Environmental Assessment

for the proposed 2004 Fire Management Plan for Mojave National Preserve

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1.0 Introduction

1.1 Purpose of and Need for Proposed Action

Mojave National Preserve was established by the California Desert Protection Act in 1994 to preserve outstanding natural, cultural, and scenic resources while providing for scientific, educational, and recreational interests.

Since the Park's establishment in 1994, the fire management strategy for Mojave National Preserve has been to suppress all fires – human-caused and natural ignitions – using minimum impact suppression techniques. The Preserve was treated as a full suppression area and there was no formal Fire Management Plan. The purpose of this Fire Management Plan is to implement a broader range of fire management strategies to better achieve the goals of the Mojave National Preserve General Management Plan.

Additionally, this plan fulfills responsibilities under several directives including:

- the *2001 Federal Wildland Fire Management Policy* that directs that "Every area with burnable vegetation must have an approved Fire Management Plan;"
- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-year Comprehensive Strategy Implementation Plan* to improve fire prevention and suppression, reduce hazardous fuels, restore fire-adapted ecosystems, and promote community;
- the *Interagency Fire Management Plan Template* that specifies a single interagency template for all federal agency fire management plans;
- and, the *National Park Service Director's Order #18: Wildland Fire Management and the Reference Manual #18* that directs park management to achieve multi-dimensional objectives, with a balance between suppression and fire use to regulate fuels and maintain healthy ecosystems.

General Management of the Mojave National Preserve, including general guidelines for fire management, has been assessed through the formal analysis process required by the National Environmental Policy Act of 1969 (NEPA); 42 U.S.C. 4321-4347. An Environmental Impact Statement (EIS) was written and approved for the General Management Plan and the Record of Decision was signed by the Pacific West Regional Director in September of 2001.The Fire Management Plan, which is a document tiered from the GMP, articulates specific fire management practices, procedures and policies. Adoption of programs or plans, such as those that guide or prescribe uses upon which future agency actions may be based, require environmental analyses before a decision is made. That analysis is documented in this Environmental Assessment prepared in compliance with the National Environmental Policy Act as prescribed in NPS Director's Order/Reference Manual #12: Conservation Planning, Environmental Impact Analysis, and Decision-making (NPS 2001b).

1.2 Overview of the Preserve

The Mojave Desert comprises the southwestern quadrant of the Basin and Range physiographic province, a vast region dominated by rugged mountain ranges and alluvium-filled basins that

extends from northern Nevada to Mexico and from the California's Sierra Nevada and southern coastal region eastward to central Arizona and Utah. The Mojave Desert is transitional between the lower, hotter Sonoran Desert to the south and the colder high desert of the Great Basin to the north. The Mojave Desert is characterized by extreme variations in daily temperatures and more arid conditions than other American desert regions. Freezing temperatures occur during the winter, particularly in higher elevation regions. Summers tend to be hot, dry, and windy. Average precipitation in the region is less than 12 cm, but is highly variable from one year to the next (Stoffer 2004). Almost all precipitation arrives in the winter, but the region also experiences rare, intense late summer thunderstorms associated with the southwest monsoon.

Mojave National Preserve encompasses an eastern portion of the of the greater Mojave Desert ecosystem region. The Preserve consists of nearly 1.6 million acres of varied landscapes including rugged mountains, canyons, volcanic fields, alluvial fans, dune fields, and dry lake basins. Elevations in the Preserve range from the highest point at Clark Mountain (elevation 7929 feet; 2417 m) to the lowest elevation at Soda Lake (932 feet; 284 m). Other high upland areas include portions of the Granite, Providence, and New York mountains. Ecological habitats vary with the landscape and precipitation: pinyon-pine forests and frost-tolerant species occur above 5,500 feet (1675 m) where average precipitation is as much as 25 cm (some of which falls as snow); Joshua tree forests occur in the range of 4,000 to 6,000 feet (1220 to 1828 m); mixed desert shrub communities exist in the middle elevation regions and along the mountain range fronts, and; creosote bush and other drought-tolerant species survive in the lower elevation regions where rainfall averages less than 5 cm per year.

1.3 Relationship to Statutes, Regulations or Other Plans

Neighboring Jurisdictions and Fire Policies

The majority of the neighboring lands to the Preserve are federally-owned and managed by the Bureau of Land Management (BLM) which also adheres to the Federal Wildland Fire Policy and is simultaneously writing a new fire management plan for their lands. While it is not in final form yet, under the BLM plan all human or lightning-caused fires must be suppressed although some prescribed fire is allowed primarily for pile burning and non-native tamarisk reduction.

Starting in 2004, Mojave National Preserve is in the California Desert Fire Planning Unit. This unit includes 14 administrative units, managed by four federal agencies, and includes approximately 32 million acres. This Fire Planning Unit works collaboratively to implement the fire management and interagency planning actions required under the new Fire Program Analysis program. The Mojave National Preserve Fire Management Plan has been discussed with the Fire Management Officers in the California Desert Fire Planning Unit and is considered compatible with adjacent federal lands.

There is a limited amount of state or private lands in or adjacent to the Preserve. These lands are under state jurisdiction of the California Department of Forestry and Fire Protection (CDF), who has contracted the San Bernardino County Fire Department to provide fire suppression services on those lands. All fires, regardless of location or ignition source are suppressed on both state

and private lands. Prescribed fire is limited to pile burning of vegetation trimmings or non-native invasive tamarisk reduction.

Statutes and Regulations:

Management plans developed by the National Park Service are required to comply with federal law and policy. The most pertinent are the following:

National Environmental Policy Act of 1969 (NEPA); 42 U.S.C. 4321-4347
Endangered Species Act (ESA); 7 U.S.C. 136; 16 U.S.C. 460 et seq. (1973)
National Historic Preservation Act (NHPA); 16 U.S.C. 470 et seq. (1966)
Clean Air Act and Amendments (CAA); 42 U.S.C. s/s 7401 et seq. (1970)
The Wilderness Act; 16 U.S.C. 1131 et seq. (1988)

Specific to fire, the following laws and policies are also pertinent:
16 U.S.C. 1 through 4
Federal Wildland Fire Management Policy (interagency)
10-Year Comprehensive Strategy (interagency)
National Park Service Director's Order #18: Wildland Fire Management

Other Plans

The recently completed General Management Plan (NPS 2001a) summarizes the purpose of the Mojave National Preserve:

- To preserve and protect the natural and scenic resources of the Mojave Desert, including transitional elements of the Sonoran and Great Basin Deserts,
- To preserve and protect cultural resources representing human use associated with Native American cultures and westward expansion, and
- To provide opportunities for compatible outdoor recreation and promote understanding and appreciation of the California Desert.

The General Management Plan identifies nine objectives that directly or indirectly relate to fire management in Mojave National Preserve:

- Seek to protect significant natural and cultural resource and values, including geologic features, and to foster an improved understanding of fire and its role as a natural process through monitoring efforts and scientific research;
- Educate visitors regarding the National Park Service mission and the natural and cultural resources of the Preserve, including the ecological role of fire;
- Seek to continually improve the efficiency and effectiveness of fire management operations and administration. Adopt and incorporate sustainable practices into all aspects of the Preserve's fire management operations;
- Perpetuate scenic and cultural landscapes;
- Protect wilderness values and the wilderness experience in areas congressionally designated as wilderness and manage desert resources, including wilderness, for

maximum statutory protection provided for under the law, and adopt strategies to minimize impacts of fire management activities in all areas;
- Full protection of unique natural and cultural features;
- Suppress all human caused fires, and implement all fire management actions using methods, equipment and tactics that cause the least impact to natural and cultural resources;
- Use minimum requirements analysis for fires in wilderness. Use of mechanized equipment will continue to remain an exception to be used sparingly; and
- Assess research needs and initiate and promote long-term studies.

As presented in the General Management Plan, the vision for Mojave National Preserve is the protection and perpetuation of the natural environment and cultural landscape for the enjoyment and use of future generations. The Park does not have a Resource Management Plan.

Fire Management Plans articulate specific goals, tasks and protocols in the application of fire management. Consistent with the general guidance provided by the General Management Plan, the Fire Management Plan will:

- manage all fires to minimize impacts to all natural and cultural resources by limiting suppression tactics to engines on established roads, handcrews, and helicopter water drops and crew transport.
- delineate fire management units and identify appropriate fire management strategies, with consideration for protection of human life and property, protection of sensitive resources, as well as preservation of natural habitats and processes
- allow fire to resume its natural role in wilderness where natural fire regimes are unaltered, provided that fire does not pose a threat to structures, historic mine sites, or tortoise habitat.
- provide basic guidelines for post-burn rehabilitation to minimize and mitigate impacts of fire suppression activities and to reduce risks to critical human, cultural, and natural resources from post-fire watershed effects
- identify fire-related research needs and establish a fire effects monitoring program to gain a better understanding of fire effects on soils and biotic communities.
- Although the GMP allows for minimal use of mechanized equipment in wilderness for fire suppression, the National Park Service will make every effort possible to avoid use of such equipment. In situations where no other options are available to fight fires in wilderness, a Minimum Requirements Analysis will be completed.
- establish guidelines for smoke management to protect air quality and sensitive receptors consistent with the Clean Air Act

It has been determined that implementation of the proposed Fire Management Plan requires analysis under the National Environmental Policy Act (NEPA) and this environmental assessment has been prepared for that purpose. An environmental assessment is a brief NEPA document that is prepared to (a) help determine whether the impact of a Proposed Action or alternatives could be significant; (b) aid NPS in compliance with NEPA by evaluating a proposal that will have no significant impacts, but may have measurable adverse impacts; or (c) evaluate a

proposal that either is not described on the list of categorically excluded actions or is on the list but exceptional circumstances apply.

1.4 Fire Planning Issues

Initial public scoping for the fire management plan was conducted September 17-19, 2002 at Hole-in-the Wall, Needles, and Pasadena, California. This scoping was held jointly with the scoping for the grazing management plan. Public comments reflected the concerns of private property owners within and adjacent to the Preserve about fuels management and fire protection. Specifically, the comments focused on the spread of non-native grasses and the effects of the discontinuation of grazing from large areas of the park. Property owners also offered suggestions and asked questions relative to how, and to what degree, they would be involved in the pre-suppression planning process. Several had questions regarding structure protection and clearance requirements for vegetation around their homes and outbuildings.

Other issues that affect fire management in the Preserve have been identified by Preserve staff and include the following:

- Fire management in designated wilderness using the Minimum Requirements Analysis;
- Fire effects and fire suppression effects on four federally listed threatened or endangered wildlife species;
- Fire effects and fire suppression effects on other sensitive habitats and species, including numerous state listed plant species;
- Incomplete information regarding the location and extent of many species of flora and fauna;
- Incomplete information regarding the location and vulnerability of prehistoric and historic cultural resources;
- Lack of information regarding fire response and fire ecology of many desert species;
- Safety concerns associated with firefighting in and around abandoned mines;
- Poor access and long response times to many remote areas of the Preserve; and
- Large blocks of privately owned lands with structures and relatively heavy fuel loads.

2.0 Description of Alternatives

Under all alternatives, human caused wildfires and any fire which does not meet prescribed conditions or is an immediate threat to human life or property will be suppressed. Also, minimum impact suppression tactics which minimize ground disturbance will be used whenever practical in both emergency and non-emergency actions.

2.1 Proposed Action: Implement the 2004 Fire Management Plan as written, including, Suppression, mechanical fuel management, and wildland fire use for resource benefit.

The Proposed Action is to implement a range of fire management practices including suppression, wildland fire use and mechanical fuel management. This alternative does not include the use of management-ignited prescribed fire. The full details of this Proposed Action are presented in the Fire Management Plan and Appendices developed in conformance with the National Fire Plan and applicable federal laws and agency standards.

Approximately 1,246,400 acres (approximately 78% of the Preserve) are zoned for suppression, primarily for the protection of the threatened desert tortoise, structures, and private lands. Approved suppression tactics consist of fire engines operating on pre-existing roads, hand crews, and helicopters for crew transport and water drops. Hand crews use hand and power tools to cut, scrape or wet down vegetation to create a barrier to fire spread. Engines are used to apply water or soap-based surfactants (Class A foam) to vegetation. The following fire fighting tactics are not approved for use in Mojave National Preserve: heavy equipment (dozers, backhoes, loaders, graders), chemical fire retardant (except for Class A foam), and use of engines or other vehicles off-road. Class A foam is approved for infrequent use and is not the preferred firefighting surfactant. It will be used solely where there is available engine access and at least 1/8 mile away from surface water sources.

Wildland fire use is where lightning-caused fires may be allowed to burn in certain areas, under prescribed conditions, to achieve resource management objectives and allow fire to play its natural role in the ecosystem. Under the Fire Management Plan, 342,900 acres of designated wilderness are zoned for wildland fire use. This is approximately 22% of total lands within Mojave National Preserve and 44% of Preserve lands that are designated wilderness. These wildland fire use areas are located in the higher elevation lands found in portions of Clark Mountain, Piute Range, Woods Mountains, Hackberry Mountains, Providence Mountains, and Granite Mountains as well as the sparsely vegetated lands along the Park's western boundary at Kelso Dunes, Kelso Mountains, Devil's Playground, Cowhole Mountains, Old Dad Mountains, and Soda Dry Lake.

Mechanical fuel management uses hand and power tools to cut or remove vegetation to decrease either the volume or flammability of the fuels. Fuels treatments are planned activities that are conducted before a fire occurs in order to reduce fire risk. Mechanical fuel reduction is the only non-fire fuel treatment identified for implementation in this Fire Management Plan. Mechanical fuel management uses hand and/or power tools to cut or remove live or dead vegetation to decrease either the volume or flammability of the fuels. Fuels treatments are planned activities that are conducted before a fire occurs in order to reduce fire risk. The only fuel treatments

proposed in Mojave National Preserve are hazard fuel reduction immediately adjacent to park owned structures and hazard fuel reduction in the campsites in the Mid-Hills Campground. Mechanical treatments in wilderness will be avoided to the extent possible. Operation of dozers and fire engines are specifically prohibited in wilderness. In the rare case where mechanized equipment is needed, use will be limited to hand-held mechanized tools (e.g., chain saws, water pumps) and a Minimum Requirements Analysis completed.

The park will also incorporate hazard fuel reduction and fire preparedness requirements into various permits and agreements that involve structures inside of Mojave National Preserve.

Additional details of this alternative are found in the Fire Management Plan and its appendices. These documents include several environmental protection measures, such as criteria for using a resource advisor, endangered species avoidance and mitigation requirements, smoke management requirements, burned area emergency response, and fire effects monitoring and research.

This is the Preserve's preferred alternative and is also the environmentally preferred alternative because it best accommodates natural fire as an ecological process while protecting other values at risk. This proposal is the only option that has incorporated specific environmental protection measures. For further elaboration, reference Fire Management Plan Appendices A-E. This alternative also provides for the use of resource advisors and specifically disallows the use of firefighting tactics that could be environmentally harmful, including retardants, dozers, and off-road engine use.

2.2 No Action Alternative: Continue with full suppression and no written plan.

Implementation of this No Action alternative would be a direct violation of several interagency and NPS directives that require a written, comprehensive fire management plan. Nevertheless, the National Environmental Protection Act (NEPA) requires that the No Action alternative must be fully analyzed in all environmental assessments (such as this one) and environmental impact statements, even if another law prohibits the adoption of the No Action alternative or the park is under legislative or other command to act. The No Action alternative sets a baseline for comparing the impacts of existing actions with the Proposed Action.

There is no specific written plan for the implementation of this alternative. Rather it is the continuation of the "default" fire management program in absence of a written Fire Management Plan. National and regional policies and guidelines still apply, but there are no specific plans written to provide detailed directions for the implementation of those policies or directives as they apply specifically to fire management.

Under this alternative, all fires, regardless of location or ignition source, would be suppressed. Wildland fire use would not be allowed to achieve resource management goals in Mojave National Preserve. Minimum impact suppression tactics would be used to the extent that they can meet fire suppression objectives and protect values at risk. Fire fighting equipment and tactics used on each fire would be considered on a case-by-case basis and there would be no specific prohibitions against use of engines off-road, dozers for fireline construction, or retardant.

Protection of endangered species habitat and wilderness values would be addressed on a case-by-case basis consistent with general park procedures and policies, but there would be no specific fire-related considerations and the policies and procedures in Fire Management Plan Appendix A and B would not apply. Resource advisors would be used at the discretion of the incident commander and there would be no specific guidelines to determine when a resource advisor would be called into a fire incident. There would be no pre-established communication and coordination procedures to address air quality concerns with the Mojave Desert Air Quality Management District and Fire Management Plan Appendix D would not apply.

Fuels would not be manipulated by prescribed fire or chemical means. Consistent with NPS policy, mechanical removal of hazard fuels would continue as needed to provide defensible space immediately adjacent to park owned structures. Nevertheless, there would be no specific implementation schedule for treatments and there would be specific environmental protection measures except as cover general park operations.

This is not environmentally preferred because it continues the status quo. It does not accommodate natural fire. It does not have pro-active environmental protection measures such as wilderness management, tortoise management, or specified use of resource advisors. IT does not specifically prohibit any use (e.g., retardants etc.)

2.3 Alternatives Considered but Rejected

Use of Prescribed Fire

This alternative to use management-ignited prescribed fire alone or in concert with other fire management strategies was considered but rejected due to insufficient knowledge of the precise fire ecology and natural fire regime of Mojave Desert ecosystems. This deficiency is further exaggerated due to the uniqueness of the desert communities included in Mojave National Preserve. Because the Preserve is a transition area between three distinct deserts -- Great Basin Desert, Mojave Desert, and Sonoran Desert – it is unclear to what extent knowledge gained in other areas applies to the transition desert of the Preserve. Such knowledge is needed to fully describe desired future conditions, a prerequisite for using prescribed fire to simulate natural fire.

Full Mechanical Simulation of Fire Effects

This alternative was considered but rejected due to the high implementation costs and the unsatisfactory residual effects in the desert ecosystems. The primary fuels of the Preserve are desert shrubs, an unmerchantable product necessitating that the costs of any mechanical treatments be fully borne by the agency. Furthermore, desert soils are very fragile and the level of disturbance that would result from any large-scale mechanical treatments would be very detrimental. And finally, as described under prescribed fire, we lack sufficient knowledge of the precise fire ecology and natural fire regime of Mojave Desert ecosystems to adequately simulate natural fire.

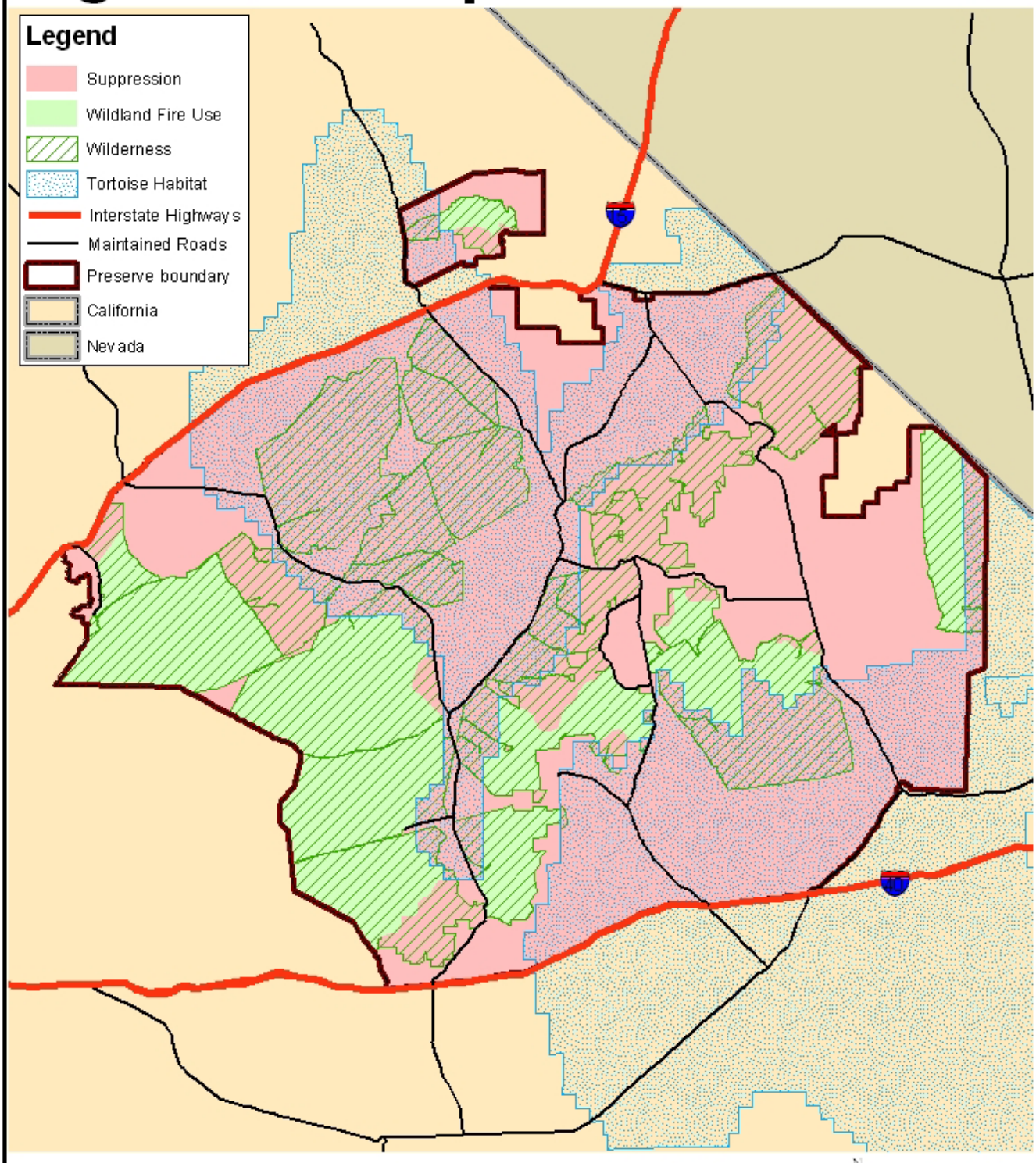
No suppression at all; all fires allowed to burn freely:

This alternative was considered but rejected due to the unacceptable risks posed to human life and property, as well as the environmental, social, and economic costs. Furthermore, this alternative would be in direct violation of many federal laws, the National Fire Plan, and NPS policies.

