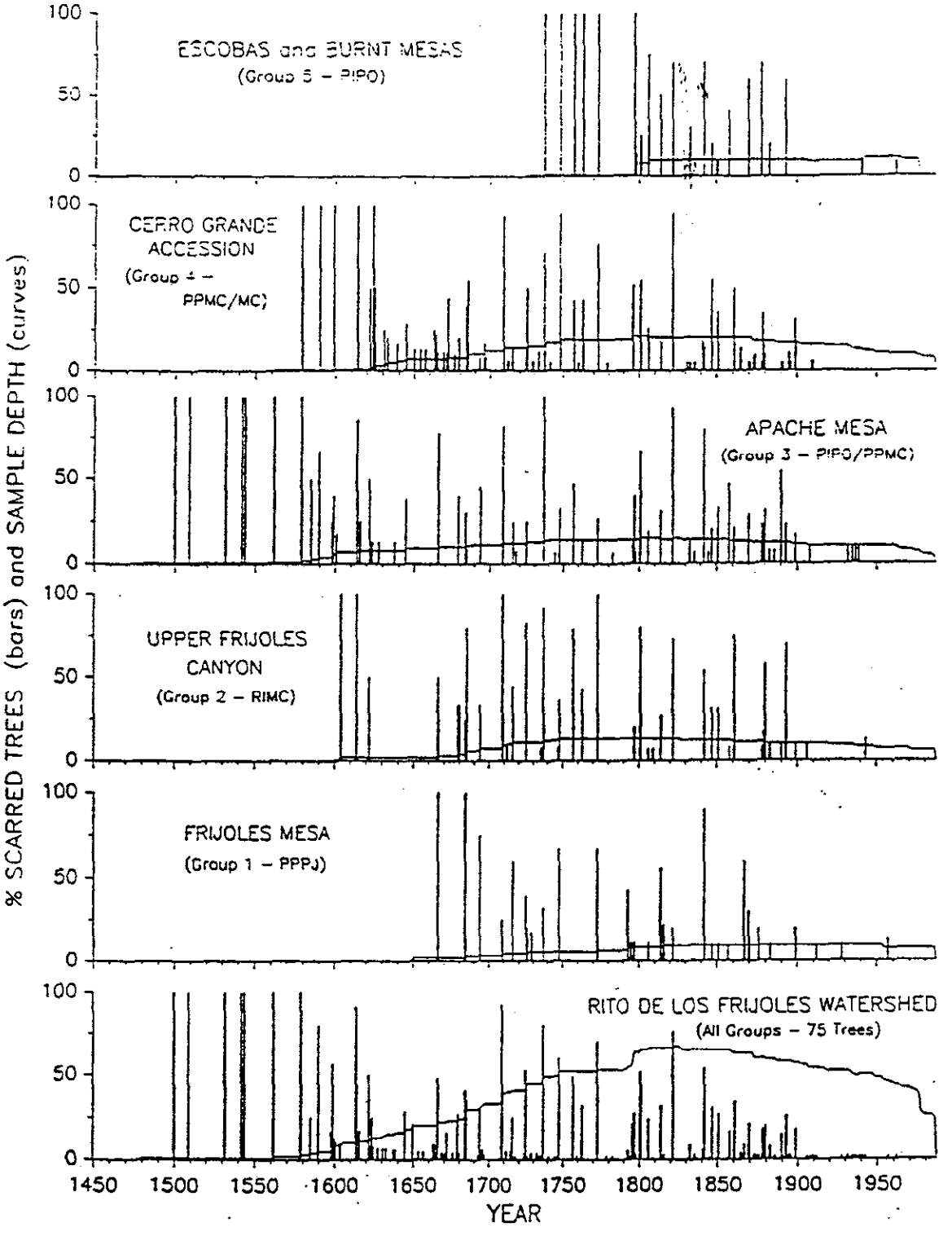


Figure 4. Frijoles Watershed Fire History.

FIGURE 5. Mixed conifer forest size-class distribution near sample point #471, Cerro Grande slopes.

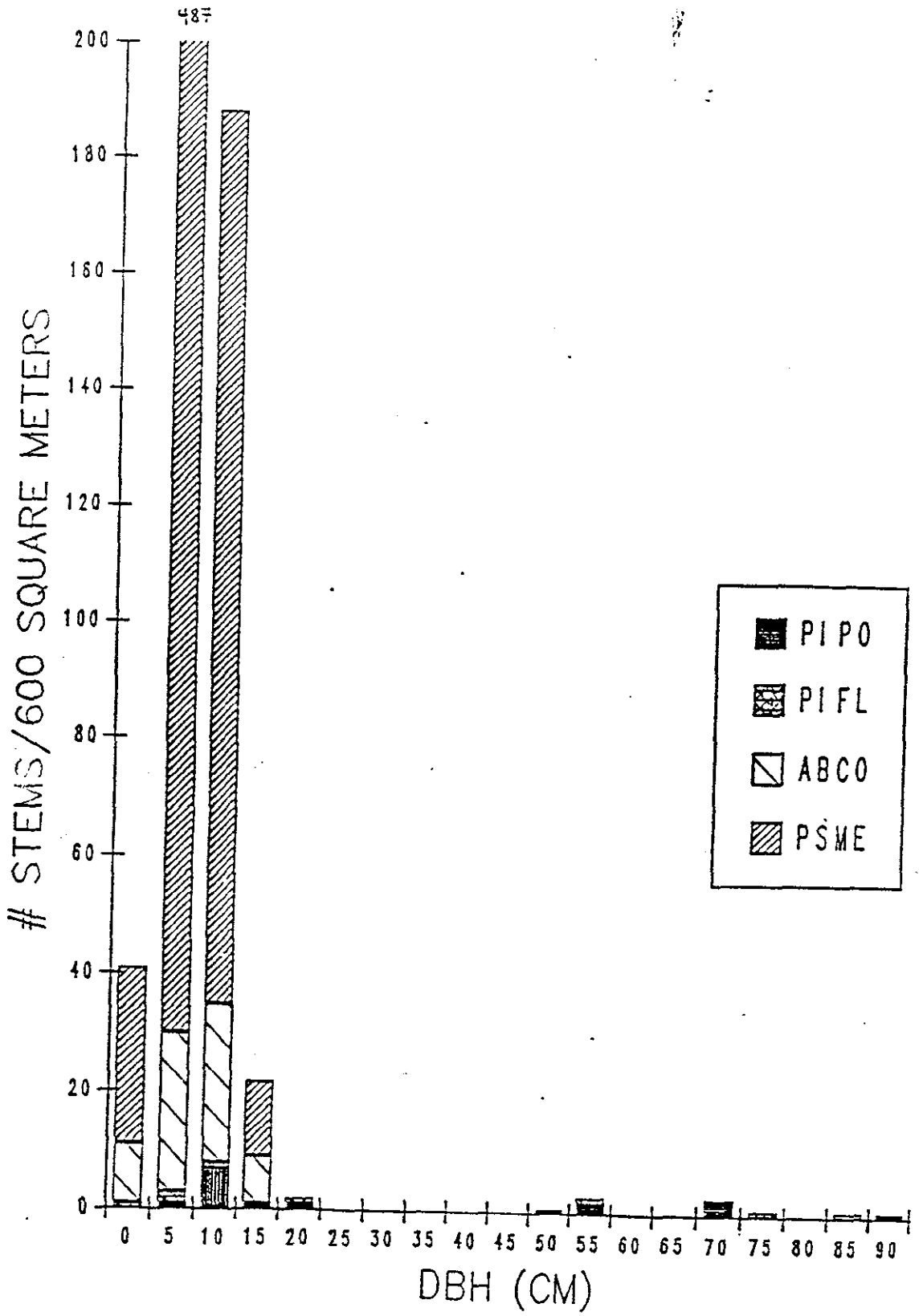
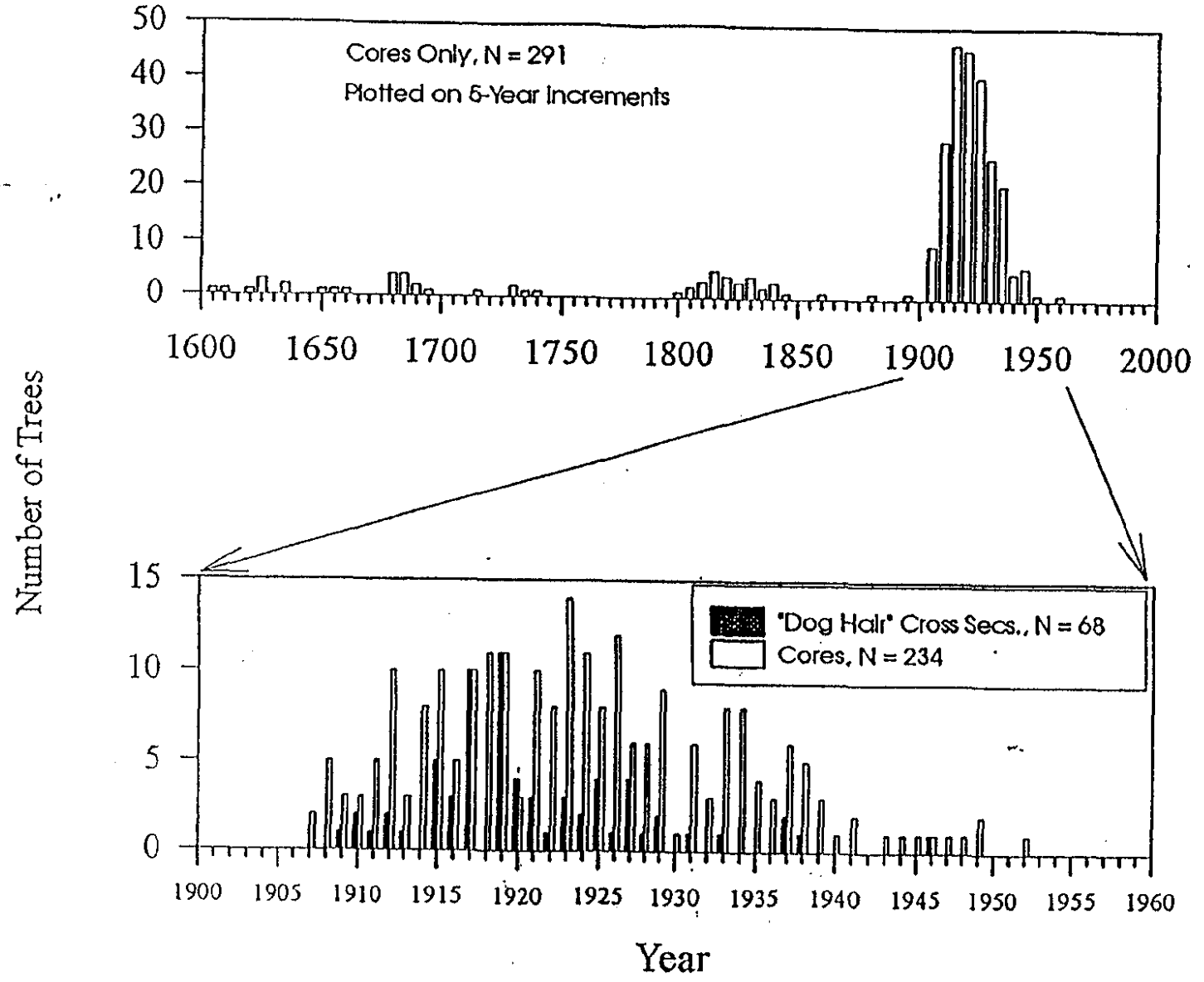