Mojave National Preserve
California
Fire Management Plan

National Park Service
U.S. Department of the Interior

Figure A1: Proposed Action



Produced by S. Dingman, Biologist, Mojave National Preserve

October 2004

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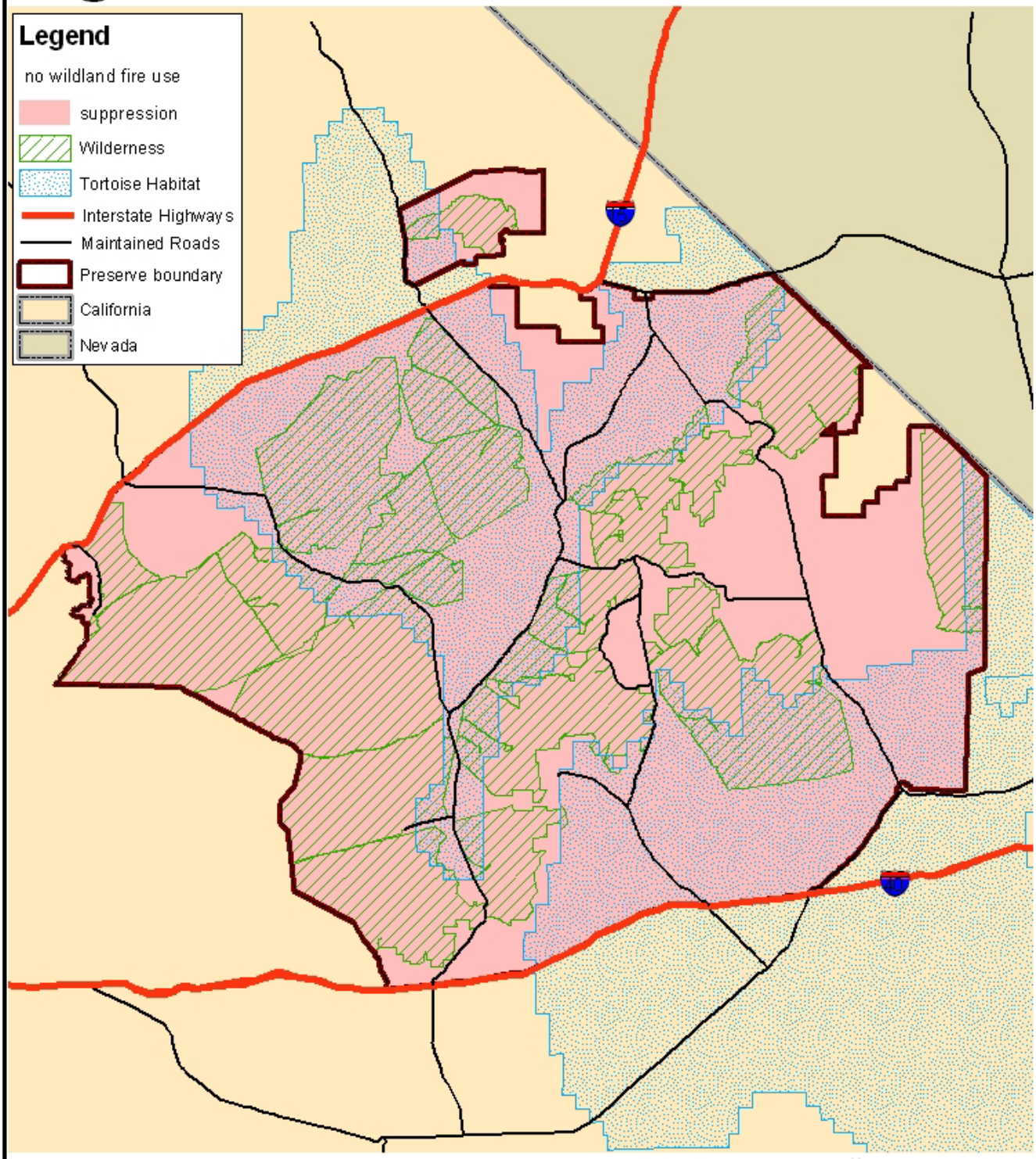
Mojave National Preserve
California
Fire Management Plan

National Park Service
U.S. Department of the Interior

Figure A2: No Action Alternative



Produced by S. Dingman, Biologist, Mojave National Preserve

October 2004

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3.0 Environmental Analysis

Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making and *Director's Order 12 Handbook* (NPS 2001b) together set forth the policy and procedures by which the National Park Service carries out its responsibilities under the National Environmental Policy Act (NEPA). Specific natural, cultural or socioeconomic resources that would be affected by the Proposed Action or alternatives (including No Action) are called impact topics. The magnitude, duration, and timing of the effect to each of these resources are evaluated in the impact section of a NEPA document. This is the impact section of the Fire Management Plan Environmental Assessment.

3.1 Impact Analysis Parameters

- Direct effect: An impact that occurs as a result of the Proposed Action or alternative in the same place and at the same time as the action (NPS 2001b).

- Indirect effect: Reasonably foreseeable impacts that occur removed in time or space from the Proposed Action. These are "downstream" impacts, future impacts, or the impacts of reasonably expected connected actions (NPS 2001b).

- Duration: This is an estimate of the period of time that a resource will be impacted. Duration is determined to be either short-term or long-term.
  - Short-term: Impact is not likely to be observed beyond five (5) growing seasons.
  - Long-term: Impact is likely to be observed beyond five (5) growing seasons.

- Magnitude: This is an estimate of the intensity of the impact that a resource will be subjected to. Magnitude is determined to be negligible, minor, moderate, or major.
  - Negligible: Impact is barely discernable.
  - Minor: Impact is barely measurable and is generally localized.
  - Moderate: Impact is measureable and may be localized or regional in scope.
  - Major: Impact is obviously measureable and is generally regional in scope.

- Direction: This is a value assigned based on the purposes for which the Preserve was established. Direction can either be positive or negative.
  - Positive: Impact or change that promotes the long-term preservation of natural resources, ecological processes, and/or cultural resources.
  - Negative: Impact or change that is adverse to the long-term preservation of natural resources, ecological processes, and/or cultural resources.

3.2 Impact Topics

Not all resources within the Preserve are affected by fire or fire suppression, for example, fire has no effect on geologic resources because rock is itself inflammable and is unlikely to be chemically or physically altered by the short fires that characterize desert fuels. As per Director's Order/Reference Manual #12: Environmental Compliance, this impact analysis is focused on those resources that have the potential for direct or indirect impact from fire or fire management.

Geology, Paleontology, Geomorphology, Soils: National Park Service management policies direct that all resources are protected in units of the National Park System and effects on those resources must be considered when selecting and implementing management actions. Nevertheless, the short duration and small extent of fires commonly found in the desert are generally insufficient to alter the basic physical resources of the environment. Furthermore, minimum impact suppression tactics are used to avoid and minimize even local ground disturbances caused by fire suppression activities. Therefore, no measurable direct or indirect effects are anticipated to geology, paleontology, geomorphology, or soils, thus these topics are not further analyzed.

Water Resources: Surface waters are rare in desert landscapes, yet are critical for maintaining wildlife and accommodating human use. Groundwater resources are critical to the maintenance of surface waters and provide much of the water used for human consumption. Wetlands and floodplains are also critical water-related resources and there are specific legal requirements for their protection (EO11990 and EO11988). Both fire and fire management activities have the potential to cause direct and indirect effects on water resources. Therefore, impacts to water resources are further analyzed.

Air Resources: Both National Park Service policy (NPS 2001c) as well as the Clean Air Act direct the protection of clean air. Smoke generated by wildland fire has the potential to significantly affect air quality. Therefore, impacts to air quality are further analyzed.

Natural Quiet: National Park Service policy (NPS 2001c) directs that natural soundscapes will be preserved in national parks. Fire itself can generate sounds, but as a natural process the effects of fire on natural quiet are considered natural. Nevertheless, fire suppression activities are not natural and they also have the potential to impact natural sound. Therefore, impacts to natural sound by fire management activities are further analyzed.

Vegetation: Because vegetation is essentially the fuel that burns in a fire, both fire and fire management activities have a great potential to cause both direct and indirect impacts to vegetation. Therefore, impacts to vegetation are further analyzed.

Wildlife: Individual animals, populations, and habitat have the potential to be affected by both fire and fire management activities. Therefore, impacts to wildlife are further analyzed.

Threatened and Endangered Species: National Park Service Policy (NPS 2001c) as well as the Endangered Species Act direct parks to consider the effects of their management decisions on threatened and endangered species. There are four federally listed species that occur or might occur in the Preserve: desert tortoise (*Gopherus agassizii*, known populations as well as designated critical habitat), Mohave tui chub (*Gila bicolor mohavensis*, known populations), least Bell's vireo (*Vireo bellii pusillus*, undetermined presence), and southwestern willow flycatcher (*Empidonax traillii extimus*, undetermined presence). Both fire and fire management activities have the potential to affect individual animals, populations, and habitat. Therefore, impacts to threatened and endangered species are further analyzed.

Cultural Resources – Prehistoric, historic, cultural landscapes, and ethnographic resources: National Park Service Policy as well as the National Historic Preservation Act direct that parks consider the effects of their management decisions on cultural resources. Both fire and fire management activities have the potential to affect cultural resources. Therefore, impacts to cultural resources are further analyzed.

Visitor Use: National Park Service policy directs that parks consider the effects of their management decisions on visitor use. The short duration and small extent common to desert fires make it unlikely that visitor use would be significantly affected by either fire or fire management activities. In rare instances, fires may create an unsafe condition that requires a temporary visitor use closure or restriction as necessary to minimize risk to visitors or resources. In such cases, closures will be conducted under the Superintendent's authority and the public will be notified via press releases and posting to the Preserve's website. Such emergency closures are exempted from full environmental analysis under NEPA as an emergency action. Therefore, impacts to visitor use are not further analyzed.

Wilderness: National Park Service policy as well as The Wilderness Act directs that parks consider the effects of their management decisions on designated wilderness. There is almost 700,000 acres of designated wilderness in Mojave National Preserve, thus fire and fire management activities are likely to affect wilderness. Therefore, impacts to wilderness are further analyzed and implementation of the Minimum Requirements Analysis tool is addressed.

Development: There exists a variety of infrastructure in the Preserve, including numerous private land holdings that contain primary or vacation homes, improved public properties not managed by the NPS, and NPS owned structures. Both fire and fire management activities have the potential to affect these developments. Therefore, impacts to existing development are further analyzed.

Socio-economic: While large fire incidents can have a significant affect on local economies, it is unlikely that any such incidents would occur within the Preserve due to the light and discontinuous fuels. Most firefighting resources that are used in the few extended attack fires within the Preserve are obtained from local federal or state agencies and it is unlikely that there will be an increase in contract fire work within the Preserve under any fire management scenerio. Also, there are very few businesses within or immediately adjacent to the Preserve, so there are limited opportunities for the fire management operation to have an impact, positive or negative, on local economies. Furthermore, the firefighters duty-stationed within the Preserve are housed in government quarters in the interior of the Preserve and generally have limited economic interactions with the few communities in or adjacent to the Preserve. Therefore, socio-economic impacts are not further analyzed.

Park Operations: As funding for the fire management program and for any fire incidents comes from federal sources separate from the Preserve's operating budget, there is no impact on park operations. The existing Hole-in-the-Wall Fire Center is expected to adequately handle the housing, office, and storage needs of the fire management program for many years to come so there is no anticipated new construction that would interfere with on-going park operations. Therefore, impacts to park operations are not further analyzed.

Impairment: The mission of the National Park Service as defined in the Organic Act of 1916 (16 USC 1) and reaffirmed by the General Authorities Act, as amended (16 USC 1a-1), specifically requires that the NPA leave park resources and values unimpaired, unless a particular law directly or specifically provides otherwise. This prohibition against impairment must, therefore, be addressed in any discussion regarding potential impacts to park resources. Both the Proposed Action and the No Action alternatives are assessed for potential to significantly damage or impair the resources and values of Mojave National Preserve.

3.3 Impact Analysis

3.3.1. Water Resources

Affected Environment (excerpted from NPS 1999a)

The water sources inside the Preserve include springs, seeps, wells, and guzzlers. Almost no permanent streams or reservoirs exist. A spring has a visible flow, whereas a seep normally is evidenced by riparian vegetation. Springs and seeps appear when groundwater is forced to the surface by some geologic configuration, such as a hard stratum, fissure, or fault line. Typically, a spring's flow continues on the surface for a short distance, before disappearing back into the alluvial materials common to arroyos of the area. Springs and seeps offer essential water for wildlife. In most cases, spring water quality is adequate for wildlife and stock, and many springs yield potable water.

Over 200 springs and seeps have been identified in the Preserve (Mendenhall 1909). Springs in the Preserve cluster along the principal mountain chain of the Granite – Providence Mid-Hills – New York Mountains, with 78 percent of the springs and seeps in the Preserve occurring between 4,000 and 6,000 feet elevation (Hall 1981; BLM data 1998). Most springs are small and flow less than five gallons per minute (Freiwald 1984).

At the eastern edge of the Preserve, Piute Creek, fed by Piute Spring, flows for about a mile on the surface. The average flow of the spring 1988 – 1998 has been about 42 gallons per minute (National Park Service 2000). Cornfield Spring also supports a small stream.

Many springs have been altered over the years by the installation of retention tanks, pipelines, and troughs for ranching use. It is traditional to catch and store spring water in stock tanks during wetter periods of stronger flow, for use in drier times. Wells pumping water from greater depths typically are coupled with storage tanks, and windmills may provide the power.

Guzzlers are artificially constructed devices which catch surface runoff during storms and divert it to a storage tank, with a trough arrangement so that animals can drink from it. Surface water is rare; nevertheless, in some igneous or hard rock areas, rainwater may collect as small pools in rock bowls (tinajas or "tanks") and remain for a few weeks, depending on the conditions of evaporation (Mendenhall 1909). Wildlife benefits from these tinajas.

Playas in the area consist generally of clay with minor amounts of sand, and may include chemically deposited salts. Two playas, Soda Lake and Silver Lake, are some of the largest playas in the Mojave Desert region, having an area of about 60 square miles. These deposits were mostly laid down in temporary or perennial lakes in the playas during the Pleistocene epoch. Material continues to be deposited. In wet years, water may stand on the surface of a playa (Thompson 1929).

As of 1998, approximately 138 functioning wells are found in the area of the Preserve, plus another 100 dry wells where monitoring had been attempted. In a subset of 10 wells investigated, well depths range from 14.5 to 1090 feet, with depth to water ranging from 14 to 418 feet. Basically random fluctuations were observed in groundwater levels between the 1950's and 1980s, presumably related to pumping and yearly climatic variations.

Impacts to Water Resources

Fire is known to alter watershed response within burned areas. The degree that watershed response is altered varies by location depending on slope, soil condition, as well as the volume and timing of precipitation events. Watershed response is also dependent upon soil changes that are an expression of burn severity and vegetation changes that are a result of fire intensity. Changes in watershed response due to fire may include increased runoff and development of hydrophobic soils that result in flooding, landslides, debris flows, and mudflows. Such responses can alter surface water features such as streams, springs, and seeps. Groundwater recharge may be temporarily increased, but otherwise fire is unlikely to affect groundwater resources.

Fire suppression efforts can also affect water resources. Line construction, particularly large firelines constructed with heavy equipment, can alter surface flows, causing flows to channel in the suppression line. Chemical retardants are clay-based chemicals aerially applied as slurry in large volumes that can severely alter the chemical composition of surface waters and may potentially affect groundwater as well. Class A foam is used in small loads as a wetting agent applied with water to help water cling to vegetation and structures. Class A foam is essentially a detergent (or soap?) and is generally used in such small amounts that contamination of water resources is not an issue. Hazard fuel reduction can also affect water resources if sufficiently large volumes of vegetation are removed to alter the water budget through reduced evapo-transpiration, or if the removal of fuels creates new paths that alter surface flows.

Both the Proposed Action and the No Action alternatives would allow line construction with an emphasis on using minimum impact suppression tactics that would result in negligible impacts to surface water resources. The Proposed Action does accommodate about 342,900 acres of wildland fire use where naturally ignited fires may be allowed to burn under prescribed conditions and line construction would not occur. The No Action alternative provides for full suppression of all fires, thus it is likely that more line would be constructed under the No Action alternative than under the Proposed Action. The Proposed Action specifically prohibits the use of engines off road, bull dozers, and other heavy equipment for line construction, thus limiting the size of constructed lines and possibly limiting the total amount of constructed line. The No Action alternative does not specifically prohibit any type of equipment for use in the Preserve and such use is considered on a case-by-case basis. While it is unlikely that heavy equipment

would be used in the Preserve under the No Action alternative, it is possible. Thus, the size of constructed lines and the total amount of constructed line is likely to be greater under the No Action alternative than under the Proposed Action.

The Proposed Action would prohibit the use of chemical retardants in the Preserve, thus there would be no impacts to surface water or groundwater resources. The No Action alternative does not specifically prohibit any type of equipment or material for use in the Preserve and such use is considered on a case-by-case basis. While it is unlikely that chemical retardant would be used in the Preserve under the No Action alternative, it is possible. Both alternatives allow for the use of Class A foam, although the Proposed Action specifically prohibits its use adjacent to Lake Tuendae and MC Spring at the Soda Springs district for the protection of endangered fish habitat.

Both alternatives allow for the use of helicopters for water drops. Throughout most of the Preserve, water would be acquired from wells via hydrants or water tenders. In a few areas of the Preserve, water could be taken from artificial ponds or stock tanks, thus reducing the availability of surface waters in those areas. Under the Proposed Action, drafting from the Tui Chub Ponds at Zzyzx/Soda Springs is specifically prohibited for the protection of endangered fish habitat. Due to equipment limitations, no ponds or tanks could be used to the point that they were caused to dry up. As artificial ponds and stock tanks are by definition unnatural, there is no impact from this use.

The Proposed Action specifically calls for the reduction of hazard fuels immediately adjacent to park owned structures and in the campsites of the Mid-Hills Campground. Such efforts are confined to previously disturbed areas where the surface flows have already been altered, thus there is no impact to surface flows. The vegetation removal would be so minimal and isolated that it would not have an appreciable affect on the water budget. Hazard fuel reduction is not specifically addressed in the No Action alternative because a written plan does not exist for this alternative. Nevertheless, fuels immediately adjacent to park owned structures would likely be removed to provide for defensible space as per NPS policy. The impact of this action would be negligible as described for the Proposed Action.

The effect of fire on water resources is a natural process, and thus is not perceived as negative to the mission of the Preserve. The discontinuity of desert fuels generally limits fire size, thus it is unlikely that fire would result in large-scale watershed effects that would impact roads or utility systems. The organic component in most of the soil is insufficient to result in hydrophobicity, thus the potential for landslides and mudflows is minimal. Furthermore, the natural hydrologic response of the desert is that of infrequent but intense rainfall resulting in flash flooding of desert washes and the short-range transport of moderate volumes of unconsolidated substrates, generally pebble and sand. A burned area might contribute slightly more material than an unburned area, but such responses are within the normal range of variability for the desert. The persistent wind is likely to scour fine ash particles from a burned area in a short time after a fire, resulting in desert pavement similar to unburned and unvegetated areas of the desert. The Proposed Action allows for about 342,900 acres of wildland fire use where naturally ignited fires can be allowed to burn under prescribed conditions, while the No Action alternative calls for full suppression. Consequently, there may be more burned acres under the Proposed Action than

under the No Action alternative. Under either alternative the impacts of fire on water resources in negligible.

Water Resource Conclusions

In conclusion, the impacts to water resources from implementation of the Proposed Action are found to be negligible and short-term. The impacts to water resources from the continuation of the No Action alternative are likewise likely to be negligible and short-term; nevertheless, because the No Action alternative is not based on a written plan with specific protection measures, there is the potential for minor or even moderate long-term impacts.

3.3.2. Air Resources

Affected Environment

All federal agencies are required to adhere to the Clean Air Act. This Act established national ambient air quality standards for several "criteria pollutants" including carbon monoxide and particulates and established a classification system for airsheds. The Preserve is considered a Class II "floor" area that allows for moderate increases in some pollutants, but it can never be redesignated a Class III area that would permit a large volume of new pollution. Enforcement of the Act in California has been delegated to the state, through the California Air Resource Board who has developed more stringent standards for the "criteria pollutants". Local air districts may also be developed to enforce air quality standards, and Mojave National Preserve is located within the Mojave Desert Air Quality Management District.

Under certain wind conditions, Mojave National Preserve is downwind of the air pollutants generated in the heavily populated Los Angeles Basin. Statewide, the air pollutants that have been most problematic and required the most regulatory attention are ozone and particulate matter because they have known adverse effects on human health. Ozone also adversely affects some species of vegetation, and particulate matter contributes to visibility degradation; thus, these same two pollutants are of concern for their effects on the Preserve's resources as well as on human health. In addition, deposition of nitrogen (NO^{3-} or NH^{4+}) via precipitation, fog, or as dry deposition, may affect aquatic and terrestrial systems. Ambient air concentrations of ozone, particulate matter, and nitrogen deposition are also derived or affected by concentrations of nitrogen oxides and volatile organic compounds. Typically, primary particulate matter in the size range of 2.5 to 10 micrometer (μm) is derived from natural sources, but human activities also contribute road, construction, or agricultural dust. In California, particulate matter less than 2.5 μm typically consists largely of organic and elemental carbon and of NH^4NO^3. In urban areas, organic and elemental carbons are emitted by automobiles and other mobile sources, as well as in wood smoke. Wildfires in forested regions to the west, especially San Bernardino National Forest and Angeles National Forest, are another source of particulate carbon.

Air pollution sometimes causes impaired visibility in the Preserve, particularly in the summer. In general, winter air quality is better when the prevailing air flows are not from the direction of Los Angeles basin. Mountain peaks and other geographic features, including Big Bear in the San

Bernardino Mountains to the west are easily seen from vista sites within the park when visibility is good.

Mojave National Preserve does not monitor any air quality parameters; nevertheless, the National Park Service monitors air quality at nearby Joshua Tree National Park, a Class I area. As both parks are affected by the Los Angeles Basin and contain similar resources, data from Joshua Tree National Park are summarized here to better understand the air quality Mojave National Preserve. The resources in Joshua Tree National Park of greatest concern with respect to air pollution degradation are visibility and vegetation (Sullivan et al 2001). Ozone concentrations remain high in Joshua Tree National Park, with exceedance of the federal maximum daily 1-hr standard occurring every year from 1992-1997. The primary source of ozone and ozone precursors in the park is emissions from the South Coast Air Basin, where ozone concentrations have been declining in recent years. Nevertheless, no such trend in declining ozone has been detected in Joshua Tree National Park, and no definitive explanation is available for the difference between trends in the South Coast and the park. Based on data collected 80 km away, wet sulfur and nitrogen deposition at Joshua Tree National Park are well below levels expected to cause damage. Dry deposition measurements for the period 1995 through 1998 suggest that dry sulfur deposition is low, but dry nitrogen deposition is modest, although still below the range thought to cause damage to vegetation. There are no documented effects of air pollution on vegetation growing naturally in the park, although controlled fumigation studies have shown that a number of native plant species of the Mojave Desert are quite sensitive to air pollution. There appears to be high potential for vegetation injury caused by ozone, although injury symptoms are known for relatively few desert plant species and can be difficult to diagnose.

Impacts to Air Resources

Smoke generated by wildland fire produces emissions and releases carbon particulates that can have a localized or widespread affect on air quality (National Wildfire Coordinating Group 2001). Emissions generated by firefighting equipment, including engines, helicopters, water tenders, and chainsaws, can likewise have a localized affect on air quality.