Figure 6. Ponderosa pine recruitment dates from Monument Canyon RNA. Dates are estimated from increment cores from living trees over 10 cm dbh, and from cross sections taken at the root crown from poles in dog hair thickets. Since increment cores were taken near ground level, but often did not intercept the pith, these dates are considered less accurate than dates from cross sections.



B. Fuels

Fuels represented within the primary vegetation types have been sampled (Allen, 1987, and Forester, 1979). Although fuel loads vary widely because of history of burns, elevation, aspect, growing season, etc., the following table represents an overall view:

VEGETATION TYPE	RANGE OF FUEL LOADING(TONS/ACRE) (Represents estimates based on sample inventories.)
Subalpine Meadow/Forest	0-10 tons/acre (0-22,400kg/ha)
Mixed Conifer	20-45 tons/acre (44,800-100,800kg/ha)
Ponderosa Pine	10-15 tons/acre (22,400-33,600kg/ha)
Piñon-Juniper Woodland	0-10 tons/acre (0-22,400kg/ha)
Riparian Woodland	10-30 tons/acre (22,400-67,200kg/ha)

Effects of fire on nutrient cycling pathways is an important dynamic in discussing fuels. One dynamic is the action of monoterpenes. During a fire, nutrients incorporated in vegetation, litter and soil can potentially be volatized during combustion, mineralized during oxidation, or lost by ash convection (Grier, 1975). Nitrogen is often the nutrient limiting production in conifer forests. Fire acts as a mineralizing agent, releasing nutrients in available forms. However, nitrogen is lost during fires, which can further deplete this limiting nutrient. Without fire, nitrogen becomes tied up in partially decomposed litter (needles and woody debris). The problems faced by managers of these forest systems are how and when to use fire from a nutrient perspective. Nitrogen mineralization and nitrification patterns were higher in sites recently burned (within two years) and were lowest in sites without fire since the 1890's. Within a site, concentrations of certain monoterpenes were consistently negatively correlated with rates nitrification and mineralization. In these systems, fire promotes more rapid cycling of nitrogen, in part through combustion of monoterpene inhibitors (White, 1994).

A map of fuel models of the monument is located in Appendix D.

V. Fire Management Strategies

The park will employ (1) a suppression strategy to accomplish human safety and resource protection objectives; and (2) prescribed fire as a strategy to meet the other resource objectives stated in chapter II.

A. Wildfire Suppression

All declared wildfires will be suppressed in the monument..." at minimum cost consistent with the values at risk while minimizing the impacts from suppression activities" (NPS-18). In the Suppression Zone, all unwanted ignitions will be suppressed by employing a response appropriate to the conditions, with costs being commensurate with values at risk.

In the PNF Zone, should suppression of a declared wildfire become necessary, the initial strategy would be selected similar to that described for the suppression zone.

A map of the two Fire Management Zones is found on the inside back cover of this plan and discussed in this section, part C.

B. Prescribed Fire Management

The monument will employ Management Ignited Prescribed Fire (MIPF) to achieve objectives stated in Chapter II. Strategies to achieve objectives are outlined below and expanded on in Chapter VIII.

Prescribed Natural Fires (PNF), ignited by natural means (usually lightning), will be permitted to burn in the designated zone under specific environmental conditions with adequate management personnel and support available to achieve defined objectives. (See Fire Management Zone Map.)

C. Fire Management Zones

Under this plan, and for purposes of guiding management of fire in and around values at risk, the monument is subdivided into two areas (or "zones") where similar strategies are employed. These zones include (1) Full Suppression; (2) Prescribed Natural Fire.

1. Suppression Zone

This zone consists of three major geographic areas of the monument:

(1) The visitor center, headquarters and mesa developed area. This zone also includes major trailheads from the Frijoles Canyon Headquarters area. These features, along with attendant utilities, large cultural sites and other values are at risk for potential damage or destruction resulting from unwanted wildfire.

(2) Apache Mesa, west of the Upper Frijoles Crossing trail and the entire 1977 acquisition area of Upper Frijoles watershed.

(3) The detached Tsankawi Section.

All ignitions within the boundaries of the suppression zone will be declared wildfires and will be suppressed. However, management-ignited prescribed fires (MIPF) will continue to be utilized for purposes of hazard fuels reduction and resources management.

2. Prescribed Natural Fire Zone

The Prescribed Natural Fire Zone includes all of the remaining monument lands. This zone lies south of State Route 4 between the Ponderosa Campground and approximately one mile west of the Bandelier Entrance Station (see Appendix D). In addition, the mesas between Frijoles and Alamo Canyons, along with all land south of Alamo Canyon to the monument boundary is included within this Zone.

The strategy employed within this Zone is prescribed natural fire for all natural ignitions which meet prescription parameters (see Appendix I).

See detailed discussion regarding PNF in Chapter VIII.

D. Management Constraints

1. Chemical Retardants

Chemical retardants will not be routinely used. However, when authorized by the Superintendent, only fugitive dye type retardant will be allowed. The Chief of Resources Management should approve the use of any chemical retardants considered in suppression operations.

2. **Dozers**

Dozers are prohibited within the monument wilderness. Dozers may be used outside wilderness only if the fire is life threatening, and if the dozer is accompanied by a designated resource advisor for the monument, and with written approval from the Superintendent.

3. **Sensitive areas or species**

Sensitive areas or species (particularly threatened, endangered or candidate) in the monument will be protected from suppression activities. These areas/habitats will be included in documents such as the line officers briefing statement, prescribed burn plans, or pre-attack plans/Escaped Fire Situation Analyses. A natural and/or cultural resource advisor from the monument must be attached to the incident overhead team.

E. Fire Management Committee

The monument Fire Management Committee (FMC) is an in-house review and advisory body for the Superintendent. Consisting of the FMO (Chair), Chief, Resource Management, Research Ecologist, Biological Resources Division (USGS), and the Superintendent.

Generally, the role and function of this committee is (1) advisory to the Superintendent regarding fire management policy (including budget and fiscal) and program direction; (2) to provide a forum of discussion regarding major operational issues in fire management; (3) to recommend changes or new initiatives in areas of fire research themes, developing partnerships with other parks, brokering fire management expertise where appropriate with other areas or agencies; and (4) to review past fire management activities (MIPF, PNF, suppression, etc.) and develop new or efficient ways to improve program management.

The committee will meet at least annually during the spring (February or March), with the meeting agenda developed by the FMO with member input prior to the planned meeting.

A joint BAND-ELMA Fire Management Committee meeting will be arranged by the Area FMO as needed to discuss areas of mutual concern to both parks.

VI. Wildfire Program

This chapter discusses the major elements of a total program aimed at prevention and suppression of wildfires in and around the monument. This program will outline prevention, potential fire behavior, presuppression and emergency presuppression activities and funding, detection, suppression operations, and rehabilitation. Necessary records and reporting requirements are also covered.

A. Fire prevention

This section summarizes objectives and lists general action items established from the fire prevention analysis process.

Wildfire prevention efforts are directed toward ignitions which pose the greatest potential to cause unacceptable injury or loss to human life as highest priority; and secondly, the prevention of damage or loss to resource values.

Included in monument resource values are the following:

- visitor facilities: including two campgrounds, roads, trails, visitor center, contact station (Tsankawi section), and amphitheater; flush and pit toilets, fences, park radio repeater sites, and sewage lagoons;
- administrative facilities: including four housing areas, offices, three maintenance work areas, two corrals, a back-country cabin, and staff vehicles;
- cultural resources: including archaeological sites, historic landscapes, a historic CCC district, and collections;
- Congressionally designated wilderness;
- natural resources: including altered vegetative communities due to fire exclusion and past land use practices, restricted plant/animal species, and high "fire hazard potential" areas.

The Fire Prevention Analysis and Action Plan is included in Appendix N; however, base maps, overlays, and Prevention Zone planning worksheets are located in the Fire Management Office. The prevention analysis guides the establishment of the objectives and general action items (listed below).

The Action Plan, which contains detailed actions, will be reviewed annually and updated if changes occur which alter one or more of the identified RISKS,

HAZARDS and/or VALUES; and consequently, if changes in management actions are indicated.

1. Objectives

Prevention objectives are listed in priority order, and will guide the Prevention Action Plan:

- To reduce the threat of human caused fires through visitor and employee educational programs;
- To reduce hazards which may threaten identified values at risk; and
- To integrate the prevention message into the monument's on-site and off-site interpretive programs.

2. General action items

The following action items have been identified as elements in the monument's overall fire prevention program. They have been developed from reference materials, including 10 years of historical human-caused fire data by location, ignition source and date. These fires are displayed on a basemap contained in Appendix N.

According to the human-caused wildfire occurrence data (source: DI-1202 Fire Reports, 1984-1994), two ignition sources are identified: campfires and smokers. The following general action items address both the primary sources and summarize general parkwide actions:

a. A fire prevention message will be developed for the visitor center, fire tower, and entrance station.

Responsible person: Fire Management Officer (FMO), On-going

b. Fire danger signs will be placed at the entrance station and campground kiosk during periods of staffing class III or higher.

Responsible person: Supervisory Forestry Technician, Annually

c. The Monument Staffing Plan will call for increased fire prevention patrols during staffing level IV or higher.

Responsible person: Supervisory Forestry Technician, Annually

d. Reduce hazardous fuels through use of management-ignited prescribed fire.

d. Reduce hazardous fuels through use of management-ignited prescribed fire.

Responsible person: Fire Management Officer, On-going.

B. Presuppression

Responsibility for implementation of presuppression activities lies with the Supervisory Forestry Technician under the supervision of the Fire Management Officer.

1. Training, qualifications, and certification

Fire management has rapidly become a highly technical and professional field, requiring skilled and knowledgeable employees within the National Park Service. This section is intended to promote effective individual job performance within the suppression operation.

The monument fire training needs analysis is developed annually, and provides the information needed to determine which courses will be required, which employees are targeted to attend, and number of slots available per course. The courses identified are based on actual position needs and are reflected in the employee development plans. The numbers and levels of qualified employees will be guided by the FIREPRO analysis.

All fire training/performance assignments offered to monument personnel will be in accordance with current NPS Wildland Fire Qualifications and Certification System (WFQC System). Yearly updates, through training certificates and completed redcard submissions, occur for the Intermountain Region during January and February for permanents, April and June for the fire crew and seasonals from other sections. The Area FMO has the authority to issue red cards to all permanents and FIREPRO seasonals, and other seasonals on an as required basis. See also NPS-18, Training and Qualifications.

Each December, the FMO will issue a memo to all redcarded employees that the approved aerobic fitness test will be administered before February 15 of the following year. The fire Program Assistant will arrange testing and keep record of results. The fire Program Assistant will establish and maintain updated files (folder and SACS) for each fire-qualified individual, listing training and experience completed.

A training needs assessment will be conducted by the FMO during the month of July. Courses and trainee assignments required to meet position needs the monument (see below) will follow FIREPRO, Region and monument guidelines.

The FMO shall seek clearance from cultural and/or natural resources branches for any monument area for which training field exercises will be conducted involving potential impacts to resources (i.e., exercises involving chainsaw use, engine operations, aircraft use, etc.)

Position needs (determined by FIREPRO analysis for monument and national program) are listed below. This plan assumes the position will receive prerequisite training and experience for the target job identified.

Training needs: Suppression

Position	Target job	Target date
Chief, RM	FBAN/PSC2	12-98
FMO	PSC2	12-98
Supervisory Forestry Technician	OSC2 ATGS	12-98 12-98
Fire Program Assistant	EMTB MEDL	recertify biannually recertify annually
PFSM Leader	TBA	
PFSM Asst. Leader	CRWB	12-98
Engine Foreman	ICT4/CRWB	recertify
Archaeologist	Resource Advisor	[1]
Plant/Animal Specialists	Resource Advisor	[1]

[1] Must be certified as a Firefighter to be able to go out on the fireline.

Training needs: Prescribed Fire

Position	Target job	Target date
Chief, RM	RXB	recertify
FMO	TBA	
Supervisory Forestry Technician	RXI1 RXM2	12-98 12-98
PFSM Leader	RXI1	12-97
PFSM Asst. Leader	RXI2 RXFM	12-97 12-98
Engine Foreman	RXI2	12-97

2. National Fire Danger Ration System (NFDRS)

The normal fire season for Bandelier under FIREPRO is April 15-September 15. However, these dates are averages and periods of high fire danger can occur as early as March and as late as November.

The basis for most presuppression activities is the National Fire Danger Raging System, or NFDRS. This system requires a standardized entry of weather and fuel moisture parameters. Fire danger indices are calculated for stylized fuel models and provide the foundation for staffing activities illustrated in Appendix C.

There are three functioning weather stations in the monument: a primary standard station (290801; name: TOWER) located at the fire lookout tower, the readings from which provide the daily WIMS (Weather Information Management System) indices. A second RAWS station has been installed at the Ponderosa Campground, the data from which is accessible by computer download. The third station is sited above 9,100 ft. (2773 m) elevation in Sec. 27, T19N, R5E (data also available by computer download).

Weather observations are collected year around. By March 15, the thousand-hour time-lag fuel moisture is initially set and a new fuel stick sensor is installed. By April 1 the fuel stick season has seasoned for several weeks and readings are consistent.

A "Fire Weather Watch" is defined by the National Weather Service as a possible critical fire weather pattern. This can be brought on by winds, humidity, frontal activity, etc.

A "Red Flag Warning" is issued for an ongoing or imminent critical fire weather pattern. This is announced by the Santa Fe Zone Dispatcher (as is the Fire Weather Watch) during the daily weather broadcast.