The light fuels and discontinuity between fuels that characterize most of Mojave National Preserve result in fires that are generally short-lived and small in size. Such fires generate little smoke and smoke management is generally not an issue. Under all alternatives, the maximum smoke emissions possible from the available fuels are not expected to adversely impact human health nor violate the National Ambient Air Quality Standards Nevertheless, there is the potential for sustained ignition under extreme burning conditions as evidenced by the few relatively large fires that have been recorded in the Preserve. Furthermore, the Proposed Action provides for 342,900 acres of wilderness to be managed for wildland fire use where naturally-ignited wildland fires can be allowed to burn under pre-stated conditions. Naturally-ignited wildland fires in the remainder of the Preserve will be suppressed. All human-ignited fires will be suppressed throughout the Preserve. This accommodation of wildland fire use is a change from our previous fire management strategy where all fires in the Preserve were suppressed (No Action alternative).

Wildland fire use areas are located primarily along the western edge of the Preserve, in an area of sparse and discontinuous fuels associated with Kelso Dunes, Devils Playground and Soda Dry Lake, and with pockets of heavier fuels located in the Kelso Mountains, Old Dad Mountains, and Granite Mountains. The Piute Range on the east boundary, home to several of the Preserve's largest fires of record, is also zoned for fire use. In the center of the Preserve portions of the Providence Mountains, Mid-Hills, Woods Mountains, and Hackberry Mountains are also zoned for fire use. North of I-15, the center of the Clark Mountains is zoned for fire use in an area of high elevation montane woodland that is characterized by relatively heavy fuels in pockets interspersed with sheer cliffs and barren rock.

There are no urban areas in the immediate airshed of Mojave National Preserve. As measured from the center of the Preserve to the center of the urban area, the nearest urban areas are: Las Vegas, Nevada metropolitan area located 78 miles northeast, Barstow, California located 89 miles west, Twentynine Palms, California located 73 miles northeast, and the contiguous communities of Laughlin, Nevada and Bullhead City, Arizona located 54 miles to the southeast. There are significant orographic features separating the Preserve from any of these urban areas. The small size and short duration of most of the fires recorded in Mojave National Preserve make it very unlikely that a smoke column would rise high enough to be carried to these urban areas.

There are several small communities in or immediately adjacent to the Preserve. These communities have populations of a few dozen to a few hundred people. Other concentrations of people in the Preserve include two campgrounds, two university research stations, and vacation homes of Round Valley. Depending on the location of a fire and the prevailing winds, some of these communities could experience short-term smoke concentrations.

To address concerns related to smoke, a communication and coordination protocol (California Air Resources Board 2004) has been established with the Mojave Desert Air Quality Management District (Fire Management Plan Appendix D). This protocol includes specific responsibilities for notification and may result in the management of fires to reduce smoke production where smoke is a concern.

Air Resource Conclusions

Given the short duration of most fires and the sparse population in and adjacent to the Preserve, air quality impacts associated with implementation of the No Action alternative are expected to be minor and short-term.

Given the short duration of most fires, the sparse population in and adjacent to the Preserve, and the existence of a communication and coordination protocol for the management of wildland fire use, air quality impacts associated with implementation of the Proposed Action are expected minor and short-term.

3.3.3. Natural Sound

Affected Environment

An important part of the NPS mission is to preserve and/or restore the natural resources of the parks, including the natural soundscapes associated with units of the national park system. Natural sounds are intrinsic elements of the environment that are often associated with parks and park purposes. In planning for soundscape preservation and noise management, park superintendents must use the best science available to determine the impact of existing or proposed noise sources on the soundscape, wildlife, aquatic and marine life, cultural resources, other resources and values, and the visitor experience, as appropriate. With respect to determinations related to the impacts of sound on the park soundscape, the natural soundscape is the "affected environment." Environmental analyses determine the type, magnitude, duration, and frequency of occurrence of noise that is compatible or incompatible with protecting the resources or the visitor experience for which the park was established and planned, as well as determining the significance of noise levels or impacts. This may also include determining whether certain noise sources are necessary or appropriate.

The Preserve is a vast area and though it is located between the densely populated cities of Los Angeles and Las Vegas, and bounded by Interstate highways 15 and 40, opportunities to experience natural quiet abound. Limited soundscape monitoring was conducted in the Preserve in 2001 at three locations. Natural sounds such as wind and insects dominated the sample time. Human caused sounds heard most often were the passing trains and automobiles. Jet and propeller plane fly-over as well as military aircraft were also found to be common sources of human-caused sound.

Impacts to Natural Sound

Fires themselves generate noise by the combustion of fuel, albeit the noise is generally considered a “natural” sound and thus is part of the natural soundscape. Therefore, noise generated by the fire is not considered an impact.

Fire suppression activities also generate noise, which is not a part of the natural soundscape. Noises include the sound of diesel fire engines and water tenders, pumps, saws, and helicopters. The sound produced by any of these pieces of equipment will exceed the background noise in a local area and may even be heard some distance away, depending on wind direction and topography. Generally, the only firefighting equipment that most visitors or residents are likely to notice is the helicopter(s) as the other equipment tends to fade into general traffic noise that most people are accustomed to hearing. Furthermore, helicopters tend to traverse a much larger area than the ground-based equipment and have the potential to project sound over a muh larger area. The noise generated by any of these pieces of equipment will likely disrupt wildlife, but that wildlife is likely to already be disrupted by the presence of a fire in the immediate vicinity.

Natural Sound Conclusions

The Proposed Action and the No Action alternative both include the use of fire suppression equipment that will generate noise. Both alternatives are expected to have moderate and short-term impacts on natural sound.

3.3.4. Wilderness

Affected Environment

The California Desert Protection Act of 1994 (CDPA) designated 695,200 acres of Mojave National Preserve as wilderness. These lands are managed in compliance with The Wilderness Act of 1964, which defines wilderness as "...an area of undeveloped Federal land retaining its primeval character and influence, which permanent improvements or human habitation, which is protected and manage so as to preserve its natural conditions...." It is important to note that in this discussion, the term *wilderness* applies specifically to those lands designated as such in the California Desert Protection Act and does not apply to the more generic "backcountry" lands that also exist in the Preserve.

Management of wilderness is guided by Director's Order #41, Wilderness Preservation and Management (NPS 1999c). The order directs that fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness. Actions taken to suppress wildfires must use the minimum requirement concept, and will be conducted in such as way as to protect natural and cultural features and to minimize the lasting impacts of the suppression actions and the fires themselves. In the Mojave Desert, additional guidance is found in the Desert Managers Group's "Principles for Wilderness Management in the California Desert" (Desert Managers Group 1995) and its annexes, including "Annex 5 – Principles for Fire Management within Wilderness Areas of the California Desert" (Desert Managers Group 1999). These policies and principles apply to all fire management activities in wilderness under both the Proposed Action and the No Action alternative.

Two important concepts applied to wilderness areas managed by the NPS are "minimum requirement" and "minimum tool." Minimum requirement is a documented process used to determine the appropriateness o f all actions affecting wilderness. It is a two-step process that documents 1) a determination as to whether or not a proposed management action is appropriate or necessary for the administration of the areas as wilderness, and does not pose a significant impact to the wilderness resources and character; and, 2) if the project is appropriate or necessary in wilderness, the selection of the management method that causes the least amount o impact to the physical resources and wilderness character. A Minimum Requirements Analysis has been prepared for the Fire Management Plan. Minimum Tool refers to a use or activity determined to be necessary to accomplish an essential task and which makes use of the least intrusive tool, equipment, device, force, regulation, or practice to achieve the wilderness management objective. Note this is not the same as the term "primitive tool," which refers to the actual equipment or methods that make use of the simplest available technology.

Impacts to Wilderness

Naturally-ignited fires are a natural process, thus fire effects are not considered an impact on wilderness. In fact, the perpetuation of fire as a natural process consistent with the values and purpose of wilderness (Arthur Carhart National Wilderness Training Center 1995) and was the

primary purpose for zoning 342,900 acres of wilderness for fire use in the Proposed Action where naturally ignited fires are allowed to burn under prescribed conditions.

There are many aspects of fire suppression and fire management that can have an impact of the physical resources of wilderness or on wilderness character. Certain fire management activities must be carefully evaluated before implementation within designated wilderness (Arthur Carhart National Wilderness Training Center 1995). Generally, these activities include the use of motorized equipment or mechanized transport and their planned use must be considered in a Minimum Requirements Analysis as was prepared for the Fire Management Plan. In the event that fire poses an imminent threat to life or property, fire suppression activities can be classified as "Emergency Needs" and, as such, do not require documented analysis prior to approval of a generally prohibited activity or use in wilderness.

Under the Proposed Action, 342,900 of Preserve's wilderness lands will be managed for fire use where natural ignitions are allowed to burn under prescribed conditions. In total, 352,300 acres of wilderness will be treated as full suppression for the protection of other values at risk, most notably habitat for the threatened desert tortoise and cultural resources. All human caused ignitions will be suppressed including ignitions in wilderness and in the fire use zone. There are no hazard fuel treatments proposed in wilderness under this alternative. This alternative would be implemented as described in the written Fire Management Plan, including the appendices to that document. One of the appendices that has been prepared for the Fire Management Plan is the Wilderness Minimum Requirement Analysis (Appendix B). These documents include specific guidelines to minimize impacts of fire management activities on wilderness, including the following provisions:

- A Resource Advisor will be assigned to all extended attack fires, including those occurring in or near wilderness.
- Fire camps and incident command centers will be located outside of wilderness.
- Throughout the Preserve, motor vehicle use is restricted to existing roads.
- Throughout the Preserve, handlines will be located to make full advantage of natural barriers such as rock outcroppings, trails, and dry washes. Handlines will be no wider than necessary to stop the spread of fire.
- Within wilderness, chain saws, helicopters, or pumps will only be used when essential to meet suppression objectives, but with due consideration to impacts on wilderness character and subject to minimum tool determination.
- Heliports and helipads are not allowed in wilderness.
- For fire management purposes, it is generally possible to use unimproved helispots in wilderness and walk into the work site if such an unimproved helispot is available within a 15 minute walking distance.
- To the extent possible, non-emergency use of helispots in wilderness will be avoided. If it cannot be avoided, the decision to use a helispot in wilderness will be detailed in a Wilderness Minimum Requirement Analysis as well as an environmental compliance document (i.e., the Environmental Assessment or Categorical Exclusion).

Under the No Action alternative, all fires are suppressed without regard to location or ignition source. As a result, impacts to wilderness under the No Action alternative include impacts to wilderness character by excluding fire as a natural process and impacts to physical resources of

wilderness due to the suppression activities that are likely to occur in wilderness, including: line construction, use of mechanized equipment (saws, pumps, etc), use and/or improvement of helispots. Furthermore, there is no written plan for this alternative so the provisions listed above for the Proposed Action are not required under the No Action alternative. While the general policies of wilderness management still apply there is a stronger potential that impacts could occur in wilderness and there is no requirement to use a resource advisor to specifically advise the incident commander about wilderness concerns. While unlikely, there is also no specific prohibition against placing fire camps and incident command centers in wilderness. Without the use of a resource advisor, there is also the potential that there could be unintentional impacts to wilderness because boundaries are poorly defined on the ground in some areas and without the GIS support a resource advisor provides to the incident commander some activities could unknowingly be located in wilderness. There are no hazard fuel treatments anticipated in wilderness, but there is no written hazard fuel implementation plan for any treatments and no specific prohibitions against hazard fuel treatments in wilderness in the future.

Wilderness Conclusions

Implementation of the Proposed Action is likely to have minor long-term impacts to wilderness character due to the suppression of naturally-ignited fires in 352,300 acres of wilderness for the protection of other resource values. Suppression activities are likely to have only negligible, short-term impacts to wilderness resources due to the adoption of specific guidelines to minimize and avoid fire suppression impacts to wilderness in Mojave National Preserve.

Implementation of the No Action alternative is likely to have moderate, long-term impacts to wilderness character due to the exclusion of fire as a natural process throughout the Preserve, including naturally ignited fires in wilderness. Suppression activities are likely to have minor, short-term impacts to wilderness resources due to adherence to general wilderness management directives, but no specific guidelines for management of fires in wilderness in Mojave National Preserve.

3.3.5. Developed Land Use

Affected Environment

Large blocks of private land are located within the Preserve boundary, primarily in the central and eastern portions, including Gold Valley, Round Valley, Pinto Valley, Cedar Canyon and Lanfair Valley. Approximately 200 full-time residents live in the Preserve and another 150 occasionally occupy weekend residences, primarily in Round Valley. Sub-dividing of land is currently occurring in Gold Valley, and as more lots are developed for either full or part-time residences, there will be an increase in the potential for wildland fires to impact populated areas. There are also numerous scattered and isolated homesites throughout the Preserve, some on private land, and some in trespass on NPS land.

Two research facilities associated with universities are located within the Preserve. The Soda Springs Desert Study Center is located at Zzyzx, in the northwestern part of the Preserve, and is

part of the California State University system. The complex of both historic and modern buildings provides lodging and classroom space for researchers and students attending field classes and extended education courses. The Granite Mountains Natural Reserve is located in the southwest portion of the Preserve and consists of 9,000 acres set aside for use by the University of California. The reserve serves as a classroom, laboratory, and ecosystem library for field studies in natural sciences.

Within the boundary of Mojave National Preserve is the Providence Mountains State Recreation Area, managed and operated by the State of California. The prime attraction is Mitchell Caverns, where guided tours are offered. There is also a small developed campground within the Recreation Area. There are several buildings on site for visitor use, administrative use, and employee housing.

There are hundreds of facilities associated with rights-of-way in the Preserve including roads, the Union Pacific Railroad tracks, two major gas pipelines, two major electrical transmission corridors, numerous small electrical transmission lines, telephone transmission lines and microwave sites, and numerous communication sites such as cell towers and radio repeaters.

The Preserve currently manages park housing and/or administrative facilities in the Preserve at Hole-in-the-Wall, Kelso, Cima, Kessler Springs Ranch, Valley View Ranch, and OX Ranch. In total, there are fewer than a dozen occupied structures but there are several dozen structures owned by the Preserve. Additionally, there are two visitor use facilities inside the Preserve: Hole-in-the-Wall Visitor Center currently in operation, and Kelso Depot scheduled to open to the public in 2005. There are also two public campground managed by the NPS in the Preserve: Mid-Hills and Hole-in-the-Wall.

In total, there are 1320 acres in the Preserve mapped as human development or land use (Thomas et al 2004), although this figure does not include linear features such as underground utility systems.

Impacts to Developed Land Use

Populated areas have more potential ignition sources, such as charcoal, wood ashes, cigarettes, vehicles and equipment such as weed-eaters and lawn mowers, so as the population of the area increases, ignitions are expected to increase. Many of the residents are moving in from more urban areas and have expectations of municipal-level structural fire response of five minutes or less, 24-hours a day, which does not exist in the area. Structural fires are under the jurisdiction of San Bernardino County, which provides limited service based on the "unfunded" status of the desert lands. The closest staffed structural fire stations are located in Needles, Harvard and Barstow, each with a response time in excess of one hour to the locations along the perimeter of the Preserve. A volunteer station that is only staffed when a fire occurs is located in Newberry Springs. The Preserve fire crews are funded, trained, certified and equipped to suppress only wildland fires, though they can and do assist the County during emergency incidents upon request.

Fires can also impact development by burning from wildland fuels into developed areas. The potential for this fire spread is relatively low due to the relatively light fuel loads and discontinuity of fuel that characterize much of the desert. Nevertheless, two of the most populated areas within the Preserve do not occur in this classic Mojave Desert fuel type and instead occur in relatively heavy and continuous fuels. Round Valley Community occurs in a pinyon-juniper woodland with a significant understory of big sagebrush resulting in an almost continuous fuel bed and many structures tucked under or immediately adjacent to trees. Fourth of July Canyon Community occurs in an interior chaparral woodland with large trees and a dense understory where most of the houses are directly under large shade trees. These two locations pose the biggest risk for a wildland fire/urban interface fire situation. As both of these communities exist on large blocks of privately owned land, construction of any large-scale fuel breaks would require extensive community cooperation that is unlikely at the present time.

The best defense against loss of structures from wildland fire is to fully implement the concepts of survivable space as described by Firewise, a non-profit education organization developed to assist homeowners living in the wildland urban interface. The major concepts of Firewise are the use of fire resistant landscaping and fire resistant construction materials and techniques. Firewise materials are provided free of charge to anyone who asks and there is a specific training program for fire management personnel to provide assessments of homes and make recommendations for improve their survivability from wildland fire.

Neither the Proposed Action nor the No Action alternative will change the Preserve's capacity to handle structural fires. Both alternatives are specific to management of wildland fires.

Impacts to development tend to be long-term, as any loss of infrastructure due to fire would likely take a substantial amount of money and time to restore or rebuild. In this impact analysis, short-term impacts are considered to be non-existent and only long-term impacts are discussed.

The Proposed Action includes about 342,900 acres of wildland fire use where naturally ignited fires are allowed to burn within prescribed conditions. Those fire use areas occur only as large blocks in designated wilderness and are at least 0.5 mile from known structures or developments. Furthermore, there are provisions in the management of wildland fire use fires to switch management strategies to suppression if there is any threat to development. Thus, direct fire impacts to development from wildland fire use are very unlikely. The Proposed Action also includes 1,246,400 acres zoned for suppression of all fires. This suppression is unlikely to directly impact development; nevertheless, suppression of natural fires could have an indirect long-term impact as a result of altered fuel characteristics such as increased fuel loads and fuel continuity, thus creating a landscape that is capable of sustaining larger fires in the future.

The Proposed Action also specifically includes hazard fuel reduction around park owned structures and in Mid-Hills Campground as well as outlines the implementation of these fuel treatments in a five-year implementation plan. The Proposed Action also incorporates hazard fuel reduction and fire preparedness requirements into various permits and agreements that involve structures inside of Mojave National Preserve. Examples include utility rights-of-way substations and communication sites, as well as the research and education facilities operated by universities. Private or public inholdings located within the Preserve that are not legally subject

to permits or agreements cannot be required to adhere to hazard fuel reduction. To encourage such owners/operators to voluntarily implement fire prevention measures, the Proposed Action includes a fire prevention and education campaign. The campaign includes annual direct mailings of Firewise literature to all known Preserve inholders and neighbors, an annual open house at the Hole-in-the Wall Fire Center, increased capacity in the Preserve's fire management personnel to conduct Firewise assessments, development of a library of Firewise educational materials for use by the public, and increased involvement in community affairs with the distribution of Smokey Bear products.

The No Action alternative provides for suppression of all wildland fires in the Preserve and there is no fire use under this alternative. There is no written plan for this alternative. While hazard fuel reduction adjacent to park owned structures would likely occur, there is no specific implementation plan or funding strategy for this action. There no specific plans to incorporate hazard fuel reduction and fire preparedness requirements into various permits and agreements that involve structures inside of Mojave National Preserve, nor is there any specific public fire prevention and education campaign.

Developed Land Use Conclusions

The Proposed Action was developed to minimize risks to developed areas through fire management zoning, hazard fuel reduction, and fire prevention and education. As a result of these measures, implementation of the Proposed Action would likely result in negligible, long-term impacts to development.

The No Action alternative has no written plan and no specific considerations for hazard fuel reduction or fire prevention or education. Consequently, implementation of the No Action alternative could result in moderate, long-term impacts to development, particularly to those communities that are located in heavy fuels.

3.3.6. Vegetation

Affected Environment

As of 2004, the Preserve is known to host a total of 816 plant taxa, representing 85 plant families from the Mojave, Great Basin and Sonoran desert ecosystems. Vascular plant inventories are on-going but are currently incomplete for significant areas of the Preserve. Non-vascular plants have not been systematically inventoried within the Preserve.

The U.S. Geological Survey recently published a vegetation community map for the central Mojave Desert, including Mojave National Preserve (Thomas et al 2004). Maps were based on photo interpretation of 1:32000 aerial photography, predictive modeling, field data, and expert opinion. The minimum mapping unit was 5 ha. Vegetation types were identified to the alliance level thematic resolution based on the National Vegetation Classification System (FGDC 1997). The most common vegetation communities in the Preserve are dominated by creosote, Joshua tree, or Mojave yucca (Table 1).

Introduced species are non-native to an ecosystem, having been introduced by humans, either deliberately or accidentally. Approximately 62 nonnative plant species have been documented within the Preserve. The most noteworthy are tamarisk or salt cedar (*Tamarix ramosissima*), Russian thistle or tumbleweed (*Salsola iberica),* red brome (*Bromus rubens),* cheatgrass (*Bromus tectorum*) and schismus ((*Schismus arabica*). Many of these species grow aggressively and can out-compete native plant populations.

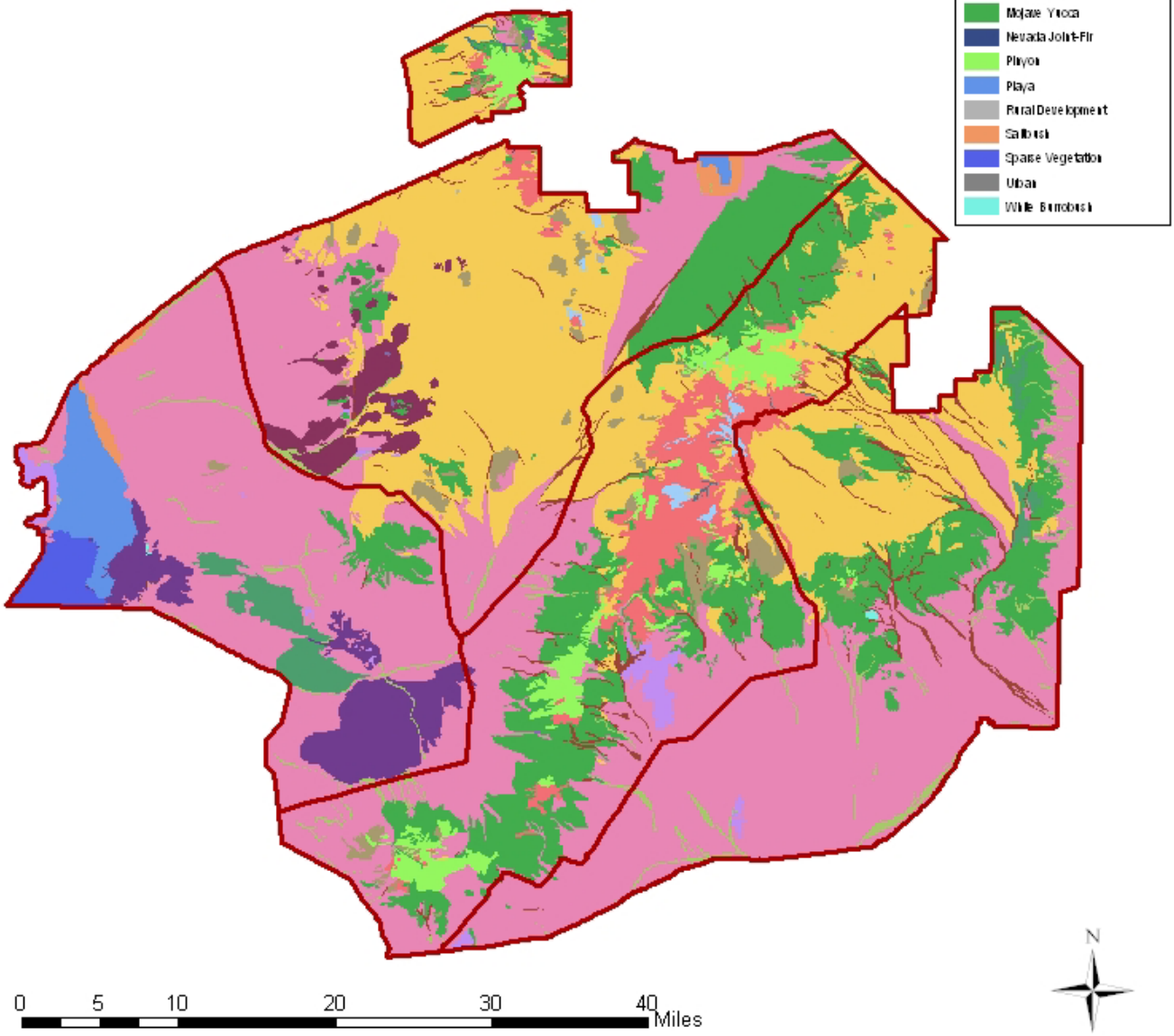
Table A1. Thomas et al (2004) vegetation data in field "label_1" which is vegetation type representing an alliance, alliance complex, or land use type. Percentage is the percent of the total land area of the Preserve occupied by that vegetation type.