C. Emergency Presuppression

1. Staffing plan

The chart (see Appendix C) was developed to direct incremental presuppression actions in response to increasing fire danger. It contains five staffing classes (1 - 5), which are approved for a burning period. Break points between classes are determined by cumulative percentages of occurrence of the ERC (Energy Release Component). The most critical break points occur at the 90th and 97th percentiles (automatically defined by the FIRDAT run), and define staffing classes 4 and 5 respectively.

2. Funding

These "emergency presuppression" accounts are available to open any time the staffing level reaches 4 or higher (and an FMO judgement call) to cover potential extra expenses. These may include extra workhours for the fire crew and overhead, hiring emergency firefighters, aerial reconnaissance etc. Extreme conditions due to fire weather watches or redflag warnings may also precipitate these actions, particularly when dry lightning activity is predicted.

D. Pre-attack plan

The monument pre-attack plan is intended as a way to assist monument fire management personnel in arriving at informed decisions, particularly (but not limited to) suppression actions. This plan is located in Appendix P. It documents such cumulative information as monument fuel types, values at risk, water sources, boundaries, potential control lines, incident base/camp locations, helispot locations, etc.

E. Detection and dispatch

Activities under this heading relate to surveillance of NPS and cooperating agency lands around the monument. The monument maintains a fire lookout, and funding is authorized under FIREPRO to staff the tower at management discretion.

A specific Standard Operating Procedure for the fire tower operation is located in Appendix E.

During declared fire season a daily roster of certified and available red carded personnel will be maintained by the Fire Program Assistant. The roster will be posted following appropriate clearances with the employee's supervisor and with the employee, listing where the employee is authorized to take assignment (i.e., monument, state, out-of-state, etc.), and will be in effect for a full 24 hour period. The employee, once on the call-out roster, is expected to be ready to travel within 2 hours of a dispatch call. The only out-of-monument wildfire dispatch calls accepted by the monument are from Santa Fe Zone. The monument FMO will coordinate all dispatches (including PNF), and arrange for transportation. Any changes in the employee's call-out status during this 24-hr "on-call" period must be made to the FMO immediately with adequate justification. If the FMO is unreachable for some reason, the Supervisory Forestry Technician will be notified. During periods of national fire emergency and/or staffing level 5, it is expected that all red-carded employees will be available for dispatch for the standard 21-day assignment (30 days for Alaska/Hawaii).

The monument engine (Engine 91) will be dispatched through Santa Fe Zone. Bandelier, plus areas under cooperative agreement (including Santa Fe National Forest and New Mexico State Forestry jurisdictions; See Appendix F), will be subject to initial attack action by Bandelier resources, with an immediate call to Santa Fe Zone Dispatch. Unless otherwise notified by dispatch or an appropriate agency representative, the duty engine foreman will assume the IC position on cooperating agency fires only through the initial attack phase. Dispatches of Engine 91 to all other fires will be through Santa Fe Zone, using procedures outlined in the "Santa Fe Zone Action Plan" (in FMO office, Bandelier NM).

For additional details on dispatch procedures, see the Southwest Area Mobilization Guide (Fire office) and monument fire SOP's (Appendix E).

F. Suppression

Chapter V ("Fire Management Strategies") briefly outlined appropriate suppression response actions for each management zone. This section further details suppression activities to be employed for declared wildfires.

There are three suppression strategies: confine, contain, and control. The objective of the confine strategy is to restrict the wildfire to pre-determined boundaries, established either prior to or during the fire. The objective of the contain strategy is to restrict the fire to a defined area, using a combination of natural and constructed barriers to stop the spread under prevailing and forecasted conditions, until out. The control strategy requires aggressively suppressing a wildfire by establishing firelines to prevent the fire's spread and to extinguish hot spots, etc. until out. The Escape Fire Situation Analysis (EFSA) is the fire suppression strategy decision document used by management, Appendix P.

The Fire Complexity Analysis (FCA) is a checklist intended to guide the Superintendent in determining when a transition from extended attack to a management team of higher level is necessary. It must be completed by the IC, FMO and Superintendent before additional resources are ordered. The FCA guide is contained in NPS-18, Section III, Chapter 8, Exhibit 4.

1. Interagency contacts and coordination

The monument actively coordinates with other agencies. Principle contacts are:

- Fire Management Officer, Jemez District, Santa Fe National Forest
- Fire Management Officer, Española District, Santa Fe National Forest
- Fire Staff, Santa Fe National Forest (Supervisor's Office)
- Fire Management Officer, Bernalillo District, New Mexico State Forestry
- Fire Management Officer, New Mexico State Forestry, Santa Fe
- Fire Management Officer, Eight Northern Pueblos, Bureau of Indian Affairs
- Fire Chief, Los Alamos County Fire Department
- Resident Manager, Corps of Engineers, Cochiti Reservoir
- Los Alamos Police Department (Shift Supervisor)
- Manager, Emergency Operations Center, Los Alamos National Laboratory

A listing of these contacts with addresses and phone numbers is in Appendix O.

Formal coordination is maintained through the various interagency agreements. The Joint Powers Agreements and Initial Attack Operating Plan, Santa Fe Unit is in place to provide mutual aid assistance among signatory agencies, using closest available resources concept. Under the agreement and operating plan (see map, Appendix F), Bandelier is responsible for initial attack action on over 40,000 ac (16,200 ha) of USFS and private lands bordering the monument.

There is also an agreement to provide extended attack management team services between Bandelier National Monument and the Santa Fe National Forest (Appendix F). Qualified personnel from both agencies serve on this team for extended attack.

2. Transition

If the incident increases in complexity and/or size, or escapes initial attack, the Incident Commander may be relieved by a higher qualified individual such as a Type II IC with or without appropriate team function heads. See "Interagency Agreement, Extended Attack Incident Management Team, Santa Fe NF and Bandelier National Monument", Appendix F.

The procedures for managing the transition between initial attack/extended attack organization and an interagency incident management team (Type III, II or I) are found under the Line Officers Delegation of Authority & Briefing Package, Appendix K. Emphasis will be given to suppression actions which maximize the protection of monument resources. This would include a designated National Park Service (NPS) agency or Superintendent's representative to attend all planning and strategy sessions; to deliver any pertinent information to personnel (including to Crew Boss level) during shift briefings; and to keep the Superintendent constantly informed of the situation and seeking decisions when required. The FMO or designee would normally assume this assignment.

G. Records and reports

Historic fire reports will be maintained in the monument archives, with a copy in the fire management office and limited entry into the SACS database. The Fire Atlas and associated fire records will be annually updated by December 15. The database will include: location, size, cause, duration, vegetative type, and event dates. A copy of all historic fire occurrence records will be forwarded to the monument curator for accession. All other documentation relating to fires, i.e., maps, photos, records will be assembled for accession to the library or historic collections, as appropriate.

A complete listing of required records and reports, frequency of preparation, responsibility and distribution is in Appendix E.

H. Rehabilitation

In situations where there were impacts to monument resources resulting from suppression actions and/or the fire itself, a rehabilitation plan of some degree may be indicated. If one is prepared, it should be initiated by a staff resource advisor, reviewed by the Fire Management Officer and Chief of Resources Management, and approved by the Superintendent.

A long term rehabilitation plan is prepared usually by a BAER (Burned Area Emergency Rehabilitation) team dispatched to the fire site. The 1996 Dome fire required such services, and a plan was prepared for implementation. In most cases, a two-year (two growing seasons) followup (beyond the fire "declared out" date) period is acceptable for parks to obligate approved funds for rehab purposes.

Specifications which must be followed when implementing emergency rehabilitation measures, are as follows:

1. RESEEDING is prohibited unless activity occurs within a developed area and is preapproved. Reseeding will be done only for human safety purposes or if it has been determined by the Superintendent that significant cultural resources are threatened by erosion. Reseeding specifications for rehabilitation purposes must be specifically approved in the monument's Vegetation Management Plan.

2. All REVEGETATION and/or LANDSCAPING is prohibited unless specified otherwise. A separate revegetation and/or landscape plan must be included in the long term Rehabilitation Plan approved for a fire.

3. MULCH is to be used only in conjunction with an approved reseeding program. Only native tree bark or rice straw is permitted, not to exceed 1500 lbs/acre (1500 kg/ha).

4. Biodegradable SOIL NETTING is permitted with prior approval of specifications and manufacturer information.

5. CHECK DAMS will be permitted only using logs or loose rock. The use of these materials will be justified and approved in the long-term Rehabilitation Plan. Generally, check dams will be constructed only on highly erodible soils in severely burned areas within the developed area of Frijoles Canyon.