Vegetation type	Area occupied in the Preserve (ac)	Percentage
Creosote	652719.8	41.09
Joshua tree	363048.9	22.85
Mojave yucca	249309.4	15.69
Juniper	57807.7	3.64
Dunes	44113.5	2.78
Pinyon	37793.0	2.38
Mid elevation wash system	27222.5	1.71
Blackbrush	26693.8	1.68
Playa	25227.7	1.59
Lava beds & cinder cones	23785.5	1.50
Galleta	21864.2	1.38
Low elevation wash system	21663.1	1.36
Sparse vegetation	11918.3	0.75
Creosote-brittlebush	11712.9	0.74
Saltbush	6793.4	0.43
Big sagebrush	4211.7	0.27
High elevation wash system	1049.3	0.07
Mining	662.8	0.04
Rural development	558.7	0.04
White burrobush	371.8	0.02
Urban	83.4	0.01
Nevada joint-fir	21.6	0.00

Recent research in the Mojave Desert has concluded that invasive annual grasses benefit from fire, and promote recurrent fire, in many cases to the point where native species cannot persist and native pant assemblages are converted to alien invasive annual grasslands (Brooks and Pyke 2000, Brooks 1999, Brooks et al 2003, D'Antonio and Vitousek 1992). This vegetation type conversion can affect the suitability for the habitat for many wildlife species and can reduce overall biodiversity (Brooks and Esque 2002). At Mojave National Preserve red brome and schismus are of particular concern for fire management, as they spread quickly and form a light, flashy and continuous layer of fuel under the desert shrubs, rather than the natural open spaces. This effect is further amplified in years of high winter and spring rainfall (Brown and Minnich 1986). These invasive annual grasses withstand fire well, and can re-establish and spread quickly after a fire (Brooks 2002). In the Preserve, these species tend to be concentrated in disturbed areas, such as along roads or in areas where cattle formerly congregated (corrals, tanks, etc).

Figure A3: Vegetation

The U.S. Geological Survey recently published a vegetation community map for the central Mojave Desert, including Mojave National Preserve (Thomas et al 2004). Maps were based on photo interpretation of 1:32000 aerial photography, predictive modeling, field data, and expert opinion. The minimum mapping unit was 5 ha. Vegetation types were identified to the alliance level thematic resolution based on the National Vegetation Classification System (FGDC 1997). The most common vegetation communities in the Preserve are dominated by creosote, Joshua tree, or Mojave yucca. On this map, vegetation type is the "label_1" field and represents an alliance, alliance complex, or land use type.



Produced by S. Dingman, Biologist, Mojave National Preserve

September 2004

FILE: C:/arcgis/arcexe83/bin/Templates/NPS/A1vegetation

Much of the variation in the desert relates to patterns of fuel characteristics and fire regimes, and elevation is a primary determinant of fire ecology zones in the desert bioregion (Brooks and Minnich in press). The USGS vegetation map described above can be used to divide the Preserve into ecological zones based on those described by Brooks and Minnich (in press) to aid in understanding the basic fire ecology of the predominant plant species. (Additional information regarding fire ecology is found in Appendix C to the Fire Management Plan.) The primary fire ecological zones in Mojave National Preserve are as follows:

- *High elevation desert shrubland and woodland*: This zone occupies 95,300 acres in the Preserve and is confined to the high elevations of the Granite Mountains, Providence Mountains, Mid-Hills, New York Mountains, Castle Peaks, Ivanpah Mountains, Mescal Range, and Clark Mountain. Major vegetation types in this ecological zone include sagebrush scrub, pinyon-juniper woodland, and desert chaparral (Munz and Keck 1959). Surface fuel loads and continuity are high where sagebrush scrub and chaparral dominate, facilitating the spread of fire. Nevertheless, surface fuels are replaced by very high loads of crown fuels in closed pinyon-juniper woodlands, where fires only occur under extreme fire weather conditions and are typically very intense (Brooks and Minnich in press).

- *Middle elevation desert shrubland and grassland:* This zone occupies 1,339,950 acres and covers the vast majority of the Preserve, including the bajadas and lower elevations of the mountains as well as Cima Dome and Lanfair Valley. Major vegetation types include Joshua tree woodland, shadscale scrub, the upper elevations of creosote bush scrub (Munz and Keck 1959), blackbrush scrub, and desert scrub-steppe (Rowlands 1980). Surface fuel characteristics are variable, but loads and continuity can be relatively high, facilitating the spread of fire (Brooks and Minnich in press). Some areas of this zone were historically heavily used for ranching and there are significant concentrations of non-native grasses in and around corrals and water tanks (S. Dingman, personal observation). The presence of these non-native grasses can create a more continuous fuel bed, although the alteration from natural fire regimes is probably less than occurs in the low elevation desert shrubland because the middle elevation shrubland and grassland has a significant native fine fuel load. This ecological type includes the upper elevations of creosote bush scrub, a community that is most likely to experience a fundamental change in fire frequency and size because of the naturally barren intershub areas, as further described for the low elevation desert shrubland.

- *Low elevation desert shrubland:* This zone occupies 59,920 acres in the Preserve and is confined to the low elevation area around Soda Dry Lake and the western border of the Preserve and the small extent of Ivanpah Dry Lake that extends into the northeastern edge of the Preserve. This zone also includes numerous dry desert washes that cut across the middle elevation desert shrubland and grassland. Major vegetation types include alkali sink vegetation and the lower elevations of creosote bush scrub (Munz and Keck 1959) and succulent scrub (Rowlands 1980). Surface fuel loads and continuity are typically low, hindering the spread of fire (Brooks and Minnich in press). This is the zone that is most altered by the invasion of non-native grasses, which can occupy areas between shrubs that were naturally bare, resulting in a continuous fuel bed that can greatly increase fire frequency and fire size.

- *Desert montane:* This zone is rare throughout the Mojave Desert and is limited in the Preserve to two small islands of Rocky Mountain White Fir. One island occurs as several small stands on the north side of the peak of Clark Mountain and the other island occurs about 20 miles to the southeast and consists of a single isolated stand on the north side of the New York Mountains. These Pleistocene relicts are limited to only the very highest elevations, on the cooler north facing slopes. Surface fuels are typically sparse, separating patches of crown fuels and hindering the spread of fire (Brooks and Minnich in press).

- *Non-fuel: barren or sparsely vegetated:* This zone occupies 93,110 acres and is confined to the barren, shifting substrates that make up the Kelso Dunes and Devils Playground. While individual plants could burn if they were ignited, there is no fuel continuity to carry fire to surrounding vegetation and the shifting substrates are fairly resistant to invasion by non-native grasses.

NPS policy directs that parks consider the impacts of their actions on state-listed rare species (NPS 2001c). Systematic inventory of rare plant species at Mojave National Preserve has only recently been initiated and is not yet complete. Preliminary results of the inventory and anticipated fire effects are shown in Table A2. Anticipated fire effects were determined in consultation with botanist James Andre (Andre 2003) of Andre Botanical Consulting and Director of the University of California's Sweeney Granite Mountain Research Center located in the southwest corner of Mojave National Preserve. Only scientific names are used as many of these species do not have common names. The following attributes were considered:

- Conservation status – official state listing of the California Native Plant Society
  - List 1B: Plants rare, threatened, or endangered in CA or elsewhere
  - List 2: Plants rare, threatened, or endangered in CA, but common elsewhere
  - List 3: Plants about which we need more information - a review list
  - List 4: Plants of limited distribution - a watch list
  - R-E-D Code: R = Rarity, E = Endangerment, D = Distribution
- Longevity and Form – general description of the species, family
- Habitat flammability – description of how likely the species' habitat is to burn
  - very low - unburnable substrates with sparse, scattered plants; examples: sand dunes, dry lakes
  - low - unburnable substrates with patchy vegetation or wetlands; examples: rocky slopes, limestone outcrops, sandy washes, wet seeps
  - moderate - mineral soils with continuous, low to medium stature vegetation; examples: creosote bush scrub, desert shrublands
  - high - mineral soils with continuous vegetation that includes some trees; examples: Joshua tree woodland, pinyon-juniper woodland, sagebrush steppe
  - very high - mineral or organic soils with dense, continuous woody vegetation; examples: white fir forest, interior chaparral woodland on steep slopes
- Fire tolerance – educated guess of species ability to tolerate fire. "Seedbank" indicates that it likely would be able to regenerate post-fire from seedbank.
- FMP issues – Fire Management Plan issues, where FU refers to a fire use management strategy and SUP refers to a suppression strategy. "PRIORITY" plants are further discussed.

Table A2: Rare plant species in Mojave National Preserve (pg 1 of 4)

Species (Family)	Conservation Status	Longevity and Form	Habitat Flammability	Fire Tolerance	FMP Issues
Arbutilon parvulum (Malvaceae)	List 2 (3-1-1)	short-lived shrub	Moderate	not	FU - no issue
Agertina herbaceousacea (Asteraceae)	List 2 (2-1-1)	herbaceous perennial	Low	?, seedbank	FU + SUP - no issue
Allium nevadense (Lilliaceae)	List 2 (3-1-1)	bulb	Low	tolerant	FU + SUP - no issue
Arctomecon merriamii (Papaveraceae)	List 2 (2-2-1)	herbaceous perennial	Moderate	moderately intolerant	SUP - no issue
Arenaria congesta var. charlestonensis (Caryophyllaceae)	List 1B (3-1-2)	tufted perennial	Moderate	not	SUP - high priority
Argyrochosma limitanea var. limitanea (Pteridaceae)	List 2 (3-1-1)	fern, perennial	Low	not	SUP - no issue
Asclepias nyctaginifolia (Asclepiadaceae)	List 2 (3-1-1)	herbaceous perennial	Low	?, seedbank	SUP - no issue
Astragalus allochrous var. playanus (Fabaceae)	List 2 (3-2-1)	herbaceous annual	Low	? seedbank	SUP - no issue
Astragalus cimae var. cimae (Fabaceae)	List 1B (3-2-2)	herbaceous annual	High	?, seedbank	SUP - possible issue
Astrolepis cochisensis ssp. cochisensis (Pteridaceae)	List 2 (2-1-1)	fern, long-lived perennial	Moderate	intolerant	FU - no issue
Ayenia compacta (Sterculaceae)	List 2 (2-1-1)	shrub	High	probably not tolerant	FU - no issue
Berberis fremontii (Berberidaceae)	List 3 (?-?-1)	big shrub, long-lived	High	?, probably not tolerant	FU - no issue; SUP - possible issue
Bouteloua trifida (Poaceae)	List 2 (3-1-1)	perennial bunchgrass	High	?, fire may benefit	SUP - possible issue
Camissonia boothii ssp. boothii (Oneagraceae)	List 2 (2-1-1)	herbaceous annual	Low	not	SUP - needs avoidance; PRIORITY
Chamaesyce abramsiana (Euphorbiaceae)	List 2 (3-2-1)	herbaceous annual	very low	not	FU + SUP - no issue
Chamaesyce parryi (Euphorbiaceae)	List 2 (3-1-1)	herbaceous annual	very low	not	FU + SUP - no issue
Cheilanthes wootonii (Pteridaceae)	List 2 (2-1-1)	fern	Low	not	SUP - needs avoidance

Table A2: Rare plant species in Mojave National Preserve (pg 2 of 4)

Species (Family)	Conservation Status	Longevity and Form	Habitat Flammability	Fire Tolerance	FMP Issues
Cordylanthus parviflorus Scrophulareceae)	List 2 (3-1-1)	herbaceous perennial	Low	?	SUP - no issue, FU - no issue
Corypantha vivipara var. rosea (Cactaceae)	List 2 (2-2-1)	small cactus	Low	low tolerance	SUP - trampling, FU - no issue
Cryptantha clokeyi (Boraginaceae)	List 1B (3-3-3)	herbaceous annual	High	? Seedbank	SUP - no issue
Cymopteris gilmanii (Apiaceae)	List 2 (2-1-1)	herbaceous perennial	very high	tolerant?	FU - no issue
Enneapogon desvauxii (Poaceae)	List 2 (3-1-1)	shortlived bunchgrass	High	?	FU - no issue; PRIORITY
Erigeron utahensis (Asteraceae)	List 2 (3-1-1)	Short-lived herbaceous perennial	Moderate	?	FU - no issue, SUP - no issue
Eriodictyon angustifolium (Hydrophyllaceae)	List 2 (2-1-1)	perennial low shrub	Low	tolerant? May crownsprout	FU - no issue, SUP - no issue
Eriogonum ericifolium var. thornei (Polygonaceae)	List 1B (3-3-3)	small perennial shrub	High	not	SUP - needs avoidance; PRIORITY
Eriogonum umbellatum var. juniporinum (Polygonaceae)	List 2 (3-1-1)	small herbaceous perennial	High	not	FU - no issue
Erioneuron pilosum (Poaceae)	List 2 (2-1-1)	small tufted perennial grass	High	? Possibly	FU - no issue
Euphorbia exstipulata var. exstipulata (Euphobiaceae)	List 2 (3-3-1)	annual	Moderate	?	No issue
Galium wrightii (Rubiaceae)	List 2 (3-1-1)	herbaceous perennial	Moderate	not	FU - no issue
Glossopetalon pungens (Crososomataceae)	List 1B (3-2-2)	Small shrub	low	?, not	FU - no issue
Ivesia jaegeri (Rosaceae)	List 1B (3-1-2)	herbaceous perennial	Low	?, not	FU - no issue
Juncus nodosus (Juncaceae)	List 2 (2-1-1)	herbaceous perennial	Low	probably tolerant	no issue
Leymus salinus ssp. Mojavensis (Poaceae)	List 2 (3-1-1)	perennial bunchgrass	High	?	FU - no issue, SUP - no issue
Lithospermum incisum (Boraginaceae)	List 2 (3-1-1)	herbaceous perennial	very high	? may be tolerant	SUP - Needs avoidance; PRIORITY
Lotus argyraeus var. multicaulis (Fabaceae)	List 1B (3-1-3)	herbaceous perennial	Low	not	SUP - issue, needs mapped; PRIORITY

Table A2: Rare plant species in Mojave National Preserve (pg 3 of 4)

Species (Family)	Conservation Status	Longevity and Form	Habitat Flammability	Fire Tolerance	FMP Issues
Lotus argyraeus var. notitius (Fabaceae)	List 1B (3-1-3)	herbaceous, matted perennial	Moderate	not	SUP - issue, needs mapped; PRIORITY
Lycurus setosus (Poaceae)	List 2 (3-2-1)	perennial grass, tufted	High	? Not	SUP - issue, needs mapped
Maurandya antirrhiniflora ssp. antirrhiniflora (Lamiaceae)	List 2 (3-1-1)	small herbaceous perennial	Low	?	FU – no issue
Mirabilis coccinea (Nyctaginaceae)	List 2 (2-1-1)	herbaceous perennial/annual	Low	? Low, seedbank	SUP and FU - no issue
Monarda pectinata (Lamiaceae)	List 2 (3-1-1)	shortlived herbaceous perennial	Low	?, seedbank	SUP - no issue
Muhlenbergia appressa (Poaceae)	List 2 (2-2-1)	small, annual tufted grass	Low	?, seedbank	FU – no issue
Muhlenbergia arsenei (Poaceae)	List 2 (2-1-1)	small bunchgrass	low or very high	probably tolerant	FU, SUP - no issue
Muhlenbergia fragilis (Poaceae)	List 2 (3-1-1)	annual grass	Low	?, seedbank	FU, SUP - no issue
Muhlenbergia pauciflora (Poaceae)	List 2 (3-1-1)	wiry perennial grass	High	probably low tolerance	SUP - needs avoidance
Munroa squarrosa (Poaceae)	List 2 (3-2-1)	matted annual grass	Low	seedbank	SUP, FU - no issue
Opuntia curvospina (Cactaceae)	List 2 (3-2-3)	perennial cactus	High	not tolerant	SUP - needs avoidance
Pellaea truncata (Pteridaceae)	List 2 (2-1-1)	perennial fern	Low	not tolerant	SUP, FU - no issue
Penstemon calcareus (Scrophulariaceae)	List 2 (2-1-1)	shrubby perennial	Moderate	low tolerance	FU - needs mapped and avoidance; PRIORITY
Penstemon stephensii (Scrophulariaceae)	List 1B (2-1-3)	perennial, dies back	Moderate	?	FU, SUP - needs mapped and avoidance; PRIORITY
Penstemon thompsoniae (Scrophulariaceae)	List 2 (3-1-1)	low growing perennial	High	?	FU, SUP needs mapped and avoidance
Penstemon utahensis (Scrophulariaceae)	List 2 (2-1-1)	perennial, dies back	Moderate	?	SUP - needs avoidance
Phacelia anelsonii (Hydrophyllaceae)	List 2 (2-1-1)	annual	Low	seedbank	SUP, FU - no issue

Table A2: Rare plant species in Mojave National Preserve (pg 4 of 4)

Species (Family)	Conservation Status	Longevity and Form	Habitat Flammability	Fire Tolerance	FMP Issues
Phacelia coerulea (Hydrophyllaceae)	List 2 (3-1-1)	annual	Low	seedbank	SUP, FU - no issue
Phacelia perityloides var. jaegeri (Hydrophyllaceae)	List 1B (3-1-2)	herbaceous perennial	very high	probably low tolerance	SUP, FU - needs mapped and avoided; PRIORITY
Physalis lobata (Solancaeae)	List 2 (3-1-1)	herbaceous perennial	Low	probably low tolerance	FU – no issue
Physaria chambersii (Brassicaceae)	List 2 (2-1-1)	short-lived perennial, tap root, low growing	low, moderate	low tolerance	FU, SUP - no issue
Pinus edulis (Pinaceae)	List 3 (3-1-1)	pinyon pine	High	low tolerance	SUP - needs mapped and avoidance
Piptatherum micranthum (Poaceae)	List 2 (2-1-1)	perennial bunchgrass	high	?, probably tolerant	FU, SUP - no issue
Polygala acanthoclada (Polygalacaeae)	List 2 (2-1-1)	low growing perennial shrub	High	?, probably not	SUP - needs mapped and avoidance
Prunus eremophila (Rosaceae)	?	big shrub, long-lived	Moderate to low	?	SUP - needs mapped and avoidance
Robinia neomexicana (Fabaceae)	List 2 (3-1-1)	perennial, small tree	High	not tolerant	SUP - needs mapped and avoidance
*Sanvitalia abertii (*Asteraceae)	List 2 (3-2-1)	summer annual	High	seedbank	SUP, FU - protect soils
Schkuhria multiflora var multiflora (Asteraceae)	List 2 (3-1-1)	summer annual	High	seedbank	SUP, FU - protect soils
Scleropogon brevifolius (Poaceae)	List 2 (3-1-1)	short-lived perennial grass	Moderate	probably not	SUP - needs mapped and avoidance
Senna covesii (Fabaceae)	List 2 (2-2-1)	short-lived perennial	Low	probably not tolerant	FU – no issue
Sphaeralcea rusbyi var. eremicola (Malvaceae)	List 1B (3-2-3)	herbaceous perennial, dies back	Moderate	?, probably not tolerant	FU – no issue
Tripterocalyx micranthus (Nyctaginaceae)	List 2 (3-1-1)	herbaceous perennial	very low	tolerant	FU – no issue
Woodsia plummerae (Dryopteridaceae)	List 2 (3-1-1)	perennial fern	Low	probably not tolerant	SUP - needs mapped and avoidance

The summary provided in Table A2 as well as known locations and specific habitat characteristics were used to focus fire management planning on 11 priority species. These species were selected because they are extremely rare locally and/or globally and are considered endemic to specific locations within the Preserve. Species information, including species identification and known locations, will be included in standard resource advisor and burned area emergency response information materials to assure that impacts to these species are considered. As new information on any of the listed species becomes available from the rare plant inventory effort, resource advisor maps will be updated to assure that known locations are avoided during fire suppression efforts and considered during management of fire use fires.

The Preserve's knowledge of its non-vascular flora is vastly incomplete but these organisms are the primary components of a unique desert feature known variously as biological crusts, cryptogamic crusts, and microphytic soils. These biological crusts are composed of mosses, fungi, various unicellular photosynthetic organisms, lichens and photosynthetic bacteria that grow on bare ground. These crusts limit erosion and help retain soil moisture while dead parts of the crust provide the initial organic matter for soil formation. In this way, these non-vascular organisms are the building blocks of soil and thus all other plant (and animal) life in the desert. While there is some ongoing research on the subject, we do not know the full suite of non-vascular species or their distributions in the Preserve.

Impacts to Vegetation

Obviously, vegetation is directly and indirectly impacted by fire and fire suppression activities because vegetation is the fuel that sustains fire. Nevertheless, determining whether that impact is positive or negative is more problematic. While the Mojave Desert is not considered a fire-adapted ecosystem, fire must play some role as there has long been the presence of fuel and lightning. The problem is in determining to what extent that natural process has been altered by the activities of modern humans, most notably by the spread of non-native grasses that increase fuel continuity and thus flammability of the landscape. Nevertheless, the distribution and impact of non-native grass is likewise not consistent across the landscape. The impact of non-native grass on fuel continuity is probably most intense in low elevation shrub communities, such as creosote, where the barren spaces between shrubs has been invaded by non-native grasses which serve to carry fire from shrub to shrub. But not all low elevation shrub communities are equally occupied by non-native grasses. These grasses tend to be found in areas of soil disturbance, such as along roads, old homesites, and in places where cattle concentrated in the past (i.e., corrals, water sources).

Determining short-term and long-term impacts is likewise problematic. Plants exposed to fire tend to die, thus a negative short-term impact. Nevertheless, many species will regenerate after fire either from seedbank (e.g., many herbaceous species) or from root or stump sprouts (e.g., perennial grasses, manzanita), thus a positive long-term impact. How long it takes to realize the benefits of fire-induced propagation varies from species to species, and in the arid Mojave Desert is likely to be heavily influenced by post-fire precipitation patterns.