The overriding philosophy of rehabilitation is that it be minimum treatment necessary for stabilization of the burn and other impacted areas and for the protection of cultural resources.

VII. Management Ignited Prescribed Fire Program

This chapter will outline the management ignited prescribed fire program, including procedures to follow to ensure that stated resource objectives are being accomplished consistent with management constraints.

A. Program overview and Ten-year Schedule

For the long-term, prescribed fire will be used extensively to maintain the historical fire return interval. These intervals will obviously vary due to the wide variation in historical fire size, intensity, and pattern of burns across the landscape. Management can then begin to adjust vegetative successional patterns back to the natural range of variation.

It is important to recognize how critical the treatment patterns will become; in other words, ignition and burn patterns should vary temporally and spatially across the landscape. Elevations, aspects and season of fires will be changed regularly to simulate pre-settlement fires. The sections describing resource objectives and strategies involving the application of prescribed fire provide the basis for establishing priorities for burning, and will drive management actions accordingly.

1. Management Ignited Prescribed Fire Units

The monument is divided into three major landform-referenced areas, each having numbered burn units. They are: "UF", Upper Frijoles (includes 1977 Acquisition, Apache Mesa, and Burnt and Escobas Mesas; "HQ", Headquarters (including administrative, residential and campground areas) and Frijoles Canyon from the Rio Grande to below Upper Crossing; "BW", Bandelier Wilderness. All burn units identified to date are listed in the ten-year Prescribed Fire Schedule and referenced to a map illustration (Appendix M).

A total of 27 prescribed fire units are identified to date. The units comprise approximately 35% of the total monument area. Boundaries of these units are in most cases simply fuel breaks (i.e., road, trail, rock, etc.). However, in areas such as in the 1977 Acquisition, fuel discontinuities do not exist and unit boundaries may require some holding line construction.

2. Ten-year Prescribed Fire Schedule and Unit Map (Appendix M)

The ten-year schedule calls for prescribed burning of between 700-2000 acres per year starting in the present year. The schedule is subject to periodic updates to provide currency for management.

This prioritized burn schedule is considered a best-case scenario. Hence, its accomplishment is contingent upon favorable prescription conditions during normal windows (March - November). The larger units will be treated using a combination of blackline, backing and/or flanking fire, and headfire according to terrain and fuel conditions. Aerial ignition will be a consideration, particularly for the larger units. Reburning of these units will be necessary to further reduce loadings and mid and/or overstory densities to more pre-settlement levels. Smaller units may also be designated for purposes of research or demonstration, and may be added to the schedule on an as needed basis.

3. Hazard fuel reduction

Many listed burn units are operationally identified as hazard fuel reduction projects. That is, these areas have met certain criteria such as treatment required to protect "values at risk". These values can be located, for example, in or around highly flammable concentrations of woody debris or unnatural densities of trees at any level in the overall forest structure. Another value at risk can be defined as ecological integrity of a vegetative community threatened by heavy fuel concentrations, or simply as the boundary with a neighboring agency.

Obviously, the hazard fuels reduction program takes the highest MIPF priority. However, as the program progresses and objectives are being met, this portion of the total prescribed fire program will begin to diminish.

4. Resource Management Prescribed Fire

This aspect of the management-ignited prescribed fire program emphasizes the accomplishment of stated resource objectives. This includes but is not limited to areas such as maintenance of fire regimes (i.e., following established fire return intervals); maintaining or re-establishing identified fire-dependent species or communities; manipulating forest structure and function; and supplementing approved forestry practices (i.e., maintaining meadows, alter erosional patterns, etc.).

B. Prescribed Fire training, certification, and organizational requirements

1. Positions

The following positions are identified as necessary to implement the prescribed fire (including PNF, see chapter VIII) program:

- 1 each Prescribed Fire Manager (type 1 and type 2)
- 1 each Burn Boss I certified to NFFL fuel Models 1, 2, 3, 8, 9, 10.
- 2 each Burn Boss II certified to NFFL fuel Models 1, 2, 3, 8, 9, 10.
- 2 each Ignition Specialist (type 1 & 2)
- 2 each Prescribed Fire Specialist
- 1 each Prescribed Fire Behavior Analyst
- 4 each Prescribed Fire Monitor
- 8 each Firefighters

(Note: Positions identified above can also be made available for assignment to requesting parks).

2. Training plan

See page 31.

C. Annual burn program management

By December 30 of each year, the FMO will review prescribed fires completed for the previous year. This review will include an analysis of objectives achieved and recommendations for refinement of burn prescriptions. The next year's annual burn plans will be prepared for review by the monument Environmental Compliance Committee and Fire Management Committee. Once approved by the Superintendent (generally by March 1), the burn plans become part of the Section annual workplan. The 10-year Management-Ignited Prescribed Fire Schedule will also be updated as needed.

1. Burn plan elements

In addition to the completion of the format prescribed in NPS-18 and found in Appendix H, each plan will have the following attachments:

a. Application and Permit, Open Burning; included are data from the burn plan as an attachment. Smoke Vector Map and Smoke Estimation Model (SASEM) calculation (required).

   Permit issued by the New Mexico State EID (Santa Fe Office).

b. Section 106 Clearance (Triple-X)

   Prepared by the burn boss; number assigned by Chief, Resources Management; reviewed/signed by Archaeologist and Superintendent.

c. Record of Review of Activities for Natural Resource Impacts (NEPA); usually a categorical exclusion (Triple-Y).

   Prepared by the burn boss and signed by Project Supervisor, submitted to and signed by all members of the Environmental Compliance Committee following review. Approval may only be granted by the Superintendent. Also addresses mitigation measures.

d. Burn Specific Computations

   For example, BEHAVE computations for scorch height, spread rates, etc.

e. Raw Data and Data Summaries

   - monitoring data/analyses
   - spot forecasts
   - weather observation forms

f. Photographic records (video, 35 mm, etc.)

g. Postburn Narrative (see Appendix H for example format)

2. Prescriptions

A prescription is a set of values which specify conditions under which fires can be ignited and managed to meet specified resource objectives. Due to seasonal variations, the prescriptions specified for prescribed fires at Bandelier are listed

under "spring" or "fall". Timing and patterns of ignition, spatial pattern, size, duration, behavior and return intervals all contribute to re-creating the complex fire mosaics on the landscape. Spring fires (normally March through June) can present potential complications for larger unit treatment, because weather can change within a few days. Dry winter fronts can produce high local winds which may affect control aspects of a multi-day prescribed fire, especially in the hazard fuels units. It is expected that some areas of large fires may be out of prescription on the low-range (i.e., "cool") side while other areas may actually exceed the upper limits for short periods of time.

The range of prescription elements are specified to give management a window or combination of fire behavior scenarios with which to achieve the burn objectives and ensure control-ability to the degree possible.

Most elements were derived from previous burning experience, the work of other fire managers in similar vegetative types, and literature review. They are designed to keep fire behavior within a "natural range" of intensities. However, in areas where the objective is to reduce mid-story tree density, for example, fires may need to be more intense to cause torching.

Prescriptions are found in Appendix I. They will be subject to continuous refinement, particularly when more information is learned about fire effects.

D. Prescribed Fire monitoring

Levels 1, 2, and 3 monitoring will follow the Fire Monitoring Handbook (FMH): level 4 (long-term monitoring) will follow the requirements of the Handbook with some special case studies possible.

E. Documentation requirements

1. Fire Report, DI-1202.

Required for all prescribed fires; signed and entered on the (SACS) within 5 days after the fire is declared out (burn boss).

2. Postburn narrative

Due with final fire package, within 30 days after fire is declared out (burn boss); also, entries on the SACS under "Project Accomplishment Report" screens

(remarks and cost data) are required once cost summaries are received from accounting.

3. Data

Monitoring data sheets are completed by the monitors and maintained by the resident monitor supervisor (New Mexico - West Texas Fire Monitoring Group).

4. Maps

Enter burn unit location into the Geographic Information System (GIS) (Supervisory Forestry Technician/Monitor Supervisor-GIS Operator).

5. Filing

Assemble final fire package and file in FMO office. Outline of package contents is found in the SOP binder, Fire Program Assistant's office.

F. Fire evaluation

The evaluation will be conducted by the FMO for the purpose of improving operations and procedures. In cases where the fire is declared a wildfire, separate review procedures are discussed briefly in Chapter XIII, Fire Critiques.

The fire evaluation format is found in Appendix H.

VIII. Prescribed Natural Fire Program

This section reviews guidelines to be followed in arriving at the decision to declare, and subsequently managing, prescribed natural fires. The previous discussion in chapter V briefly outlined the strategy for PNF within the designated zone.

A. Management guidelines for Prescribed Natural Fires (PNF)

A Fire Situation Analysis (FSA) will be prepared by the Burn Boss (or RXFM) for each PNF (except those posing no risk, surrounded by natural barriers) in the zone and will be recertified daily. All PNF's (except those surrounded by natural barriers and termed inconsequential) will receive daily monitoring to ensure compliance with the approved prescription.

The decision to classify a natural ignition as either PNF or wildfire will be made only by the Superintendent using the certification process.

The following guidelines will serve to ensure an orderly and safe management of all potential or on-going PNF.

1. The Superintendent has ultimate authority and responsibility for approving or disapproving PNF, including the continuation of same.

2. A Fire Situation Analysis (FSA) or similar approve document* (per NPS-18) shall be completed for each PNF by the RXB1, RXB2, or RXFM and approved by the Superintendent. The format for this analysis is found in NPS-18, Section III, Chapter 5, Exhibit 1. FSA Part 1 must be completed daily by the lead fire monitor and reviewed by the RXB1 (or RXB2), and a recommendation made to the Superintendent to continue or terminate the PNF. The Superintendent will document daily his/her decision with a signature on the NPS-PNF decision record (NPS-18, Section III, Chapter 5, Exhibit 2). This completed form must be held in a secure location as legal evidence of the decision.

   *Note: The FSA is due to be replaced by an interagency PNF burnplan, subject to agency adoption in near future.

3. If any prescription parameter for a PNF in the zone in which the fire is located is exceeded for a period of four continuous hours, the PNF will be declared a wildfire.

4. If any PNF is spreading towards either of the other zones or other agency boundary, the Superintendent will be notified and the PNF will be re-evaluated. If holding actions cannot prevent the PNF from escaping these limits, or if any identified values at risk (i.e., cultural resources, administrative facilities, etc.) are threatened, the PNF will be declared a wildfire. If the guidelines established in the decision chart are exceeded, the PNF will be declared a wildfire and will be suppressed. All holding actions shall be subject to the application of minimum impact suppression techniques.

5. Any ignition classified as a PNF must also meet all criteria stated in the Southwest Area Preparedness Levels (Appendix I). (Note: this issue is under review for possible revision at the time of writing.)

   Presently the criteria specify that any natural ignition occurring after the declaration of Southwest Area Preparedness Level IV or higher will be declared a wildfire, except those that are of "no significance or risk". For existing PNF, those designated under a lower preparedness level will continue to be manage as such unless the prescription or other decision criteria has ben exceeded.

6. A Burn Permit will be obtained from the State Air Pollution Control Bureau for any PNF which is or may produce substantial volumes of smoke. (Note: this requirement is presently under review for possible revision.)

7. The allowable number of PNF's is determined by the monument's qualified staff capability to adequately manage each according to standards described in section (C) below. There now exists several national level (NPS) Prescribed Natural Fire Management teams which can be resource ordered to assist with complex and/or multiple PNF incidents.

8. Once any PNF is declared a wildfire, it cannot later be reclassified as a PNF.

9. Other considerations:

   (a) According to the FSA, Part I, Section 7, any 24-hour weather forecast of sustained winds in excess of those in the approved prescription will prompt immediate suppression of all PNFs.

   (b) If the assigned resource advisor for cultural resources determines that mitigation actioi for sites or features is required (i.e., fuel reduction or other protection measures) and documented in a XXX form, that holding resources be assigned immediately to accomplish this work under direction of the arachaeologist (or whomever assigned).

(c) Most of the PNF zone is rugged and remote. Safety of all assigned personnel is of the highest priority; and as such, safety briefings will be held by the RXB1 or RXB2 (or designee) prior to any planned actions on PNF's.