Fire management activities can directly impact vegetation through hazard fuel removal and line construction during fire suppression operations. Both of these actions result in direct mortality through the removal of plants. These actions might also result in indirect impacts through soil disturbance that may make it easier for non-native species, including invasive grasses, to become established. Fire management activities can also indirectly impact vegetation locally through the transport of non-native seeds on equipment and vehicles, although the likelihood of this is relatively low as tools and engines are routinely cleaned after each fire. Another indirect impact of fire suppression is the alteration of natural fire regimes by suppressing naturally occurring fires. Such impacts are poorly understood but might result in an unnaturally large fuel load that is then capable of sustaining more intense or more widespread fires than would have occurred if natural fires were allowed to burn. Fire suppression might also fundamentally alter the landscape patterns of plant communities, resulting in a more homogenous landscape. Nevertheless, failure to suppress fires (i.e., fire use) also has impacts. In some instances, failure to suppress fires may result in direct losses of rare species to fire. Likewise, the failure to suppress fires in areas where invasive grasses are present might result in the unnatural spread of fire and higher mortality to native species and the disturbance resulting from fire and fire suppression might promote non-native species under some conditions.

As both the Proposed Action and the no-action alternative include fire suppression, both would have direct and indirect impacts on vegetation as a result of suppression activities. Nevertheless, the Proposed Action would have fewer impacts than the No Action alternative, because 342,900 acres would be managed for wildland fire use. Additionally, the Proposed Action includes the use of a resource advisor for suppression fires and all fire use fires. This would likely result in fewer fire or fire suppression impacts to known rare plant locations.

The Proposed Action specifically calls for the reduction of hazard fuels immediately adjacent to park owned structures and in the campsites of the Mid-Hills Campground. The Proposed Action includes a specific implementation plan that includes pre-planning and a schedule to assure that environmental clearances, including rare plant surveys, are completed prior to implementation. Hazard fuel reduction is not specifically addressed in the No Action alternative because a written plan does not exist for this alternative. Nevertheless, fuels immediately adjacent to park owned structures would likely be removed to provide for defensible space as per NPS policy. The vegetation impacts of either alternative are likely to be similar, although there might be fewer impacts associated with implementation of the Proposed Action because fuel treatments are preplanned.

It is unknown how fire or fire suppression might affect non-vascular plants or their habitats. Of particular concern are the biological crusts because of their ecological importance in the desert ecosystem. Ground-based fire suppression would likely have localized, negative impacts that, if severe enough, might even result in long-term damage to biological crusts and increased erosion. In most cases, nevertheless, it is expected that the damage to biological crusts would be negligible as vehicles are restricted to existing roads that presumably do not contain biological crusts and fire personnel on foot are unlikely to concentrate their activity enough to result in damage. Constructed lines would be the only probable location for severe damage to biological crusts. Direct fire effects on biological crusts are likely, but the intensity of the effect is difficult to determine. Recent research (Belnap et al. 2001) indicates that fires can cause severe damage to

biological crusts but that recovery is possible. The degree to which crusts are damaged by fires apparently depends on the intensity and frequency of the fire. Low intensity fires do not remove all the structure of the crust, allowing for regrowth without significant soil loss. Shrub presence (particularly sagebrush) increases the intensity of the fire, decreasing the likelihood of early vegetative or crust recovery. Fire frequency is increased in areas invaded by annual grasses, particularly cheatgrass. Increased fire frequency can prevent crust recovery. Given the abundance of shrub species in the fuel load of Mojave National Preserve, it is possible that fires could result in moderate or severe impacts to biological crusts. The areas zoned for fire use are remote and sustain relatively low occurrence of cheatgrass and other invasive annual grasses, so fire use is not likely to increase fire frequency impacts to biological crusts.

Vegetation Conclusions

Both alternatives have the potential for major, long-term negative impacts to vegetation through alteration of native plant communities as a result of fire suppression. Nevertheless, the Proposed Action includes specific protection measures that minimize the environmental risks of fire suppression and includes fewer overall acres managed for suppression. The Proposed Action also includes fire use where naturally-ignited fires are allowed to burn as a natural process in vegetation communities. Thus, the long-term vegetation impacts of the Proposed Action are expected to be minor due to the accommodation of fire use and the short-term vegetation impacts of the Proposed Action are expected to be moderate due to fire suppression and negative fire effects on biological crusts. Both the long-term and the short-term vegetation impacts of the No Action alternative are expected to be moderate due to fire suppression.

3.3.7. Wildlife

Affected Environment

The Mojave National Preserve encompasses elements of the Mojave, Sonoran and Great Basin Deserts and has approximately 35 wildlife habitat types. This variety of habitats contributes to the diversity of wildlife found within the Preserve. Approximately 300 species of wildlife are found here, including 36 species of reptiles, 206 species of birds and 47 species of mammals. Nevertheless, the inventory of wildlife is incomplete. Particularly understudied are biologically rare species, nocturnal species, and the many invertebrate species.

One of the more noteworthy mammalian species in the Preserve is the native population of Nelson's bighorn sheep (*Ovis Canadensis nelsonii*). This population of desert bighorn is not currently listed by the U.S. Fish and Wildlife Service or the State of California, but it is of conservation interest to biologists and wildlife enthusiasts due to the fragmentation of habitat throughout its range. It is currently considered a game species by California Department of Fish and Wildlife. This species occupies the mountainous habitats in the western portion of the Preserve.

Introduced wildlife species found in the Preserve include burros (*Equus asinus*), Rocky Mountain mule deer (*Odocoileus hemionus hemionus*) and chukar (*Alectoris graeca*). The mule deer and chukar populations present were introduced by the California Department of Fish and Game and are both now popular game species. Burros were introduced in North America by the Spanish beginning in the 1600's, and can be found throughout the western states. In 1997, the Preserve initiated a program of active, non-lethal reduction of the burro population to reduce their impact to native species and habitats. The burro population in the Preserve is currently estimated at less than 1,000 head, and reduction efforts are continuing.

Federally listed wildlife species are discussed under impact topic #8: Threatened and Endangered Species. Wildlife species that are recognized by the state of California as threatened, endangered, or of special concern are discussed here. Information regarding the location, distribution, and abundance of state listed wildlife species is incomplete in the Preserve. Nevertheless, the California Department of Fish and Game maintains the Natural Diversity Database of species observation reports (California Department of Fish and Game 2004). The database is geographically searchable using the names of USGS 7.5-minute topographic quadrangles. The database was searched for a total of 57 quads, including 30 quads that include a border of the Preserve, but also include non-Preserve lands. The quality or source of the data extracted from the database could not be verified. A total of 255 wildlife observations were recorded in the quads of interest, including observations of federally listed animals that are discussed elsewhere in this document and species that have no official conservation status in California (e.g., Nelson's bighorn sheep). There were a total of 18 state listed species, including 15 birds, 1 fish, 1 mammal, and 1 reptile (Table A3). Habitat and occurrence information was derived from park records and field guides as well as consultation with Robert Fulton of the California State University, Fullerton's Desert Studies Center and Dr. Kurt Leuschner of the College of the Desert.

Impacts to Wildlife

Fire can result in direct mortality to animals. Most at risk for direct mortality are species or life stages that are not very mobile. Animals can be indirectly affected by fire through habitat alteration, including changes in species composition that result in reduction in suitable habitat or fragmentation of habitat. Most at risk to habitat alteration are species with specialized habitat requirements or those species that occupy habitats that are geographically rare.

Given the small extent of most fires in the Preserve, direct mortality to wildlife is unlikely as most species are fairly mobile. Burrowing animals, such as small mammals and lizards, can go underground even a few centimeters and escape the killing heat of a surface fire. Most birds or larger mammals can flee to unburned areas. Nevertheless, young animals may not be able to flee and so are vulnerable to direct mortality. Most of the species in the Preserve are fairly widespread, at least locally within the Mojave Desert. Direct fire impacts are not a primary concern for these species.

Of most concern is the potential for direct fire impacts to rare bird species that nest in the Preserve. As shown on Table A3, there are 15 state-listed bird species reported in the Preserve,

including 14 species that nest in the Preserve. Because eggs and young in the nest are highly vulnerable to fire, each of these 14 species was considered for fire effects based on species life history and habitat (NatureServe 2004, pers. comm. Dr. Leuschner). Of those 14 species, the prairie falcon nests in vertical cliffs that are not flammable, leaving 13 of the 14 species that nest in areas that are vulnerable to fire. Of particular concern are the seven species that nest in desert riparian or desert spring habitats (willow flycatcher, yellow-breasted chat, summer tanager, vermillion flycatcher, Arizona Bell's vireo, Crissal thrasher, and Cooper's hawk), the four species that occupy high elevation woodland habitats (Virginia's warbler, gray vireo, hepatic tanager, gray-headed junco) and the two thrasher species that occupy desert scrub (Le Conte's thrasher and Bendire's thrasher). Any of these species is vulnerable to direct mortality due to fire if fire occurs when there are eggs or young in the nest. The 342,900 acres zoned for fire use includes potential habitat for all 13 of these species, thus any could realize direct impacts due to fire use if fire occurred during nesting season. While the "fire season" is generally regarded as May – September, most natural ignitions occur in association with the southwest monsoon, bringing thunderstorms into the area in late July and August. While most species would have already fledged by that time, there is the potential that there could still be young in the nest when the monsoon arrives. There is, therefore, the added potential for moderate impacts to state-listed bird species.

Additionally, there are potential indirect impacts to these species due to habitat alteration. Most at risk are the seven species that are obligates of desert riparian and desert spring habitats because these habitats are so rare in the Mojave Desert that the loss of one spring area could cause significant displacement or even local extirpation of these species. Conversely, willow and some other wetland plants regenerate vigorously after fire, potentially improving the habitat quality in the long-term. The thrashers that occupy desert scrub habitats are less likely to experience displacement due to fire because there are hundreds of thousands of acres of similar habitat in the immediate vicinity. Nevertheless, there is the potential that fire could promote the invasion of non-native annual grasses, which in turn could increase the flammability of the habitat in general or cause other changes that affect the suitability for these desert specialists. The four species that occupy the high elevation woodland habitats could potentially experience local displacement as this fuel type generally supports relatively large fires, but there are thousands of acres of similar habitat scattered throughout the Preserve and surrounding area to absorb any displaced individuals. While the primary plant species of these high elevation woodlands – pinyon, juniper and sagebrush – are somewhat slow to recover from fire, fire is an important process in this habitat type and there is a diverse suite of shrub species that colonizes burned sites at this elevation. The historic fire regime was likely characterized by relatively large, patchy to complete, moderate intensity surface to crown fires, and a long fire return interval (Brooks and Minnich in press). Thus, fire may be necessary to maintain this habitat in the long-term. In general, fire is expected to have minor, short-term, indirect impacts to state-listed bird species but may be beneficial in maintaining some of these habitats long-term.

Fire is unlikely to directly or indirectly impact the three state-listed non-bird species. The pale big-eared bat roosts in mines and caves, habitats that are clearly not flammable. The Saratoga Springs pupfish lives in man-made Lake Tuendae at Zzyzx Soda Springs and co-exists with the federally listed endangered Mohave tui chub. These species are clearly not subject to direct fire effects and indirect fire effects (i.e., mud slides or water chemistry changes) are improbable due

to the scarcity of fuels immediately adjacent to the pond. The banded gila monster is a reptile that occurs in the Sonoran Desert. There are a few historical reports of this species in Mojave National Preserve, although attempts to verify these reports or to observe any animals in recent years have been unsuccessful. Therefore, it is unlikely that this species exists in the Preserve.

Some fire impacts, direct and indirect, would be expected under either the Proposed Action or the No Action alternative due to the occurrence of wildland fire. The Proposed Action includes 342,900 acres of fire use where naturally ignited fires are allowed to burn under prescribed conditions. Thus more acres will be subjected to fire under the Proposed Action than under the No Action alternative. Thus both the negative fire impacts as well as the positive fire impacts are expected to be greater under the Proposed Action.

Fire suppression activities could have direct impacts on wildlife species by disturbing their natural behaviors. Generally, species that are disturbed by fire suppression operations will flee the immediate area. The relatively short duration of most fire-fighting operations in the Preserve and the small number of firefighting resources assigned to most initial attack situations makes this impact very short-lived and localized. Extended attack fires have the potential to include a larger number of firefighting resources, including helicopters, which could likewise extend the period of displacement of some species. The movement of equipment to and from a fire has the potential for direct road-kills on species, particularly those individual animals that are fleeing a fire or whose vision is impaired by smoke.

Fire suppression could have indirect impacts on some species due to localized habitat alteration where fire suppression lines were constructed. These impacts could result in removal of vegetation that provided nesting or perching sites for birds, including some state-listed rare species. Fire suppression lines are generally too narrow to significantly disrupt surface movements of small animals. Indirectly, the suppression of fires in habitats that would have naturally burned could result in changes in species composition or structure that could have long-term impacts on species, although whether that impact is positive or negative would vary by species and would be highly speculative due to the lack of information regarding fire ecology of most animals and their habitats. Potential fire suppression impacts to the Saratoga Springs pupfish are mitigated through the protection measures implemented for the Mohave tui chub.

Both the Proposed Action as well as the No Action alternative include fire suppression and the use of minimum impact suppression tactics, although more acres would be subject to fire suppression under the No Action alternative because there is no accommodation of fire use. Additionally, the Proposed Action incorporates several environmental protection measures as outlined in the written Fire Management Plan and its appendices. One of these measures is the use of a resource advisor who would advise the incident commander on environmental protection issues specific to a fire management incident. Thus, direct impacts due to suppression under the Proposed Action would likely be minimized.

As our knowledge of invertebrate fauna in Mojave National Preserve is very incomplete, it is difficult to accurately assess fire or fire suppression impacts to these species. This issue is further complicated by the diverse array of invertebrate taxa and their even more diverse life histories and habitat requirements. There are no known state- or federally- listed invertebrate species in

the Preserve, but recent inventories have located some species that are currently thought to be endemic and others that are new to science and thus our knowledge of their regional or global distribution is severely limited. Impacts to local populations of these species could have more severe ecological ramifications than impacts to more widespread species. It is possible that invertebrates could be negatively impacted by either fire or fire suppression activities if they are relatively immobile and occur on the soil surface or on plants that burn. Any invertebrates that occur in the soil are unlikely to be impacted as lethal heat penetrates only the top few centimeters of mineral soil. Likewise, fire induced changes to plant species composition and soil properties could have negative impacts on some invertebrates while other species could benefit. In general, it is beyond our current level of knowledge to accurately analyze impacts to invertebrates with any level of detail.

Wildlife Conclusions

Wildlife species and their habitats are highly variable in their response to fire and the same fire can have both positive and negative impacts on different species, thus it is difficult to draw global conclusions. That said, implementation of the either the Proposed Action or the No Action alternative could result in direct, moderate short-term impacts to state-listed bird species and minor short-term indirect impacts to these same species due to habitat alteration. Additionally, fire suppression activities could result in minor, short-term impacts to wildlife under either alternative. Nevertheless, the potential for negative impact due to suppression activities would be minimized under the Proposed Action by the incorporation of environmental protection measures, including the assignment of a resource advisor on incidents, thus impacts are more likely to be minor or even negligible. The potential for negative impact due to suppression activities would be greater under the No Action alternative due to the lack of a written plan or specific environmental protection measures. The potential for long-term benefit to wildlife habitats by realizing fire as a natural process is greater under the Proposed Action than in the No Action alternative due to the accommodation of fire use in 342,900 acres, while the continuation of fire suppression under the No Action alternative could have moderate long-term impacts on these habitats due to changes in habitat structure or species composition. Conversely, species that could be negatively impacted by fire would be better protected under the No Action alternative. Impacts to invertebrate species are unknown.

Table A3. State listed wildlife species reported to occur in Mojave National Preserve. (Source: California Natural Diversity Database)

Taxa	Name	Status	Habitat	Nesting time	vulnerable to fire?
bird	Cooper's hawk *(Accipiter cooperii)*	State-listed special concern	dense woodlands, desert riparian	April - July	yes, during nesting season
bird	Swainson's hawk *(Buteo swainsoni)*	State-listed threatened	desert scrub, juniper	none	no, does not nest in MNP
bird	Willow flycatcher *(Empidonax traillii)*	State-listed endangered	desert springs	April - July	yes, during nesting season
bird	prairie falcon *(Falco mexicanus)*	State-listed special concern	nests on cliffs, forages in openland	April - July	no, nests in cliffs that are not flammable
bird	yellow-breasted chat *(Icteria virens)*	State-listed special concern	desert riparian, desert scrub	April - July	yes, during nesting season
bird	gray-headed junco *(Junco hyemalis caniceps)*	State-listed special concern	woodlands and grasslands	April - July	yes, during nesting season
bird	hepatic tanager *(Piranga flava)*	State-listed special concern	pinyon-juniper woodland	April - July	yes, during nesting season
bird	summer tanager *(Piranga rubra)*	State-listed special concern	riparian woodland	April - July	yes, during nesting season
bird	vermilion flycatcher *(Pyrocephalus rubinus)*	State-listed special concern	desert scrub near water	April - July	yes, during nesting season
bird	Bendire's thrasher *(Toxostoma bendirei)*	State-listed special concern	desert scrub, Joshua tree woodland	Mar-May	yes, during nesting season
bird	Crissal thrasher *(Toxostoma crissale)*	State-listed special concern	pinyon-juniper woodland, desert riparian	Mar-May	yes, during nesting season
bird	Le Conte's thrasher *(Toxostoma lecontei)*	State-listed special concern	creosote bush scrub, saltbush, desert washes	Mar-May	yes, during nesting season
bird	Virginias warbler *(Vermivora virginiae)*	State-listed special concern	desert scrub, pinyon-juniper woodland	April - July	yes, during nesting season
bird	Arizona bell's vireo *(Vireo bellii arizonae)*	State-listed endangered	riparian woodland	April - July	yes, during nesting season
bird	gray vireo *(Vireo vicinior)*	State-listed special concern	pinyon-juniper woodland, sagebrush shrubland	April - July	yes, during nesting season
fish	Saratoga Springs pupfish *(Cyprinodon nevadensis nevadensis)*	State-listed special concern	Lake Tuendae at Zzyzx	NA	No, habitat not flammable
mammal	pale big-eared bat *(Corynorhinus townsendii pallescens)*	State-listed special concern	hibernates and maternity roosts in caves/mines	NA	No, habitat not flammable
reptile	banded gila monster *(Heloderma suspectum cinctum)*	State-listed special concern	rocky areas, bajadas of the Sonoran Desert; probably does not occur in Mojave	NA	No, habitat has low flammability

3.3.8. Threatened and Endangered Species

Affected Environment

Note: This section addresses only federally listed species. State listed species are addressed under vegetation and wildlife sections as appropriate.

A species list provided by the U.S. Fish and Wildlife Service in June 2004 indicates that there are four federally listed species that may occur in the vicinity of Mojave National Preserve: endangered southwestern willow flycatcher (*Empidonax traillii extimus*), endangered least Bell's vireo (*Vireo bellii pusillus*), threatened desert tortoise (*Gopherus agassizii*), and the endangered Mohave tui chub (*Gila bicolor mohavensis*).

There are no records of occurrence for the two bird species inside the Preserve, although species specific surveys have not been completed. As both species are restricted to riparian habitats and are known from the Mojave River and Colorado River, it is unlikely that either is found inside the Preserve due to the lack of riparian habitat. The only potential location is Piute Creek, a 2 mile long perennial stream with riparian woodland vegetation. Unfortunately, half of the Piute Creek habitat was burned by a human-caused fire in September 2004 and it is unlikely that the remaining vegetation would be sufficient to support either species for the immediate future.

The Mohave tui chub is known from two human-made impoundments in the Zzyzx historic district of Mojave National Preserve. Lake Tuendae and MC Spring are considered one population by the US Fish and Wildlife Service with regard to species recovery. Moreover, this is one of just three remaining populations of genetically pure Mohave tui chub in existence. Threats to the Zzyzx population include sedimentation of Lake Tuendae, an artificial impoundment, and overgrowth of emergent vegetation at both Lake Tuendae and MC Spring. MC Spring is a groundwater-fed impoundment of unknown origins. If left untreated, the sedimentation and emergent vegetation would eventually result in decreased water volume which, in turn, might expose the chub to inhospitable water quality conditions and increased predation by birds.

The Preserve hosts known populations of the desert tortoise as well as 800,000 acres of designated critical habitat (Fish and Wildlife Service 1994). As fire effects and fire suppression activities are likely to impact the desert tortoise, the Preserve has prepared a separate biological assessment (Appendix A of the Fire Management Plan) and is seeking a biological opinion and incidental take permit from the U.S. Fish and Wildlife Service. Fire and fire suppression impacts on the other three species are addressed in this Environmental Assessment.

Impacts to Threatened and Endangered Species

Tui chub could potentially be impacted by drafting of water from their habitat for fire suppression and the contamination of their habitat with either retardant or Class A foam. The Proposed Action specifically prohibits the use of retardant in the Preserve and restricts the use of Class A foam near the tui chub ponds. The Proposed Action also prohibits the drafting of water from the tui chub ponds. The No Action alternative is not based on a specific written plan, thus

there are no specific protection measures for tui chub habitat and no provision for a resource advisor. While it is unlikely, it is possible that any of these three actions could occur under the No Action alternative. Drafting, retardant use, or class A foam use in the tui chub ponds could result in major, long-term impacts to these endangered fish and their habitat.

Desert tortoise habitat covers almost half of the Preserve, and fire is known to have resulted in impacts to tortoises and their habitat in other parts of the Mojave Desert as well as the Sonoran Desert (Brooks and Esque 2002, Esque et al. 2002, Esque et al. 2003). Thus, impacts to tortoise and their habitat is a major concern for fire management at Mojave National Preserve.

Fire can result in direct mortality to adult tortoises, juveniles, or eggs. Tortoises lack the mobility to flee from fire, so animals caught above ground may be killed directly by exposure to flame, heat, and smoke associated with wildland fire. Animals that escape direct impact by fire may still be indirectly impacted by fire-induced habitat alteration, possibly resulting in reduced viability, lowered reproductive success, increased predation, increased starvation, and increased dehydration – all resulting in reduced viability of this threatened species. Fire can also cause indirect effects as a result of habitat alteration due to consumption of fuels and the post-fire vegetation response, although such alterations might have either positive or negative long-term impacts on the species.

Suppression effects can be direct, such as the accidental crushing of tortoises by firefighting equipment (Duck et al. 1997), or indirect as a result of habitat alteration caused by suppression of fires, such as increased shrub density or changes in species composition over time. Some of these indirect effects may be detrimental to tortoise, although the extent to which this is true and the conditions under which this might occur are unknown. Because desert tortoise is a long-lived species with delayed reproduction, any impact that results in mortality of adult tortoises is considered a long-term impact (Fish and Wildlife Service 1994).

The Proposed Action includes 342,900 acres of wildland fire use; nevertheless, the fire use area was drawn to specifically exclude critical tortoise habitat. Outside of the critical tortoise habitat, there are approximately 61,000 acres of potentially suitable tortoise habitat that does occur in the area managed for wildland fire use. In those acres, it is possible that tortoise might realize direct fire impacts.