B. Decision Chart for Prescribed Natural Fires

```
Fire Discovered
    |
RXFM Team Assigned & Resource Advisor(s) notified for possible assignment
   (FMO)
    |
Fire recon info/FSA* Part I collected
    |
Cause/Location determined
    |
Natural: ----------------------------------------------------NO  Declare Wildfire
    |
Within PNF Zone? ------------------------------------------NO  Declare Wildfire
    |
FMO/RXM begins FSA (Parts I & II) & Complexity Analysis and Determines:
    |
► In Prescription? ----------------------------------------NO  Declare Wildfire
|| |
|| RXBB Available/Qualified? ---------------------------------NO  Declare Wildfire
|| |
|| Obtain Burn Permit
|| |
|| FMO/RXM completes/updates FSA & Complexity Analysis; identifies MMA;
||  briefs Ch. Res. Mgmt. & Supt.; Recommends that fire be managed as PNF
|| |
▲ FMO/RXM completes Resource Needs Assessment & prepares Assignment
||  Roster;
||  Social and political issues favorable to Supt.? ----------NO  Declare Wildfire
|| |
|| Superintendent signs FSA & PNF Decision Record; resources assigned/ordered
|| |
|| Manage as PNF (monitor per frequency requirements of Fire Monitoring
||  Handbook)
|| |
|| RECERTIFY DAILY
|| |
└◄◄
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*FSA is in the process of being replaced by the Interagency Prescribed Natural Fire Burn Plan.

C. Monitoring and reporting

Monitoring and evaluation of prescribed natural fires is the systematic process of collecting and recording data on vegetation, topography, weather, air quality, fire behavior and fire effects. Monitoring is done to ensure that the fire is staying within prescription and other parameters, and to provide data with which to adjust future prescriptions.

(1) All monitoring for PNF will be accomplished using the Fire Monitoring Handbook (FMH, located in the Fire Office or office of Chief, RM).

(2) Prescribed Natural Fires shall be monitored at minimum acceptable levels outlined in Chapter 2 ("Monitoring Schedule") of the FMH. The monitoring frequency and level (1 or 2) will be determined based on: (1) the fire's proximity to values at risk; (2) if the forecast is expected to exceed approved prescription limits; or, (3) if judged by FMO that escape from MMA (Maximum Manageable Area) is forthcoming. PNF's may be monitored from a distance (or from the air above minimum altitude for wilderness) if the information collected for the FSA can be certified as accurate by the RXB1, RXB2 and/or FMO.

(3) The Fire Management Officer assumes the Prescribed Fire Manager (RXM1) responsibilities in the case of multiple PNF's in the zone, and will assign and coordinate monitoring efforts for each.

(4) Due to the limited number of qualified prescribed fire monitors (RXFM) in the monument at any given time, the maximum allowable number of declared PNF's will be determined in part from the Resource Needs Assessment (FMO).

Prompt and accurate reporting of all monitoring data is extremely important to the program. The Biological Technician (Resources Management Section) and/or Supervisory Fire Effects Monitor will ensure that data input into the monitoring database is completed.

A PNF folder will be maintained in the Fire Office for each PNF. It will contain FSA's, maps, permits, field notes, photos, fiscal data and other documentation necessary to provide a complete record. A DI-1202 will be prepared according to established SOP found in the Suppression and MIPF sections.

D. Funding and cost accounting

See NPS-18, Section IV, Chapter 1 for complete funding guidelines governing Prescribed Natural Fires.

E. Public information actions for Prescribed Natural Fire

During PNF activities, as with Management-Ignited Prescribed Fires, the park will emphasize the positive elements of fire's past and present role in the monument ecosystem through an aggressive interpretive program.

The three actions described in Chapter XIII (Public Information and Education) of this plan will provide management guidance for this program. In addition, message-specific signs which describe a PNF in progress will be posted at appropriate trailheads and along trail(s) through or near the fire.

Post-season activities will include those tasks necessary to adequately assess how the efforts were received by the local public and cooperators. This will be accomplished through coordination meetings with neighbors, contacts with local groups, media, and the State Air Pollution Control Bureau. The purpose of this feedback is to revise plans, procedures and educational efforts regarding overall fire management at Bandelier.

IX. Air Quality/Smoke Management Guidelines

One of the key management considerations in planning and implementing a prescribed fire program is the effects on air quality and visibility, particularly from the standpoint of public perceptions. Unfortunately, today's environmentally conscious citizenry often view "clean air" as a pristine historical condition over wildlands, which needs to be returned and/or maintained. Growing evidence indicates that this condition was not the case during pre-settlement history in a fire-evolved landscape.

Burning conditions, season, and fuel characteristics basically determine levels of smoke production for any fire. Moreover, due to the unplanned nature and seasonality of wildfire occurrence, both volume and density of smoke is generally higher than that produced from management-ignited prescribed fires. It also must be understood that early wildfires in the southwest burned at the full range of intensities; and similarly that management-ignited prescribed fires can be expected to produce varying levels of both intensity and smoke.

Prescriptions for management-ignited fires have been developed based on fire and resource objectives; however, smoke production is also a primary consideration. The "hotter" end of the prescription can accomplish many such objectives and produce less smoke. For example, "greener" wood burns more slowly and combustion is more incomplete (i.e., smoldering); higher volumes of smoke and less flame is produced. Conversely, dry and well cured wood burns with higher intensity and much more flaming combustion, generally producing less smoke or particulate matter.

Management is faced with balancing the need for prescribed fires, while minimizing the impacts of smoke emissions; this balance applies to smoke produced from wildfires.

A. Smoke from combustion

The primary products of combustion of organic material include carbon dioxide, water vapor, particulate matter, carbon monoxide, hydrocarbons, nitrogen oxides and trace minerals. These are described below:

- Carbon dioxide produced is 2000 to 3500 pounds per ton of organic matter burned. It is not state regulated, but is fast becoming an important constituent in the global climate change issue.

- Water vapor produced in burning is 500 to 1500 pounds per ton of organic matter; it may have an effect on total visibility during prescribed fires.
- Particulate matter emissions range from 20 to 180 pounds per ton of total products, and are a "criteria" pollutant. They are of concern from the standpoint of public health.
- Carbon monoxide emissions produced are approximately 20 to 500 pounds per ton of total emissions. Due to relatively rapid dilution, they are not a concern to the general public. However, there is a management concern of the effects on firefighters and prescribed fire crews.
- Hydrocarbons compose 10 to 40 pounds per ton of total emissions and are not presently a criteria pollutant. Nitrogen oxides compose 1 to 9 pounds per ton of total emissions and are a criteria pollutant; however, due to low emissions they are not of concern to management at this time.

Finally, visibility is of major concern. The Environmental Protection Agency (EPA) is requiring the state to consider the impacts of prescribed fires on visibility, and thus the permit process for each proposed burn.

B. Compliance and public Information

The State of New Mexico requires a permit (NMED 8/96) for all management fires. The application asks for date(s) of fires requested, site location, type/quantity material treated, method of ignition and control, why fires are necessary and the alternatives to fires and why they are not feasible. Procedures for the entire compliance process is found in Appendix H.

Public coordination and information is critical to any successful fire management program. Before prescribed fires are conducted, the monument will notify a variety of agencies (including Los Alamos National Laboratory), media, and others via a preplanned list.

A monument brochure has been prepared and made available at the Visitor Center, Entrance Station, campground kiosks, and on-site. This brochure covers the rationale and objectives of the prescribed fire program, safety and other pertinent information which will help the public understand why the program exists. A key concept which must be conveyed to our publics is that fire, and therefore smoke, is a natural process; and that visibility may be temporarily diminished, but is representative of how things may have looked during the pre-European settlement period.

C. Smoke management strategies

The term "smoke management" can be described as a preplanned management action in which, under prescribed meteorological and fuel moisture conditions, ignition and firing patterns are utilized to keep smoke emissions within acceptable limits.

Smoke monitoring frequency for prescribed fires in grass fuel types (NFFL Models 1, 2, 3) is once every 15 minutes during active spread; for forest fuels (Models 8, 9, 10) once every two hours during active fire spread and every six hours during low fire spread. Otherwise, once per day for maximum of three days (NPS FMH). Monitoring weather at specified intervals each day requires using a belt weather kit, RAWS station, or weather station containing a hygrothermograph, fuel moisture sticks, rain gauge and anemometer. Data is required two weeks prior to planned ignition of burns over ten acres in most cases.

Thresholds for alteration of planned operations due to smoke production are outlined in the Fire Monitoring Handbook.

Strategies to be considered for each planned prescribed burn plan are:

- Reducing fuels available for combustion through removal, and using head-fire ignition (with a wind) wherever practical.
- Burn at higher large (i.e., 1000-hr TL and above) fuel moistures; a 1% increase in 1000-hr fuel moisture can result in a 3% decrease in particulate emissions. Combine this with burning at lower fine fuel moistures.
- Reduce the particulate emission factor for the fuel consumed. Employ those firing techniques which favor flaming combustion such as a backing type which, under certain conditions, can consume more mass through flaming combustion. This can vary by fuel types.
- Avoid putting smoke into smoke-sensitive areas, such as highways, the Los Alamos National Laboratory technical areas, Los Alamos townsite, and monument headquarters area during heavy visitor-use periods.
- Avoid burning when there are inversions or very stable high-pressure systems present or forecasted.
- Coordinate burns with other area agencies planning burns;

Reference is made to Appendix F, "Memorandum of Understanding, New Mexico Smoke Management" (rev 1997).

X. Fire research and monitoring

Fire is an integral process which has shaped the structure and function of most Bandelier ecosystems (Allen 1989). To properly manage fire at Bandelier requires improved scientific understanding of the interactions between the process of fire and other ecosystem components, especially vegetation. This scientific information can be developed through both research and monitoring activities.

Past fire-related research at Bandelier has focused largely upon the effects of the 1977 La Mesa Fire (cf. Foxx 1984) and upon determining prehistoric patterns of fire occurrence (Caprio **et al** 1989)--ongoing research activities are largely following up or elaborating on this work. A second La Mesa Fire Symposium (March, 1994) presented the results of this followup research. The 1996 Dome fire will also add to the growing body of fire effects information.

Proper resource management requires monitoring the effects of management activities to feedback information to allow "adaptive" management. Fire effects monitoring was begun in 1992 to provide this type of feedback. The monitoring protocols outlined in the NPS Fire Monitoring Handbook will be utilized.

Currently, a fire effects monitoring module is based at Bandelier and is scheduled to complete fire effects monitoring work at Bandelier, El Malpais and Lake Meredith.

XI. Public and employee safety

Public and employee safety at Bandelier is a primary management concern. The topographic relief, limited surface water, limited access routes, proximity to the Los Alamos National Laboratory technical areas, and confined developed areas combine to create hazardous situations under extreme fire behavior.

The highest risk area is the headquarters/visitor center/housing complex in Frijoles Canyon. The one entrance road for entry and exit present potential visibility problems from smoke; and hazards associated with evacuation of large numbers of vehicles. Entrapment is possible, especially between headquarters/visitor center parking and the camera overlook. Vehicles could possibly be cutoff or exposed to heat while trying to escape the canyon. Early evacuation of the public, employees and others from the canyon is indicated under conditions of extreme fire behavior below the headquarters.

Smoke is a potential hazard to visitors, both from prescribed and wildfire situations. Protection ranger staff and interpretive staff will be briefed on proper and orderly movement of visitors out of the canyon area if indicated. Fire management personnel will place appropriate warning signs along roadways where visibility is affected during prescribed fires. Ranger personnel and/or Los Alamos Police units are also available for assignment to traffic control.

Juniper and Ponderosa Campgrounds are areas to concentrate efforts in cases of threats from wildfire incidents. The Chief Ranger and Superintendent will be notified immediately of any potential need to evacuate these areas. Routes will be preselected by the appropriate overhead (generally the Incident Commander) in consultation with the Chief Ranger. The Chief Ranger will coordinate with New Mexico State Police and Los Alamos Police Department on all emergency movement of visitors and vehicles, closures of highways, and communications to ensure plan accomplishment.

Backcountry visitor safety during "high" to "extreme" fire danger is also a concern. Alerting hikers of possible impending hazardous situations is the responsibility of the Chief Ranger (with concurrent notification of the Superintendent and visitor center) on wildfire incidents. A request will be made through monument dispatch for appropriate ranger assistance to contact hikers via horse and/or foot patrols. This operation requires careful coordination to ensure that all trails, campsites, etc. are covered. If a fire threatens to cross the monument boundary, the Incident Commander will notify the neighboring agency at least 24 hours in advance of the fire's predicted crossing. Also, the designation of a qualified deputy Incident Commander from the neighboring agency will be considered at this time.

The employee housing areas are also at high risk. There are four housing areas, each with unique situations with respect to interface with the wildlands. The Wildfire Prevention Analysis (Appendix N) illustrates the degree of risk for these areas. The primary focus, for purposes of this plan, is to create defensible space for structures identified as "at risk".

The present course of action under threat of wildfire is: (1) The Incident Commander (IC) will notify the Chief Ranger and Superintendent; (2) The Chief Ranger will coordinate the orderly evacuation and followup security of housing areas, beginning with the highest priority threat; and (3) The IC will work with administrative officer to document the action with dates, times of evacuation, etc. and a photographic record developed for possible future reference.

XII. Public information and education

Adequate and accurate public information on the goals and program rationale for fire management at Bandelier is critical to program success. The local communities of Los Alamos, Española, and Santa Fe are to some degree affected by the monument programs, particularly fire management. Smoke generated from prescribed fire is of special concern, since public health and safety are affected. One vehicle for dissemination of information is through monument interpretive media. The Fire Management Officer will cooperate with the Chief of Interpretation on the following programs:

- Development of a brief interpretive handout which will discuss the basic objectives of both using Management Ignited Prescribed Fire and Prescribed Natural Fire at Bandelier.
- Develop outlines for offsite programs targeted at elementary and secondary school groups with prevention and fire ecology themes.
- Develop an outline and materials for an evening program which contains a prevention message and describes the fire program.

Public education programs on fire management themes is most effective when the smoke is present. Interpretive tours and on-site talks during prescribed fires and/or prescribed natural fires will be planned on a case by case basis. Signs will be designed and built that will convey short informative messages to the public on monument trails and roads.

XIII. Cultural Resources

See Chapter III, section E (page 12) for a description of monument cultural resources.

Bandelier contains cultural resources that are culturally affiliated with Puebloan peoples. The Zuñi and Hopi, for example, are now claiming affiliation. Under the Native American Religious Freedom Act, these peoples are afforded the opportunity to comment and provide input into many park policy and management documents.

A. Effects of fire management activities on cultural resources

Basic information on fire's effect on cultural resources is poor. However, archaeologists have examined the effects of several wildfires (Jones and Euler 1986, Lissoway and Propper 1988, Pilles 1984, Switzer 1974, Traylor, et al 1979) on federal lands. The latest of these investigations is the Dome fire of 1996 on the Santa Fe NF and Bandelier NM. A summary report on the fire effects assessment and rehabilitation efforts will be prepared.

Many of these studies have commonalities with respect to fire and cultural resources, some of which are listed below:

- Direct effects of heating, i.e., flame and/or glowing combustion. Effects vary from melting, charring, spalling, to complete incineration. Other effects, such as changing in firing profiles of ceramics, remain to be studied.
- Dozer blades and tracks can cause severe damage in and around sites by cutting deep into soils and displacing cultural materials. Handline and helispot construction, especially at night, could result in exposure of subsurface debris and may potentially affect structural sites by loading with discarded vegetation. Surface collecting by fire personnel can be an associated impact (Traylor, et al, 1979).
- Some damage to exposed walls resulting from retardant drops by air tankers and helicopters has been observed. Possible corrosive effects on cultural materials have not yet been studied.
- During mop-up, damage may result from any of the following: engines and other vehicles moving around inside the fire, moving hose, digging roots and stumps in or around a site, and snag felling operations.

- Activities associated with fire rehabilitation such as water bar construction and installation, berm leveling, equipment used for reseeding, planting, salvage logging and fuelwood collection could damage sites and materials.
- Wildfires can expose previously unknown or inaccessible cultural sites and materials to theft or vandalism.
- Prescribed fires can also damage cultural resources if burn unit preparation is done inappropriately. This would include line construction, porta-tank and hoselay setup, snagging, pre-treatment of fuels with chemicals, mechanical fuel reduction, vehicle and/or packstock movement in and around the area, mop-up and patrol operations.
- Longer term, indirect effects can include degrees of site erosion ranging from minor to extreme site alteration/cutting.

B. Management and protection strategies for cultural resources

The following checklists will be used during planning and implementing any Bandelier fire management project or activity:

1. Planning and preparation

- Use the most current site inventory information (Incident Commander, Prescribed Burn Boss, Archaeologist).
- Perform an evaluation of the resources (i.e., have the archaeologist determine what mitigation is needed: avoidance, removal of fuels, etc.).
- Identify and map cultural values at risk in consultation with the Archaeologist.
- Predict how fire may affect cultural materials in the Line Officers Briefing to the Incident Commander (FMO/Resource Advisor).
- Prepare Triple-X clearance (Burn Boss).
- Outline any Native American concerns from consultation with the monument's Native American Affairs Liaison or appropriate representative of local Pueblos (Chief, Resources Management).
- Identify and present training in cultural site identification, protection measures, etc. to fire personnel (Archaeologist).
- Train and fire-qualify monument cultural resource staff in preparation for position(s) as resource advisor (FMO).

2. **Mitigating impacts on On-going Fires**

- Restrict any use of dozers in the park.

- Assign one or more firefighter qualified archaeologists to mark and monitor sites and other cultural features during suppression through mop-up and rehabilitation; this position is to be assigned immediately.

- A cultural resource specialist (resource advisor) will participate in shift briefings for overhead, especially crew and felling supervisors, strike team leaders (engine & crew), and field observers.

- Plans for all operational periods should contain clear and specific written instructions regarding line construction and other suppression activities as necessary around cultural values. Appendix K contains instructions.

3. **Mitigation of impacts on Prescribed Fires**

- All burn plans will be reviewed by the Environmental Compliance Committee which includes the park archaeologist and Chief, Resource Management.

- The FMO will provide an annual list and detailed map of proposed burns each year by March 1.

- Survey all proposed burn units by June 1 annually (Archaeologist).

- Consider preparatory physical removal or reduction of fuels in and around cultural sites.

- Thoroughly brief all burn personnel on identification and proper protection of cultural features.

- Consider using archaeologist(s) to physically remove and document artifactual materials from a burn site; this is recommended as a last resort, and must be supervised by qualified cultural resource personnel approved by the Superintendent following appropriate consultation by the System Support Office and the State Historic Preservation Officer.

XIV. Fire Critiques

Several types of fire critiques or evaluations will be used to assess program success. One type is used for prescribed fire projects, and is intended to review and recommend corrective measures. Another is the review of a wildfire incident, consisting of types of reviews found below.

A. Hotline review for Wildfire incidents

The purpose of the "hotline" review is to examine the progress of an on-going fire incident, regardless of size. The review will provide a confirmation of the decisions being made daily in the Escaped Fire Analysis or determine where the decision process has been faulty and corrective actions are needed. The park FMO normally conducts the review with the Incident Commander and the Command and General Staff before the team is released from the incident. (See NPS-18)

B. Incident Management Team closeout

All teams assigned to in-park incidents will be subject to a closeout session, which will include generally the Superintendent, Fire Management Officer (presiding), Chief of Resources Management, resource advisors, the Incident Commander and members of the Command & General Staff and others selected at the discretion of the IC. In some cases, the System Support FMO or representative may attend. This meeting is normally held before the team is released from the incident.

C. National Review

National reviews are also possible. Sample review formats are also found in Chapter 9, NPS-18.

D. Program Reviews

Program reviews, operations evaluations, and/or FIREPRO audits are conducted periodically to ensure compliance with standards and procedures. This plan will be reviewed annually by the park FMO, with revisions included as necessary. The plan will be fully updated every three to four years.

E. Prescribed Fire Critiques

This critique will be conducted by the Prescribed Burn Boss according to guidelines and format found in Appendix H.

XV. Consultation and Plan Review

A. Consultation

The following agencies, groups and individuals were consulted during the development of this plan:

Santa Fe National Forest: Les Buchanan, Asst. Fire Staff Officer (ret.), Santa Fe National Forest; Phil Neff, Fire Management Officer, Jemez District, Jemez Springs, New Mexico; Orlando Romero, Fire Management Officer (ret.), Española Ranger District, Española, New Mexico.

New Mexico State Forestry: Frank Smith, State Fire Management Officer, Santa Fe, New Mexico.

Los Alamos County Fire Department: Deputy Chief Douglas Tucker, Los Alamos, New Mexico.

National Weather Service: Roy Pennington, Fire Weather Forecaster, Albuquerque, New Mexico.

Terrell Johnson, Consultant; Los Alamos, New Mexico.

B. Review

The following individuals are listed as Plan reviewers:

National Park Service: Cliff Chetwin, Branch of Aviation and Fire Management, Southwest System Support Office, Santa Fe, New Mexico; Charisse Sydoriak, Chief of Resources Management, Elizabeth Mozzillo, Park Archeologist; Research Ecologist, Biological Resources Division, U.S. Geological Survey, Craig Allen, Phd.; Superintendent Roy Weaver, Bandelier National Monument.