The Proposed Action also includes fire suppression. A detailed impact analysis was done in the biological assessment for the Fire Management Plan (Appendix A of the Fire Management Plan) and a list of mitigation measures was developed in consultation with the U.S. Fish and Wildlife Service to minimize the potential for both fire and suppression related impacts to tortoise. Those mitigation measures are:

- Prohibit the use of the following fire fighting tactics in Mojave National Preserve: heavy equipment (dozers, backhoes, loaders, graders), chemical fire retardant (except for Class A foam), and use of engines or other vehicles off-road.
- Use minimum-impact suppression techniques (MIST) in desert tortoise habitat.
- Unburned pockets within desert tortoise habitat may serve as important refugia, so burning out of unburned areas within the fire perimeter will be avoided to the extent that

it does not compromise the containment of the fire given the predicted weather and other values at risk.

- Preseason training of firefighting personnel stationed at Hole-in-the-Wall Fire Center will be conducted by a qualified biologist to teach firefighters how to recognize and avoid tortoises and their burrows. This training will be conducted by a biologist and will include methods for moving tortoises from harm's way. The training will be based on applicable sections of the "Guidelines for Handling Desert Tortoises During Construction Projects" drafted by the Desert Tortoise Council. The Hole-in-the-Wall fire crew handles most of the initial attack in the Preserve and most fires are controlled in one operational period. Rarely do fires in Mojave National Preserve transition to extended attack.
- When working in tortoise habitat, check under tires of all firefighting vehicles whenever that vehicle has been stationary for more than 10 minutes. If any tortoises are found under the vehicle, gently and quickly move the animal to the nearest habitat that is not likely to be affected by the fire or firefighting activities following the guidelines covered in the pre-season training. Report this handling to the Resource Advisor or the Incident Commander.
- For all fires that transition from initial attack to extended attack, including those burning in critical tortoise habitat, a qualified resource advisor will be assigned to the incident to advise the Incident Commander of tortoise protection guidelines.
    - The advisor will assure that tortoise awareness is included in all shift briefings for firefighters.
    - The resource advisor will work with the incident Logistics Chief to assure that camps and other support services are located and managed to avoid impacts to tortoises or their habitat.
    - The resource advisor will work with the incident Operations Chief to assure that Mojave guidelines (e.g., prohibitions on certain firefighting tactics, use of MIST) are incorporated into operations plans.
    - Advise Operations Chief of the need to rehabilitate firelines immediately post-fire and inspect rehabilitation efforts to assure that firelines won't pose a barrier to tortoise movement or attract off-road vehicle use post-fire.
- For all fires that burn in desert tortoise habitat, a resource advisor will conduct a post-fire assessment to quantify direct mortality of tortoises, determine the potential for indirect habitat alteration, and make recommendations for implementation of burned area emergency rehabilitation including the need for post-fire tortoise population surveys. These recommendations and their implementation will be made in emergency consultation with the US Fish and Wildlife Service.

The No Action alternative does not include any wildland fire use and all fires in the Preserve would be suppressed, so the opportunity for direct fire impacts to desert tortoise are less than with the Proposed Action. The suppression of all fires under this alternative would result in direct and indirect impacts to desert tortoise and their habitat. These impacts would be similar to those described for the suppression action under the Proposed Action; nevertheless, they would be more extensive because under the No Action alternative, the full park acreage is managed for suppression. Furthermore, there is no specific written document for this alternative and there has been no specific biological assessment prepared, thus implementation of the mitigation measures developed for the Proposed Action would not be required. While some actions might be taken to

specifically protect tortoises during fire management activities, there would be no requirements beyond those measures that apply to park operations in general.

Threatened and Endangered Species Conclusions

Advanced planning with specific considerations for endangered species and extensive consultation with the U.S. Fish and Wildlife Service resulted in a Proposed Action designed to: avoid all impacts to Mohave tui chub, avoid fire impacts to desert tortoise, and minimize fire suppression impacts to desert tortoise and their habitat. Consequently, implementation of the Proposed Action would result in no impact to the endangered Mohave tui chub and their habitat. There would be minor, long-term impacts to the threatened desert tortoise and their habitat as a result of minimal take caused by fire impacts in the fire use area and unavoidable suppression impacts in other areas.

As there is no written plan and no specific mitigation measures for the protection of desert tortoise during fire suppression, implementation of this alternative would likely result in moderate, long-term impacts to the threatened desert tortoise and their habitat. While it is unlikely, this alternative also has the potential for major, long-term impacts to the endangered Mohave tui chub and their habitat because there is no specific prohibition against drafting from the tui chub ponds or use of fire fighting chemicals (retardants and class A foam) near the tui chub ponds.

3.3.9. Prehistoric Resources

Affected Environment

The prehistoric cultural resources found in the Mojave National Preserve are numerous and varied. This situation is the direct result of the variable climate of this region over the long period it has been occupied. The eastern Mojave Desert has likely been at least sparsely populated for 11,000 years or more and the native inhabitants here gradually modified their lifeways to accommodate both a changing environment and, much later, an evolving set of social interactions. Accordingly, the material culture of these people changed through time as well. What today remains of the tools, trash, structures, and other artifacts of past human behavior has also been modified by environmental and human forces since it was first deposited, resulting in the mosaic of different prehistoric cultural resources now found in the Preserve. In the paragraphs that follow, an attempt is made to summarize the major facets of the interaction between culture and environment which shaped the archaeological record of the eastern Mojave. Although there have been a number of other analyses, this discussion is largely based on the synthesis developed by Warren (1984) whose extensive research has resulted in the widely accepted chronology and interpretations presented here.

There is considerable evidence, primarily from pollen records and packrat middens, that the low-elevation woodlands of the Mojave Desert were replaced by true desert vegetation between 12,000 and 8,000 years ago. This finding suggests an increase in temperatures, especially summer temperatures, and a decrease in precipitation between the end of the Pleistocene and

early Holocene. This drying trend was not, nevertheless, smooth or unidirectional and relatively short-term reversals into wetter periods likely took place. For instance, a reconstruction of the late Pleistocene-early Holocene geomorphic history of Lake Mojave identified four major high water intervals between about 14,500 and 7,500 years ago. After that time the lake system essentially dried up and environmental records indicate a period of minimum effective moisture between 7,500 and 5,500 years ago. Most Mojave Desert paleoclimatic reconstructions suggest higher effective moisture than today between 3,800 and 1,500 years before present during which time slightly higher winter precipitation may have been accompanied by slightly lower average annual temperatures. Finally, it has also been suggested that a late Holocene "neopluvial" or wet period, ended between 1,500 and 500 years ago. In short, the detailed late Holocene environmental proxy records from this region suggest a highly variable climate and resultant hydrological regime.

Lake Mojave Period (10,000 - 5,000 B.C.)

It has been argued that the peoples inhabiting this region during the Lake Mojave Period followed a generalized hunting and gathering lifeway in which lakeside sites were part of an economy which focused on lacustrine resources during at least a substantial portion of the seasonal round. Warren (1984:410) has stated that "the transition from pluvial to arid conditions at the end of the Pleistocene" (considered by convention to have been about 10,000 years ago) "was the most severe and dramatic environmental change in the California deserts during the period of their occupation. Rivers and lakes dried up, plant and animal life changed, and a new arid environment was created to which human populations adapted, or from which they withdrew to more favorable areas, such as oases around perennial springs."

The Lake Mojave complex is considered to be a Paleo-Indian assemblage by most archeologists and is also thought to be ancestral to the early Archaic cultures of the subsequent Pinto Period. This complex has become the type unit for the earliest inhabitants of the Mojave Desert, and similarities to sites in the western Great Basin and to the San Dieguito complex of southern California have been noted. Included in it are various projectile point types, among them leaf-shaped forms, long stemmed points with narrow shoulders (Lake Mojave and Parman points), short bladed stemmed points with pronounced shoulders (Silver Lake point), and the more rare fluted point. Also present are crescents in simple lunate and more eccentric forms, small flake engraving tools with one or more very finely retouched points, specialized scrapers of distinctive types, leaf-shaped knives, drills, and a few heavy core tools that functioned as choppers or hammerstones. Milling stones are rare or absent.

Sites of the Lake Mojave period are nearly always limited to the surface, and it is possible that two or more assemblages are represented at some of these sites. Many of the sites are associated with shoreline features of Pleistocene lakes, such as the shorelines of extinct Lakes Mojave and Manly, and near springs.

Pinto Period (5,000 - 2,000 B.C.)

Warren (1984) has postulated that high aridity during what he terms the Pinto Period caused Mojave peoples to alter their subsistence strategies in response to environmental stress.

Consequently, seasonal rounds covering a larger area were necessary and thus sites from this time period are rare and their constituent elements generally less concentrated. The Pinto sites are most often limited to surface manifestation or have poorly developed middens with relatively low artifact density. They appear to be seasonal camps by small groups of highly mobile people. The small number of Pinto Period sites, together with their apparent temporary occupation of hunting large and small game and collecting vegetable resources, suggests that the population was sparse and poorly adapted to the increasingly arid conditions of the desert environment. During particularly arid periods, they probably withdrew to the margins of the desert and to perennial springs and microenvironments less affected by the overall climatic deterioration, and during more moist periods they likely expanded their territory in the lower desert areas to take advantage of the shallow lakes, marshes, and springs. During the later part of the Pinto Period, when the Mojave Desert was at its most arid, the population seems to have decreased, although a mosaic of microenvironments permitted localized habitation throughout the desert.

The artifact assemblages of the Pinto Period exhibit continuity with those of the Lake Mojave Period in the use of heavy scraping implements. The most characteristic artifacts at Pinto sites are several varieties of Pinto points, large and small leaf-shaped points and knives, domed and elongated keeled scrapers, and several forms of well-made flake scrapers similar to those of the Lake Mojave Period. Drills and engraving tools occur, as do occasional Lake Mojave and Silver Lake points. Few faunal remains have been recovered from Pinto sites. Simple flat milling stones occur in Pinto Period sites, as do occasional shallow-basined specimens and handstones.

The tool assemblage of the Pinto Period sites suggests a generalized hunting and gathering subsistence system with only the beginnings of a technology for processing hard seeds. The lack of a well-developed seed grinding technology in the Mojave Desert contrasts sharply with the emphasis placed on seed grinding on the California coast and elsewhere in the southwestern desert region. It is likely that the stress imposed by the climatic shift gave rise to the technologies associated with plant food collection, processing, and storage seen during the subsequent period.

Gypsum Period (2000 B.C. - A.D. 500)

The beginning of the Gypsum Period coincided with the commencement of a moister climatic era, often referred to as the Little Pluvial, about 2000 B.C. This period was a time of intensive occupation of the desert, coupled with a broadening of economic activities and increasing contact with the California coast and Southwest. Sites are more common but probably represent the continuity of earlier cultural developments in the California desert.

The early part of the Gypsum Period is characterized by fairly abundant medium-sized to large, stemmed and notched points, suggesting the use of the dart, spear, and atlatl (spear-thrower) as the primary hunting weapons. The most common projectile point forms are Elko Eared, Elko Corner-notched, Gypsum Cave, and Humboldt Concave Base points. These points are dated at a number of sites and, in part, appear to represent influences from outside the Mojave Desert, especially a relationship with the western Great Basin. During the latter part of the period, small points of the Rose Spring series were introduced and the Gypsum Cave point type was reduced in size, thus likely indicating the introduction of the bow and arrow. Small point types occur by

290 B.C, and small points replace the dart points by about A.D 500. This transition from atlatl to bow and arrow would date the beginning of the Coso petroglyphs (found over 100 miles to the north) at some time in the Gypsum period and provide a terminal date of post-A.D. 500.

Some researchers have interpreted Gypsum Period materials in terms of Southwest influence, which can be seen in the occurrence of pit houses along the eastern fringe of the Mojave late in this period, followed by the introduction of Basketmaker III pottery. The split-twig figurine, which may have originated in northern Arizona about 2200 B.C. and reached the central Mojave several hundred years later, is another Southwest trait introduced during the Gypsum period. Some researchers have interpreted the context in which the figurines are found to mean that they may have been used either in hunting rituals or in more generalized ceremonial activities. Their distribution suggests that the split-twig figurines and associated rituals diffused as a magico-religious system across cultural boundaries. Hunting rituals specifically associated with petroglyphs may have been another aspect of the same system that reached its climax in the Coso Range to the north, and may have resulted because of the depletion of bighorn sheep after the introduction of the bow and arrow.

Generally, this was a time in which the Mojave Desert population incorporated new technological items and ritual activities and increased socioeconomic ties through trade. Although hunting continued to be an important economic pursuit during the Gypsum Period, milling stones and handstones became common during this period, indicating increased use of plant foods and reliance on hard seeds. Indeed, the processing of mesquite pods with the mortar and pestle may have become an important element in the subsistence system. Because of these new means of adaptation, the return of arid conditions toward the end of the Gypsum Period probably had relatively little effect on the Mojave Desert's population density and distribution.

Saratoga Springs Period (A.D. 500 - 1200)

Cultural diversification and strong regional developments characterize the Saratoga Springs Period. This appears to be the time when native groups occupying different regions of the Mojave became more diversified. Both imported and locally made pottery make their debut and trade brought significant outside influences. In the northern Mojave, from Death Valley to the Sierra Nevada, the sites of the Saratoga Springs Period appear to exhibit cultural continuity with the Gypsum Period, change being most apparent by the reduction in size of projectile points as a result of the introduction of the bow and arrow. The Rose Spring series and small Cottonwood Triangular points dominate assemblages of this period, while milling stones and manos (handstones) continued in use along with incised stones and slate pendants. Specific changes in subsistence systems cannot be clearly identified, but a reduction in hunting large mammals, such as deer, in the northern Mojave has been postulated. Numic-speaking groups, who were the ancestors of the historic Shoshone and Paiute who inhabited the region at the time of Euro-American contact, presumably began their eastward expansion across the Mojave at this time.

Turquoise mining and long-distance trade networks appear to have attracted both the Anasazi and the Hakataya into the Mojave from the east and lower Colorado River Valley respectively. Research suggests that the Anasazi controlled turquoise mines near Halloran Spring in the east-central Mojave between about A.D. 700 and 900, followed by Hakataya peoples who withdrew

about A.D. 1200-1300. The area of Anasazi influence can be mapped by the distribution of Anasazi sherds occurring in considerable frequency at sites in southern Nevada and in California as far west as the Cronise Basin, west of Soda Lake. This pottery style has also been found at sites in the Granite Mountains. Anasazi influence set the eastern Mojave apart from the remainder of the desert. Finally, the Southern Paiute utilized the area in late prehistoric times.

During this period, the Mojave River also developed as a trade route between the Colorado River and the California coast. As a result of this trade, the ceramic and projectile point styles of the lower Colorado River spread through the Mojave River Valley, along with shell beads and ornament styles from the coastal region. In the Antelope Valley of the western Mojave, trade with the coast may have been the impetus for the creation of large permanent villages during this time, a trend which does not appear to have taken place in the east Mojave, where a fairly mobile hunting and gathering lifeway largely persisted.

The cultural development of the Mojave Desert south of the Mojave River and into the Providence Mountains diverged from that in the northern area. Few points of the Rose Spring series and virtually no Anasazi pottery occur in the southern Mojave. Artifact types (such as knives, drills, milling stones, mortars and pestles, stone pipes, bone awls, and shell and stone ornaments) show close similarities to their counterparts in the later pottery-bearing sites along the Mojave River. Sites in the southern Mojave, containing brown and buff, paddle and anvil pottery, and Cottonwood Triangular and Desert Side-notched points, are suggestive of Hakataya influence as early as A.D. 800 and continuing until historic contact.

Protohistoric Period (A.D. 1200 until Euro-American contact)

The archaeological assemblage dating to the Protohistoric Period in the eastern Mojave is very similar to that extending northward to the Owens Valley and the Coso Range. Warren (1984:427) indicates that this "assemblage can be identified as relating directly to the historic Paiute" and is derived from the cultural continuity seen farther to the north. The Anasazi influence faded after A.D. 1200 as a result of changes in climatic conditions, population movements, settlement patterns, social organization, and trade alignments. The diagnostic artifacts for this period, which appear to have originated in Owens Valley, are small Rose Spring and Desert Side-notched points. Various poorly defined types of crude brownware pottery, including Owens Valley Brownware, replaced Anasazi pottery.

The Mojave River Valley and the southern Mojave continued to be influenced by the well-developed trade system in which the Antelope Valley people of the western Mojave functioned as middlemen between California coastal and interior populations. In the Mojave Desert south of the Mojave River, the Hakataya influence continued. The assemblage from the upper Mojave River, as well as along the entire length of the river to the Mojave Sinks and eastward through the Mid Hills and the New York and Providence mountain ranges to the Colorado River in southern Nevada, includes brown, buff, and red-on-buff pottery apparently derived from the lower Colorado River, as well as Desert Side-notched and Cottonwood Triangular points. Shell beads, ornaments, and steatite from the southern California coast occurred throughout much of the area

Prehistoric Cultural Resource Types

Although the subsistence technology changed little from the early Gypsum Period to the end of the Protohistoric Period, the subsistence strategies that were employed reflect the adaptation of this technology to changing environmental and social conditions (Warren 1984:430). Over the last 2000 years, these adaptations appear to have resulted in a wider range of food resources being used and a shift in emphasis from hunting to collecting. This shift influenced the location and nature of sites within the present Preserve, as did natural and cultural post-depositional processes. Although there are differences between the artifact assemblages of the various time periods, a fundamental classification of primary site types that span the entire period of occupation can be defined for the 1100+ known prehistoric sites in the Preserve. In other words, the time periods defined by Warren and others provide a framework of temporally defined prehistoric contexts within which essentially the same sorts of site types occur. Due to a variety of factors including successive use of the same sites over both long periods and within the same seasonal round, many sites may combine more than one of the following types.

1. Habitation Sites (including rock shelters): These sites (comprising 29.3% of the known total) generally include a variety of artifact types (e.g., hunting, food processing, pottery, flaking debris, etc.) and often contain organic midden soils.
2. Artifact/Lithic Scatters: These sites are very common (38.5%) and consist of scatters of artifacts, usually, but not always, flaked stone, found on the surface, often within definable clusters.
3. Quarry Sites: Lithic quarries (3.1%) are identified by the large quantities of flaked stone blanks and flaking debris found at locations of desirable lithic resources.
4. Petroglyphs/Pictographs: Rock art sites (17.0%) are often found in conjunction with other site types. For instance, many sites classified primarily as habitations also have rock art.
5. Agave Roasting Pits: These circular, rock lined pits (3.8%) may be either prehistoric or historic in age.
6. Isolates: As the name suggests, isolates (6.1%) are individual finds of artifacts or flaking debris.
7. Other Site Types: These sites (2.2%) include rock rings and alignments of indeterminate use, trails, bedrock mortars and grinding slicks, and others.

Prehistoric National Register Properties

Three prehistoric archeological sites or districts located in or near Mojave National Preserve are listed on the National Register of Historic Places:

Piute Pass Archeological District -- August 14, 1973.
Aiken's Wash National Register District (Baker Vicinity) -- May 24, 1982.
Aiken's Wash Archeological Site "J" (Baker Vicinity) -- May 24, 1982.

Eleven archeological sites located in or near the national preserve were determined eligible for listing on the National Register on May 24, 1982:

CA-SBR-2759 [also known as Aiken Willows Cave]
CA-SBR-2760 [also known as Aiken Willows Petroglyphs I]
CA-SBR-2761 [also known as Aiken Willows Petroglyphs II]

CA-SBR-2762 [also known as Aiken Willows Petroglyphs III]
CA-SBR-2817 [also known as Aiken Willows Petroglyphs IV]
CA-SBR-2842 [also known as Aiken Willows Petroglyphs V]
CA-SBR-2843 [also known as Aiken Willows Petroglyphs VI]
CA-SBR-2844 [also known as Aiken Willows Petroglyphs VII]
CA-SBR-2763/H [also known as Aiken Tanks Petroglyphs]
CA-SBR-3150 [also known as Aiken Wash Alignment]
CA-SBR-7011 [also known as Aiken Cinder Mine Petroglyphs]

Impacts to Cultural Resources

Buenger (2003) recently conducted research regarding fire effects on archaeological resources in a variety of fuels, including grass, sagebrush, and pinyon-juniper. These three fuel types are similar to the fuels found in Mojave National Preserve, although fuel loads are generally less in desert regions (such as the Mojave Desert) than in the intermountain areas where this research was conducted. This research demonstrated that the important variables to consider when assessing the potential impact of natural fire on archaeological resources include: 1) fuel load; 2) fire behavior; 3) peak temperature and duration of heating; 4) proximity of artifacts to fuels; and 5) class of artifact. Because the impacts of fire on archaeological resources are influenced by such site and incident specific circumstances, it is impossible to predict impacts with any precision. Nevertheless, the observations of Buenger specific to different fuel types and artifacts provide valuable tools to anticipate the potential impacts that might be experienced at Mojave National Preserve. The impact of fire in grass fuels is primarily limited to deposition of combustive residue on the surfaces of artifacts and Buenger suggests that these deposits naturally weather off and should not be considered detrimental to the integrity of most archaeological materials. Fire in grass fuels does not result in subsurface heating, even at a depth of only 1 cm below the surface, so only those artifacts found immediately on the surface of the ground are subject to any impact and those impacts are very limited. The impact of fire in sagebrush fuels is limited to that area directly beneath the canopy of the plant and artifacts in that heating zone can experience significant thermal alteration, including deposition of combustive residue on all classes of artifacts, partial combustion and thermal fracturing of bone materials, limited thermal fracturing of chert, other cryptocrystalline silicates (CCS), and volcanic glass, and melting of lead materials. The impact of fire in pinyon-juniper fuels was found to be potentially significant, resulting from the extreme fire conditions that characterize this community. Thermal alteration of artifacts exposed to fire in pinyon-juniper fuels include severe thermal fracturing and mineral oxidation of chert and other CCS, severe charring and thermal fracturing of bone, thermal fracturing of volcanic glass and alteration of obsidian hydration rinds, delamination and charring of shell. Furthermore, buried artifacts in close proximity to large roots of woody fuels, including sagebrush and pinyon-juniper, could potentially be exposed to sustained extreme heat capable of thermally altering the artifacts. Fire effects on archaeological resources in desert shrubland fuel types (e.g., Joshua tree woodland, creosote bush shrubland) have not been researched; nevertheless, given the fuel load and arrangement of fuels, desert shrublands would likely exhibit fire effects between those observed for grass fuels and those observed for sagebrush. Most likely, thermal effects would be limited to areas directly beneath a shrub's canopy, particularly in the creosote bush shrublands where shrubs are widely spaced with barren ground in between.

Many of the National Register properties in Mojave National Preserve are rock art sites, of which the most common are sites where designs are pecked into the surface of a boulder or rock face (petroglyphs). Pictographs, another form of rock art, are also found in a few sheltered locations, where designs have been painted on the stone. Pictographs are especially susceptible to damage by fire (Hanes 2001). When exposed to intense heat, painted designs can be soot-blackened, scorched or completely burned away while petroglyphs on friable stone, such as sandstone or limestone, can exfoliate (Pilles 1982; Noxon and Marcus 1983).

Fire can also impact archaeological resources indirectly, as described by Hanes (2001). Loss of ground cover normally leads to greatly enhanced visibility, exposing sites that were previously difficult to find and leaving such sites vulnerable to looting. The water holding capabilities of litter, duff, and surface soils are also reduced by fire, which sometimes generates erosion hazards that can alter archaeological sites or remove artifacts. Fire can also affect the materials used for several dating techniques, resulting in erroneous dates due to thermal or chemical alteration of materials. The following dating techniques are known to be altered by fire (Traylor 1981, Pilles 1982): radiocarbon, thermoluminescence, obsidian hydration, archaeo-magnetic, and cation-ratio.

Fire suppression activities can also result in significant impacts on cultural resources, although most damage has been observed following the use of heavy equipment, such as dozers, to construct fire line (Piles 1982). Likewise, retardant has been known to cause significant damage to cultural resources, particularly historic fabrics, porous stone, and wood. Specifically, retardants have the potential to stain, corrode, and alter weathering processes through application of salts and other desiccants.

Because prehistoric resources are by their nature irreplaceable, any impact is considered to be long-term.

The Proposed Action includes 342,900 acres zoned for fire use, so the potential for direct fire impacts to prehistoric archaeological resources is generally greater than the No Action alternative which calls for suppression of all fires. Nevertheless, the areas zoned for fire use were zoned specifically to avoid known archaeological sites (including all National Register properties) and the acres zoned for fire use support only sparse fuels such as grasses and desert shrubs, thus mitigating much of the potential impact to prehistoric artifacts. Hence the Proposed Action is expected to have minor direct impacts on archaeological resources due to fire effects while the No Action alternative is expected to have negligible impacts on archaeological resources, with the potential for minor impacts in situations where fire suppression is delayed by poor access to remote locations. The potential for indirect fire impacts via exposure of sites, increased erosion, or alteration of dating techniques, are generally minor for either alternative due to the small size and short duration of most desert fires.

Either alternative has the potential for impacts to archaeological resources due to suppression activities. Nevertheless, those activities that are most likely to cause impact are specifically excluded from the Proposed Action and a the environmental protection measures outlined in the Fire Management Plan and its appendices, including the use of a resource advisor, would be

implemented to mitigate potential impacts from those suppression tactics that are authorized (such as handline construction and water drops). Because of these measures the Proposed Action is expected to have minor impacts on archaeological resources, with impacts primarily in the form of unavoidable damage to previously undocumented sites. There is no written plan for the No Action alterative and, while minimum impact suppression tactics are usually used, there are no specific prohibitions on the use of aggressive tactics or heavy equipment (i.e., dozers and retardant). In that case, the environmental protection measures in the Fire Management Plan and its appendices do not apply. Thus, while impacts are likely to be minor, there is the potential for the No Action alternative to result in moderate or even severe damage to pre-historic resources due to fire suppression activities.

The Proposed Action also calls for the reduction of hazard fuels immediately adjacent to park owned structures and in the campsites of the Mid-Hills Campground. Such efforts are confined to previously disturbed areas and the potential impacts to cultural resources would be mitigated through planned, on-the-ground consultation with the Preserve's archaeologist to locate and avoid cultural resources within the project areas, as outlined in the Five-year Work Plan for the Fire Management Plan. Hazard fuel reduction is not specifically addressed in the No Action alternative because a written plan does not existing for this alternative. Nevertheless, fuels immediately adjacent to park owned structures would likely be removed to provide for defensible space pursuant to NPS policy. Similar to the Proposed Action, the Park's archaeologist would be consulted as per NPS policy and arrangements would be made to avoid or minimize the potential impacts to pre-historic resources. Thus the impacts to prehistoric resources under either alternative are expected to be minor with impacts limited to unidentified, below ground resources that are disturbed by vegetation removal.

Prehistoric Resource Conclusions

The Proposed Action is expected to result in minor direct and indirect impacts on archaeological resources due to fire effects. Fire suppression tactics under the proposed alternative are clearly defined and environmental protection measures are identified, thus fire suppression impacts are expected to be minor. Fuel reduction adjacent to park owned structures is outlined with specific consultation measures and thus it is expected to result in minor impacts to prehistoric resources.

The No Action alternative is expected to have minor indirect impacts and negligible direct impacts on prehistoric resources due to fire effects. Impacts due to fire suppression activities are likely to be minor, but have the potential to be moderate or even severe due to the lack of a written plan for the No Action alternative. Fuel reduction adjacent to park owned structures is expected to result in minor impacts to prehistoric resources.

3.3.10. Historic Resources

Affected Environment

An impressive inventory of historic resources remains in the Mojave National Preserve. The mountains and valleys of the desert contain sites resulting from as early as the Spanish exploration of the area through WWII military camps and the mining and ranching operations still in business today. The Euro-American history of the east Mojave can perhaps be most readily described in terms of several major historic contexts or themes, each of which resulted in a characteristic but interrelated set of cultural resources.

Transportation

Much of the history of the Mojave National Preserve relates to transportation, from the Native American trails to the heavily used present day interstate highways and railroads. The seasonal movements of the region's prehistoric inhabitants between water sources and hunting and harvesting sites, as well as in their pursuit of trade, created a network of routes that was likely used for thousands of years and which was later followed by explorers. The first Euro-American expedition to enter the Mojave Desert region, led by the Spanish Franciscan priest Francisco Garcés during 1775-76, was intended to find a new trade and communication route between the Spanish settlements of Alta California and those of the upper Rio Grande Valley in New Mexico. Garcés crossed the desert from the mission at San Xavier del Bac near Tucson along what has become known as the Mojave Indian Trail through the present-day Preserve, eventually arriving at Mission San Gabriel near modern-day Los Angeles. He later crossed via a more northerly route, also through the present Preserve, once again accompanied by Mojave Indian guides.

In 1826, Jedediah Strong Smith also crossed the desert along the same east-west trail first used by Garcés. As the route became known, fur trappers, traders, and other "mountain men" traveling to the Spanish settlements along the coast in southern California gradually converted the path into a wagon route that linked the same perennial water sources used for millennia. In the 1850s the U.S. Army began a series of expeditions to survey a route for a transcontinental railroad along the 35th parallel. Most traces of the earlier expeditions across the Mojave would have been obliterated as road improvements were made by successive expeditions. Indeed, the resulting Mojave Road served as the major transportation corridor through the desert until a railroad was constructed farther to the south in 1883. In the interim, the Army dispatched troops to protect the mail and wagon trains from periodic depredations by Southern Paiute and Chemehuevi bands. Relay posts were established across the desert at Soda Springs, Marl Springs, Rock Spring, and Piute Creek to provide escort riders for the mail carriers between Fort Cady on the Mojave River and Fort Mojave on the Colorado to the east. Although by 1870 peace had been attained and these outposts were abandoned after only short occupations in the late 1860s, important remnants of the structures, along with associated artifacts, are still found in the Preserve today. Portions of a stage station constructed at Soda Springs in 1871-72 were probably later incorporated into some of the buildings still found at Zzyzx on the west shore of Soda Lake.

By April 1883 the Southern Pacific Line was completed across the desert from Mojave to Needles and was connected to the Atlantic and Pacific Railroad when a bridge spanning the Colorado River was completed later that year. This opened a transcontinental rail line between California and Springfield, Missouri that is now owned and operated by the Burlington Northern

Santa Fe Corporation but at the time of its completion stimulated the economic and mining development of the eastern Mojave.

The Nevada Southern Railroad completed a line from Goffs to the mining settlement of Manvel (Barnwell) in the New York Mountains by the summer of 1893. This line was subsequently extended into the Ivanpah Valley and, after acquisition by the Santa Fe, on to Searchlight, Nevada, operating until 1923.

The San Pedro, Los Angeles, and Salt Lake Railroad constructed its tracks through the center of the present Preserve in 1905, thus filling the last significant gap in transcontinental lines between Salt Lake City and Los Angeles. This railroad came under the full control of Union Pacific, which would construct the extant Kelso Depot in 1924 to serve as a hotel, restaurant, and office for train crews operating the helper engines which assisted trains climbing Cima Hill. Cima emerged as a small railroad community, as did Kelso, while the hotel, restaurant, and workers' club at Kelso Depot would continue to operate for another 38 years. The café did not close until 1985 and the building remains an excellent and rare example of a mid-1920s Mission Revival style railroad station. The Kelso Depot is currently being renovated to serve as a Visitors' center for the Mojave National Preserve. The Union Pacific maintains heavy use of the rail line.

From 1907 to 1940 the Tonopah and Tidewater Railroad also operated between Ludlow northward through the present Preserve to Beatty, Nevada. Originally designed to carry borax from mines in Death Valley to the California Eastern railhead, the railroad, along with its feeder lines, replaced a wagon road and tapped the growing mining settlements in the eastern Mojave.

Both the Nevada Southern and Tonopah and Tidewater Railroads were abandoned and, although considerable portions have been subsequently scavenged for other uses, much remains of their road beds, loading docks, access roads and other features to this day. In addition, two spur lines from the Tonopah and Tidewater were built to access soda extraction operations on Soda Lake which were also abandoned around 1917. The two transcontinental railways are still in operation; nevertheless, as their use has changed, certain sidings, road beds, access roads, and utility buildings have fallen from use and now represent historic cultural resources.

Mining

Following the Gold Rush of 1849 in northern California, speculators turned their attention to the mineral resources of the southeastern part of the state. Gold and silver discoveries in the Colorado River Basin during the late 1850s and early 1860s spurred interest in the eastern Mojave and soon silver was discovered near Rock Spring (1863) in the present Preserve. For the next several years, mining camps proliferated in the Providence Mountains/Mid Hills/New York Mountains region and in the late 1860s expanded to include mines in the Clark Mountain area. Copper and silver discoveries in the Clarks resulted in the establishment of the first site of the town of Ivanpah, where much of the mining history of the eastern Mojave would be centered during the 1870s. The remains of this town site, represented by little more than footings and foundation walls with scatters of associated historic artifacts, are still to be found in the Clark Mountain section of the Preserve, as are the structural remains of many of the regions mines.

The coming of the railroads in the 1880s stimulated new mining ventures and the towns that supported them. The discovery of the rich Bonanza King silver mine on the eastern slopes of the Providence Mountains, for instance, resulted in the establishment of the Providence and Crow Town settlements.

Gold dominated mining ventures in the eastern California desert region during the 1890s as the use of cyanides for treating gold ore led to the reopening of many formerly unprofitable mines. New mines were also discovered and developed: the Gold Bronze and Boomerang mines in the New York Mountains, the Telegraph Mine near Halloran Springs, and the Paymaster (Whitney) Mine near Old Dad Mountain. A rise in copper prices led to the reopening of several other mines and the development of additional copper, lead, and silver deposits in the New York Mountains which in turn led to the establishment of the town of Vanderbilt.

In the early 1900s, interest in gold and silver mining rose and fell in cycles. In spite of years of exploration and effort, output of precious metals never reached the potential that speculators envisioned. Boomtowns came and went in response to economic and political changes. Improvement of transportation facilities prompted large-scale hardrock mining operations. Ephemeral mining camps, such as Vontrigger Camp, Goldbend, Gold Valley, Gold Park, Dawson, Kewanee, and Hart, sprang up and flourished until the next down turn in metallic mineral prices came in response to fluctuations in the national economy. The remains of several of these camps still exist within the Preserve.

By the mid 1900s, new uses for tungsten, tin, molybdenum, and zinc created by the advent of the automobile, electricity, and growth in the military resulted in new mining operations. Clay and fluorite were mined. Iron ore was an important commodity that had great impact on the region's economy during WWII. Exploration following WWII involved the search for precious and base metals as well as industrial minerals, uranium, and rare earth minerals. Most mining claims were abandoned and left "as is" after they were closed, thereby resulting in abundant examples of various types of mining operations across the eastern Mojave.

Ranching/Homesteading

Early small scale ranching in the eastern Mojave was closely tied to the development of mining in the area. Due to the demand for meat and produce by the mining camps, even very small patches of fertile land could be hugely profitable, at least for a short while. This close association meant that the fortunes of the rancher or homesteader were subject to the same economic cycles as the mining industry. Clearly the proximity of ranches and mining camps determined the profitability of both, so ultimately these operations went from boom to bust together.

Miners who established the Rock Spring Mining District in 1863 were likely the first to maintain cattle and horses for extended periods in the east Mojave. By this time, demand from the mining settlements was supplemented by that of military garrisons sent to protect travelers and the mail and thus providing a more continuous market for locally produced agricultural products. This situation was probably responsible for the establishment of the Kessler Springs Ranch sometime during the 1870s, which continued to operate until 2001.

The Rock Springs Land and Cattle Company was incorporated in 1894, consolidating the earliest ranches in and near the present Preserve, including the Kessler Springs ranch whose headquarters it used as a line camp. During subsequent years it extended its cattle operations over much of the eastern Mojave and into southern Nevada, spending large sums to establish claims for exclusive use and improvement of the area's water sources. The ranch was originally headquartered in Barnwell and by 1920 would have nearly 10,000 head of cattle on the more than one million acres which it controlled. The company remained the dominant force in the cattle industry in the east Mojave until 1927, when the company interests were subdivided upon the death of one of its corporate members. From 1927 until 1988, the OX Cattle Company, a descendent of the Rock Springs Land and Cattle Company headquartered in Lanfair Valley, was the largest ranch in the region, although it operated on only a fraction of the area controlled by its predecessor. Smaller operations, such as the Gold Valley, Kessler Springs, Valley View, and Blair ranches, operated in other parts of the former range.

Lured by a cycle of particularly wet years, settlers established homesteads and attempted dryland farming in the east Mojave beginning in about 1910. Although homesteads were established in many places, including Barnwell, Crucero, Goffs, and Pinto Valley, the majority (some 200-250 patents) were centered in the Lanfair Valley. Because well drilling in the Lanfair Valley proved to be only marginally successful, the settlers there were forced to haul water overland from Government Holes, the only remaining water source still in public ownership. By the end of the 1910s, the more typical dry years had returned and forced many homesteaders to leave the area. This exodus was fundamentally completed right after the abandonment of the railroad between Barnwell and Searchlight in 1923.

Communications

The first transcontinental telephone line, in operation from New York to San Francisco by 1915, crossed the present Preserve, but traces of this line have disappeared. Examples of significant communication lines in the Preserve area include the first powerline constructed from Hoover Dam to the Los Angeles area during the 1930s and an early telephone line that parallels the Santa Fe Railroad.

WWII Military Operations

General George S. Patton selected much of the eastern Mojave and part of the Colorado Desert to train his troops for the North Africa campaigns during World War II. The headquarters for the training of nearly one million troops was located at Indio, California, and most of the exercises took place on lands south of the present Preserve area. Nevertheless, an important campsite was established in the southern portion of the Piute Valley north of Arrowhead Junction at Camp Ibis (just east of the modern Preserve) and a division-level encampment, known as Camp Clipper (also known as Camp Essex), was established at Goffs in 1942. Portions of Camp Clipper, which operated until June, 1944, are in the Preserve, and the Clipper Mountains and Piute Valley on both sides of the California-Nevada border served as operating areas for military training exercises.

Recreational Development

No discussion of the historic cultural resources within the Mojave National Preserve would be complete if it did not include the historical developments along the west shore of Soda Lake. As noted earlier, this area was long important because of the perennial springs which issue from the base of the Soda Mountains. This water source was used prehistorically and by early explorers, and subsequently supported a military outpost and stage stop. During the 1870s, a public bathing establishment was built at Soda Springs, or Soda Lake Station, as it was known when it was a stage stop. In 1914, a religious group led by Pastor Charles T. Russell occupied Soda Springs, constructing five frame houses and attempting to mine gold in the nearby hills. In 1944, Curtis H. Springer arrived at Soda Springs, and finding it deserted, took possession of the land under a mining claim. He and his wife Helen developed the property into the "Zzyzx Mineral Springs and Health Resort," which operated until 1974. With the exception of several modern structures, the site is much as the Springers left it. Transferred from the Bureau of Land Management to the National Park Service in 1994, the site is leased to the California Desert Studies Consortium of the California State University.

Historic Contexts/Themes

Historic cultural resources within the Mojave National Preserve are highly varied due to the increasing complexity of modern life and its material accoutrements as the centuries have passed. Despite this obstacle, a fundamental classification of primary historic contexts or themes can be defined for the nearly 600 known historic era sites in the Preserve. Due to their changing use through time or due to multiple uses at the same time, some sites could be classified under more than one context. As an example, since water is at such a premium in the desert environment, the same spring locations were used in numerous contexts over the years. In other cases it is not possible to unambiguously assign a site or set of cultural resources to a particular context, often for the same reasons. For instance, there are numerous historic artifact scatters and dumps found in the Preserve that lack any distinct thematic affiliation and their contents, not surprisingly, vary considerably. These sites make up about 3% of the known historic sites and often consist of little more than surficial scatters of artifacts that at some locations have accumulated over extended time periods while at others they may simply represent a single dumping episode. It is also not possible on the basis of current knowledge to determine the context of a number of isolated habitation sites that together make up about 6% of the total number of known historic era sites in the Preserve.

1. Transportation Context: Under this theme may be subsumed 5.3% of the known historic cultural resources found in the Preserve. These include the remaining sections of historic roads and trails but perhaps most importantly relate to the development of the railroad in the area. A variety of structures relating to the railroad may still be found, either as standing buildings or in the form of foundations and ruins. These range from the very substantial Kelso Depot to simple utility buildings, but also include associated dwellings, a schoolhouse, and out buildings, many of which are found in the Kelso and Cima areas. The remains of tracks and roadbeds, sidings, loading areas (often related to mining), and utility/access roads are common, although many structural elements have been salvaged and reused over the years.

2. Mining Context: Sites related in some way to the mining industry are the most common of all types found in the Preserve and constitute more than 70% of the known total. These include workings of all levels of development, including adits, shafts, and simple prospects, to name just a few. These may or may not have internal shoring and in some cases are still associated with standing headframes, mills, and other devices, which themselves are highly variable in extent and composition. Structures include habitations of both wood and stone, explosives lockers and dugouts, sheds, outhouses, and a vast array of other types. Fuel tanks and dumps are among the other common features. The artifact assemblages at mining sites are often extensive in terms of both sheer numbers and typological complexity.

3. Ranching/Homesteading Context: With the recent retirement of several large grazing allotments, a large number of ranching developments have come under the jurisdiction of the Preserve. Locations related to ranching now make up about 11% of the known number of historic sites and these vary considerably in composition. Of these, there are relatively few buildings and these are mostly grouped at the ranch headquarters, especially those of the former Kessler Springs, OX, and Valley View Ranches. Standing buildings at these locations include both frame and mobile homes, barns, sheds for machines, generators, tack, and various other uses, garages, and utility buildings of numerous types. Corrals, windmills, troughs, tanks, and fences are found both at headquarters and scattered across the countryside, connected by water lines of several types. Fuel tanks and dumps are also common features and artifacts associated with ranching abound.

4. Communications Context: Historic cultural resources under this context are rare and include only the power transmission and telephone lines described above.

5. Military Context: These sites make up only 1.5% of the total of known historic sites but are very significant regionally. These consist of the few remaining military outposts of the 1860s as well as the portion of Camp Clipper (Essex) which falls within the Preserve. The early military remains generally consist of rock ruins (also constructed with adobe at Fort Piute) and alignments while the WWII resources include former foundations and roadways. Associated artifacts are no longer particularly common.

6. Recreational Context: Historic resources relating to this complex are generally confined to the extensive complex at Zzyzx..

Historic National Register Properties

The historic Boulder Transmission Lines 1, 2, and 3 Archeological District (CA-SBR-7694H), located both in the national preserve and on BLM lands, was determined eligible for listing on the National Register as an archeological (historic) district on February 16, 1994.

A National Register nomination form has been prepared for the Kelso Depot and National Register nomination forms are being prepared for the following historic properties in the national preserve:

Zzyzx Mineral Springs Historic District

Government (Mojave) Road
Rock Springs Land and Cattle Company Historic District

Ten historic sites located in or near Mojave National Preserve have been designated California Historic Landmarks or California Points of Historic Interest. These include Fort Piute, Marl Springs, Lanfair, Zzyzx Springs, Camp Rock Spring, Kelso Depot, Barnwell, Fenner, Nantan, and Vanderbilt.

Impacts to Historic Resources

Impacts to historic resources include many of the impacts outlined in the previous discussion of prehistoric resources, particularly those fire effects observed on glass materials. In addition, the wooden components of historic structures are obviously at risk to direct fire impacts due to the easily combustible nature of all wood products, especially old wood that has very low fuel moisture. Because historic resources are by their nature irreplaceable, any impact is considered to be long-term.

The Proposed Action includes 342,900 acres zoned for wildland fire use, but potential impacts to documented historic sites was avoided by specifically excluding from fire use those documented sites including a ½ mile buffer around each site. The No Action alternative calls for suppression of all wildland fires. While unlikely, the location of ignitions (human-caused or natural) could result in flame impingement upon wooden structures, and there is the potential for sustained heat under certain fuels to result in thermal alteration of glass or lead artifacts. Many of the properties listed or proposed for listing on the National Register or recognized as California Historic Landmarks are composed of non-flammable materials such as rock or stucco. Nevertheless, some of the old town sites include remains of wooden structures or wooden components that are highly flammable and direct fire effects on these resources would result in significant alteration or loss of information. Overall, direct fire effects of wildland fire on historic structures under either alternative are expected to be minor, with the potential for moderate or even severe impacts to wooden structures or wooden components. The potential for indirect fire impacts via exposure of sites, increased erosion, or alteration of dating techniques, are generally minor for either alternative due to the small size and short duration of most desert fires.

It is important to note that this discussion is limited to *wildland* fire not *structural* fire. The Preserve has no local resources to manage fire in any structure, historic or non-historic. Either alternative has the potential for impacts to historic resources due to suppression activities. Nevertheless, those activities that are most likely to cause impact are specifically excluded from the Proposed Action and the environmental protection measures outlined in the Fire Management Plan and its appendices, including the use of a resource advisor, would be implemented to mitigate potential impacts from those suppression tactics that are authorized (such as handline construction and water drops). Because of these measures the Proposed Action is expected to have minor impacts on historic resources, with impacts due primarily to unavoidable damage to previously undocumented sites. There is no written plan for the No Action alterative and, while minimum impact suppression tactics are usually used, there are no specific prohibitions on the use of aggressive tactics or heavy equipment (i.e., dozers and retardant) and the environmental protection measures in the Fire Management Plan and its appendices do not apply. Thus, while

impacts are likely to be minor, there is the potential for the No Action alternative to result in moderate or even severe damage to historic resources due to fire suppression activities.

The Proposed Action also calls for the reduction of hazard fuels immediately adjacent to park owned structures and in the campsites of the Mid-Hills Campground. Such efforts are confined to previously disturbed areas and the potential impacts to historic resources would be mitigated through planned, on-the-ground consultation with the Preserve's archaeologist to locate and avoid historic resources within the project areas as outlined in the Five-year Work Plan for the Fire Management Plan. Hazard fuel reduction is not specifically addressed in the No Action alternative because a written plan does not existing for this alternative. Nevertheless, fuels immediately adjacent to park owned structures would likely be removed to provide for defensible space as per NPS policy. Similar to the Proposed Action, in the No Action alternative the Park archaeologist would be consulted as per NPS policy and arrangements would be made to avoid or minimize the potential impacts to pre-historic resources. Thus the impacts to historic resources under either alternative are expected to be minor with impacts limited to unidentified, below ground resources that are disturbed by vegetation removal.

Historic Resource Conclusions

Under the Proposed Action, direct fire effects of wildland fire on historic structures are expected to be minor, with the potential for moderate or even severe impacts to wooden structures or wooden components. The potential for indirect fire impacts via exposure of artifacts and increased erosion is generally minor due to the small size and short duration of most desert fires. Due to the inclusion of environmental protection measures, the Proposed Action is expected to have minor fire suppression impacts on historic resources, with impacts due primarily to unavoidable damage to previously undocumented sites and/ previously unexposed artifacts. Impacts to historic resources from hazard fuel reduction activities are expected to be minor with impacts limited to unidentified, below ground resources that are disturbed by vegetation removal.

Under the No Action alternative, direct fire effects of wildland fire on historic structures are expected to be minor, with the potential for moderate or even severe impacts to wooden structures or wooden components. The potential for indirect fire impacts via exposure of sites, increased erosion, or alteration of dating techniques, is generally minor for either alternative due to the small size and short duration of most desert fires. Fire suppression impacts under the No Action alternative are likely to be minor, but there is the potential for moderate or even severe damage to historic resources due to the lack of a written plan with specific environmental protection measures. Impacts to historic resources from hazard fuel reduction activities are expected to be minor with impacts limited to unidentified, below ground resources that are disturbed by vegetation removal.

3.3.11. Cultural Landscapes

Affected Environment

Studies to identify character-defining elements of cultural landscapes are currently being conducted throughout the Preserve, and approximately 20 locations have been identified as potentially significant and thus potentially eligible for listing on the National Register. To date, cultural landscape inventories of the Kelso Club House and Restaurant (Kelso Depot) Historic District and of the Zzyzx Mineral Springs Historic District have been completed and CLI for the Rock Springs Land and Cattle Company Historic District will be completed within the year.

Impacts to Cultural Landscapes

Fire has the potential to directly and indirectly alter cultural landscapes through changes in species composition induced by fire or its exclusion. Removal of vegetation via fire, fire suppression, or fuel management obviously has the potential to result in loss of cultural landscape elements.

The cultural landscapes associated with both the Kelso Depot and the Zzyzx Mineral Springs Historic Districts are located in sparse fuel areas of the Preserve where wildland fire is unlikely to carry far; nevertheless, the species planted in both landscapes are themselves highly flammable, namely the saltcedars and palms. Thus it is possible that either cultural landscape could be significantly impacted by fire. Fire has always been a part of the cultural landscapes associated with ranching and so no additional impacts from fire than what has previously occurred naturally are expected.

Cultural Landscape Conclusions

The impacts to these cultural landscapes under either the Proposed Action or the No Action alternative are expected to be the same. Both of these landscapes are zoned for full suppression that could result in minor impacts to cultural landscapes due to removal of individual plants to prevent spread from a burning plant to adjacent plants. Both landscapes are subject to fuel management after consultation with the Preserve's archaeologist to identify cultural landscape elements to avoid during fuel treatments, thus impacts due to fuel management are expected to be negligible.

3.3.12. Ethnographic Resources

Affected Environment

For millennia, American Indian peoples lived within the eastern Mojave using the resources and lands to sustain their lives and cultures. The basic necessities for human life of American Indian peoples are, and have long been, present here - water and food, materials for tools, access to routes for travel and trade, and special places for spiritual rites that continue today, as well as a sense of land association and place identity. These peoples' presence has resulted in a tangible heritage of cultural materials, remembered place names and associations, and attachments to lands from history to modern times.

To the American Indian peoples now known as Mohave, Shoshone, Paiute, Serrano, Chemehuevi, and Kawaiisu, the lands were occupied and utilized in many ways, with flexible boundaries among these tribal groups. These peoples are differentiated by language, varied subsistence patterns, and self-identification that continue today. Specific historic geographical associations to lands and places within the present Preserve are known from compilations of information used in Federal Indian Land Claims court cases during the l950s and l960s as well as from ethnographic studies.

In general, tribal peoples historically occupied their lands in small, mobile social units of related families who traveled in regular patterns, establishing summer or winter camps in customary places with water supplies, often located at a border between scrub or woodland zones. Some localities contained richer and more dependable food resources than others but the lands did not support large numbers of persons at any one location. Many plants yielded seed, nut, tuber, or fiber foods, prepared for consumption and for storage at convenient caches. Large or small land mammals were hunted or caught, birds such as doves or quail were snared, and reptiles were collected but not all plants or fauna were sought. The diet for these native peoples was largely vegetarian, supplemented by mammals, reptiles, and insect sources. Certain places on the lands were and are today considered as specially significant; for example, land forms named in oral accounts of travels by supernatural beings, "hot" springs which have curative purposes, petroglyph sites believed to be the products of shaman's supernatural helpers, or topographic landmarks identified in complex chants known today as "bird songs." In essence, "oral maps" of northern and eastern Mojave desert lands still exist today in ceremonial knowledge held by certain Mohave and Chemehuevi individuals. Other tribal members have documented descriptive names in Shoshone language for places of settlement, gathering camps, and other important locations in the study area.

During the past two centuries, American Indian peoples inhabiting the Mojave have changed their territorial ranges in reaction to European and later American direct and indirect pressures, as well as intertribal struggles. U.S. Military presence increased at Camp Cady, east of Mojave National Preserve, at established posts in the Owens Valley, and at Fort Mohave along the Colorado River in response to increasing American settlement and mining and ranching operations. These pressures resulted in establishment of more concentrated reservations and communities by the early 20th Century.

Earlier movements were caused by groups of families moving toward growing towns, thus shifting populations from more traditional scattered patterns. For example, from the southern Nevada portion of Southern Paiute-held areas, people now known as Chemehuevi had moved toward the Colorado River valley early in the 19th Century. Kawaiisu, Koso (also known as Panamint Shoshone), and Serrano peoples were jointly using terrain around the Granite and Providence Mountain ranges during the 19th century.

During the l950-l960s, Federal Indian Lands Claims cases involving Chemehuevi, Mohave, and Owens Valley Paiute tribes included documented occupation and use of many mountain ranges, valleys, and resources within the study area. Maps illustrating Chemehuevi use of the lands now in Mojave National Preserve were accepted by Mohave tribal officials as well. Individual members of the Mohave Tribe have family historical information on early 20th century land uses in

or near Preserve lands. Today's tribal governments and communities historically associated with the region in which the Preserve is located include:

The Chemehuevi Indian Tribe Reservation (30,600 acres) was established by presidential executive order in 1971. Federal recognition was received in 1970. Economic support derives from land leases, retail businesses, tourism and recreation services, and gaming. Tribal enrollment is about 500 persons, 300 of whom reside on or near the Havasu Lake, California, developed area.

Mohave Indian Tribe Reservation lands lie in Arizona, California, and Nevada, but tribal offices and some residential areas are located in Needles, California. In 1864, a reservation was established from a former military fort reserve and nearby traditional lands. Economic developments relating to gaming, tourism and recreation, and retail business with considerable agricultural land leases provide tribal and individual incomes. The tribe population numbers approximately 1000, with some 500 people living on or near reservation lands.

The Las Vegas Paiute Tribe is composed of "Nuwuvi" people, called Paiute by others, who inhabited present-day southern Nevada from pre-European time to present. In 1911 a small parcel of trust land was established near the town of Las Vegas. Today, the tribe owns the original 16 acre area and a 3,800 acre area north of metropolitan Las Vegas. The tribe numbers about 100 people who obtain their economic support from tribal tourism enterprises, retail sales, and wage work.

The San Manuel Tribal Community in San Bernardino County is composed of historic Serrano peoples who occupied the mountainous areas in present day Riverside and San Bernardino counties, with their related neighbors, the various Cahuilla communities. The 660 acre reservation was established by Congress in 1893. The tribe consists of about 85 individuals residing on or near trust lands. Enterprises include a casino, and a curation facility.

Although all of these groups have some cultural affiliation with the Preserve, there are no traditional cultural properties presently identified.

Impacts to Ethnographic Resources

Because there are no traditional cultural properties presently identified in the Preserve, there are no impacts from either the Proposed Action or the No Action alternative. Nevertheless, the Preserve maintains on-going communication with these culturally affiliated tribes. During the public review process, the proposed Fire Management Plan and its appendices will be provided to the tribes for comment.

Ethnographic Conclusions

No impacts from either alternative.

3.4 Summary of Impacts

Table A4: Impact analysis summary

Impact Topic	Proposed action (implement 2004 Fire Management Plan)	No Action Alternative (continue with undocumented full suppression response)
Water resources	• negligible, short-term impacts • no long-term impacts	• negligible, short-term impacts • potential for minor or moderate long-term impacts
Air quality	• minor, short-term impacts • no long-term impacts	• minor, short-term impacts • no long-term impacts
Natural quiet	• moderate, short-term impacts • no long-term impacts	• moderate, short-term impacts • no long-term impacts
Wilderness	• minor, long-term impacts to wilderness character • negligible, short-term impacts to wilderness resources	• moderate, long-term impacts to wilderness character • minor, short-term impacts to wilderness resources
Development	• no short-term impacts • negligible, long-term impacts	• no short-term impacts • moderate, long-term impacts
Vegetation	• moderate, short-term impacts • minor, long-term impacts especially to biological crusts	• moderate, short-term impacts • moderate, long-term impacts especially to biological crusts
Wildlife	• potential for moderate, short-term impacts to state-listed bird species • minor, long-term impacts to wildlife habitat • unknown impacts to invertebrates	• moderate, short-term impacts to state-listed bird species • moderate, long-term impacts to wildlife habitat • unknown impacts to invertebrates
Threatened and endangered species	• minor, long-term impacts to desert tortoise • no impacts to Mohave tui chub	• moderate, long-term impacts to desert tortoise • potential for major, long-term impacts to Mohave tui chub
Prehistoric resources	•minor long-term impacts	• minor long-term impacts with potential for long-term moderate or severe impacts due to suppression activities
Historic resources	• minor long-term impacts with potential for moderate to severe impacts due to direct fire effects on wooden structures	• minor long-term and short-term impacts with potential for moderate to severe impacts due to direct fire effects on wooden structures and suppression activities

Cultural landscapes	• minor, short-term impacts	• minor short-term impacts
Ethnographic resources	• no impact	• no impact

3.5 Cumulative Impacts

Cumulative impacts are defined as "Actions that, when viewed with other actions in the past, the present, or the reasonably foreseeable future regardless of who has undertaken or will undertake them, have an additive impact on the resource the proposal would affect." (40 CFR 1508.25)

As the Preserve was only recently established, there are many management and planning documents currently being prepared for future implementation. All plans are tiered from the recently completed General Management Plan, and as such they should all be consistent with the Preserve's purpose and significance. Furthermore, there should not be any direct conflicts between the management plans.

A brief description is provided for each of the National Park Service planning projects currently underway that might include cumulative impacts to the same resources affected by the Fire Management Plan. Nevertheless, some of these planning efforts are substantially complete at this time.

- Resource Stewardship Plan: This plan is tiered from the Preserve's General Management Plan. It describes the desired future conditions for natural and cultural resources as well as outlines specific management actions needed to achieve those conditions. This plan is substantially incomplete at this time so specific actions could not be included in the cumulative impact analysis.

- Livestock Management Plan: This plan permanently retires all private grazing leases on Preserve lands and outlines management practices for park-owned stock and recreational stock use. This plan is substantially complete at this time and specific actions are included in the cumulative impact analysis.

- Wilderness and Backcountry Management Plan: This plan prescribes management of the Preserve's vast wilderness and backcountry areas. The overall concept for this plan is for the highest level of protection of physical resources of wilderness and wilderness character in those areas that best exemplify wilderness values, while still accommodating a variety of visitor and commercial uses in both wilderness and backcountry areas. This plan is substantially incomplete at this time and alternatives have not been developed so specific actions could not be included in the cumulative impact analysis.

Additionally, the Preserve accommodates on-going activities that, while not currently subject to a specific planning effort, might also contribute to cumulative impacts. Included are three activities related to motorized transportation:

- Union Pacific Railroad: This is an existing land use where Union Pacific operates freight trains along railroad corridors that exist on private land.
- County Roads: There are approximately 750 miles of maintained roads that traverse the Preserve and are managed by San Bernardino County.

- Four-wheel drive touring: Over 1000 miles of non-Wilderness, un-maintained roads are open to recreational four-wheel drive touring.

Additionally, the Preserve's enabling legislation included the continuation of public hunting in the Preserve. Primary game species are mule deer and small game. There are also limited and highly sought after opportunities for bighorn sheep hunting. The California Department of Fish and Game regulates hunting activities, including take limits and seasons.

Beyond the Preserve itself, other federal land managers (excluding Department of Defense) are concurrently developing fire management plans to meet the requirements set forth by the National Fire Plan and agency specific policies. Because most of the Mojave Desert bioregion is under federal management, these plans have a widespread influence throughout the Desert. Mojave National Preserve is part of the interagency California Desert Fire Planning Unit, a 32-million acre area that also includes Death Valley National Park, Joshua Tree National Park, most of the Bureau of Land Management's California Desert District, Sonny Bono Salton Sea National Wildlife Refuge, Coachella Valley National Wildlife Refuge, as well as the tribal lands of the Torres-Martinez Reservation and the Cabazon Reservation. As these plans are being completed on a similar schedule as the Preserve's Fire Management Plan it is not possible to compare final alternatives. Nevertheless, fire planning discussion with this group revealed that Mojave National Preserve is the only unit to accommodate fire use. All the other units operate under a full suppression management direction, but some do accommodate prescribed fire for treatment of saltcedar. It is unclear what specific environmental protection measures are being incorporated into these other agencies fire plans, but all use minimum impact suppression tactics and all fire plans that include wilderness are held to the same guidelines found in the Desert Managers Group's "Principles for Wilderness Management in the California Desert" and its annexes, including "Annex 5 – Principles for Fire Management within Wilderness Areas of the California Desert." Cumulatively, the massive fire planning effort that is taking place throughout the nation, including the Mojave Desert, should result in more consistency and better communication in fire management across agency boundaries which should benefit all resources in the area through more effective fire suppression and better protection of values at risk. Thus, implementation of this fire management plan is not expected to contribute to cumulative negative impacts on desert resources in general and wilderness resources specifically.

Both the fire management plan and the livestock management plan affect vegetation. As livestock becomes less prevalent in the Preserve, it is likely that there will be a response in the vegetation with greater fuel accumulations possible. Such accumulations will be most noticeable in areas that were previously heavily used by cattle, namely corrals and water sources, because the history of disturbance has allowed weed species to invade many of these areas. While the reduction in hoof action reduces the potential for new invasions, there are many areas where weedy species have already become established and are likely to flourish absent the pressure of livestock grazing. Particularly of concern are the areas where invasive annual grasses are established. These plants will now serve as a more continuous fuel bed, resulting in fires that are capable of spreading over a larger area and burning with more intensity. The Fire Management Plan will also result in an increase in acres burned due to the 342,900 acres zoned for fire use, but that increase will occur mostly in areas that were not previously heavily used by cattle. Thus, while both the reduction in livestock grazing and the increase in fire use will result in more acres

burned, each is occurring in different areas of the Preserve so it is not expected to result in a cumulative impact on the same location. Overall, both actions – reduction in livestock grazing and accommodation of fire use – are undertaken to promote natural conditions and processes but will indirectly contribute to cumulative impacts on vegetation in which some species will benefit and some will not.

The continued operation of fire suppression equipment on existing motorized transportation routes results in a negligible increase in traffic volume. As these are established routes of travel, continued use of those routes at the volume of traffic currently observed is considered sustainable. Off-road travel for both the general public and firefighting operations is strictly prohibited due to the well documented impacts associated with such use, including changes in soil properties that lead to accelerated erosion (Webb 1982, Webb et al. 1987), soil compaction (Adams et al. 1982) reductions in plant cover (Adams et al. 1982), and reductions in wildlife abundance and richness (Bury et al. 1977, Luckenback and Bury 1983). Unfortunately, there are numerous occurrences of illegal off-road travel by recreationists in Mojave National Preserve. Conversely, firefighting operations in Mojave National Preserve are held to a strict level of accountability for environmental protection and personal safety, thus instances of off-road travel by firefighting equipment are non-existent even during emergency situations. Thus firefighting operations are not expected to contribute to any cumulative impacts caused by off-road travel.

Operation of the Union-Pacific Railroad and motorized vehicle operation on park roads will continue to result in occasional ignitions along these travel corridors. The Preserve will continue to suppress these and all other human-caused ignitions and the vast majority of these ignitions have been held of 0.1 acre. As these ignitions occur in highly accessible areas and the proposed fire use areas are in remote wilderness lands, the impacts of these two sources of fire are not considered to be cumulative. Nevertheless, these transportation corridors are known to serve as conduits for invasion by non-native plant species and both fire and fire suppression could also promote non-native plants under certain conditions. Thus it is possible that these two actions could result in a cumulative increase in non-native vegetation in some areas, particularly along major roads and the railroad tracks.

Both fire and hunting could have impacts on wildlife species, although the hunting seasons and the primary fire season do not overlap. As described under impacts, fire and fire suppression are expected to have variable impacts on wildlife species with some species or their habitats benefiting while others are negatively impacted. Hunted species are highly mobile and, with the exception of bighorn sheep, occur in relatively high numbers with broad distributions throughout large areas of the Preserve and surrounding desert lands. These game species are not expected to be significantly impacted by the proposed fire management program and only localized displacement during fire or fire suppression is expected with rare occurrences of direct mortality for juveniles that are not very mobile. Provided that California Department of Fish and Game continues to manage for sustainable populations of these game species, there should be no cumulative impacts to wildlife populations.

3.6 Impairment

The fundamental purpose of the national park system, established by the National Park Service Organic Act of 1916 (16 USC 1) and reaffirmed by the General Authorities Act, as amended (16 USC 1a-1), begins with a mandate to conserve park resources and values. While Congress has given the Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the Park Service must leave park resources and values unimpaired, unless a particular law directly or specifically provides otherwise. This prohibition against impairment ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.

The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the Park's general management plan or other relevant NPS planning documents.

Consideration has been given to whether or not implementation of the Proposed Action would constitute impairment at Mojave National Preserve. The Proposed Action was developed specifically to further the purposes of the Preserve and to promote goals identified in the Park's general management plan. It provides environmental protections for wilderness, threatened and endangered species, and the accommodation of natural fire as part of the ecosystem process. It offers a specific action plan to carry out these protective measures. The implementation of the Proposed Action will better protect the Preserve's resources and values and, therefore, will not result in impairment.

The No Action alternative promotes the continuation of the status quo. Because Mojave National Preserve has no existing fire management plan in place and does not follow a specific action plan or environmental protective measures, No Action carries the risk of significant damage to the resources or values resulting from current fire suppression practices. It also does not accommodate natural fire as part of the ecosystem process in Mojave National Preserve. The potential for impairment to the resources and/or values of the Preserve is present in the No Action alternative.

4.0 Preparers

The following personnel were responsible for writing and/or reviewing this environmental assessment:

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5.0 Consultation and Coordination

The following people provided valuable consultation for the preparation of this environmental assessment:
Mr. James Andre, Andre Botanical Consulting - Rare Plant Inventory at Mojave National Preserve
Mr. James Aragon, Engine Captain, Bureau of Land Management – Hole in the Wall Fire Center
Dr. Matthew Brooks, Ecologist, U.S. Geological Survey - Las Vegas Field Office
Dr. Creed Clayton, Biologist, U.S. Fish and Wildlife Service – Ventura Office
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Dr. Kurt Leuschner, Associate Professor, College of the Desert
Mr. Shane Littlefield, Engine Captain, National Park Service – Hole in the Wall Fire Center
Mr. Rick Smedley, Fire Planner, National Park Service - Pacific West Regional Office

Additionally, the fire management planning effort and this environmental assessment was coordinated with the partners of the California Desert Fire Planning Unit.

The Fire Management Plan and its appendices, including this environmental assessment, will be made available for 30-days for public review. The Preserve will issue a press release to announce the availability of the Fire Management Plan and the Environmental Assessment. Both documents will be posted on Mojave National Preserve's website and copies will be distributed to the following libraries:

Los Angeles County, California
Pasadena Branch

San Bernardino County, California
- Barstow Branch
- Needles Branch
- Victorville Branch

Clark County, Nevada
- Las Vegas Branch

Nye County, Nevada
- Beatty Branch
- Pahrump Branch

Copies on CD or paper will be distributed upon request.

Substantive comments will be addressed. If it is determined that implementation of this plan will result in no significant impact to the environment, a finding of no significant impact will be prepared and the 2004 Fire Management Plan will be implemented. If it is determined that a finding of no significant impact is not appropriate, the Proposed Action will either be revised and reanalyzed in a new environmental assessment or the Preserve will issue a notice of intent to prepare an environmental impact statement.

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7.0 Glossary

A

Aerial Fuels: All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss and high brush.
Aerial Ignition: Ignition of fuels by dropping incendiary devices or materials from aircraft.
Agency: Any federal, state or county government organization participating with jurisdictional responsibilities.
Air Tanker: A fixed-wing aircraft equipped to drop fire retardants or suppressants.
Anchor Point: An advantageous location, usually a barrier to fire spread, from which to start building a fire line. An anchor point is used to reduce the chance of firefighters being flanked by fire.
Aramid: The generic name for a high-strength, flame-resistant synthetic fabric used in the shirts and pants of firefighters. Nomex, a brand name for aramid fabric, is the term commonly used by firefighters.
Aspect: Direction toward which a slope faces.

B

Backfire: A fire set along the inner edge of a fireline to consume the fuel in the path of a wildland fire and/or change the direction of force of the fire's convection column.
Backing Fire: Fire that is moving into the wind.
See also **Heading** and **Flanking Fire**.
Bambi Bucket: A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.
Backpack Pump: A portable sprayer with hand-pump, fed from a liquid-filled container fitted with straps, used mainly in fire and pest control.
See also **Bladder Bag.**
Behave: A system of interactive computer programs for modeling fuel and fire behavior that consists of two systems: BURN and FUEL.
Blackline: Refers to fuels that have burned, either intentionally or not. Many prescribed fire and wildland fire suppression techniques are based on the concept of blackline as a barrier to fire spread.
Bladder Bag: A collapsible backpack portable sprayer made of neoprene or high strength nylon fabric fitted with a pump.
See also **Backpack Pump.**
Blow-up: A sudden increase in fire intensity or rate of spread strong enough to prevent direct control or to upset control plans. Blow-ups are often accompanied by violent convection and may have other characteristics of a fire storm.
See also **Flare-up.**
Brush: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.
Brush Fire: A fire burning in vegetation that is predominantly shrubs, brush and scrub growth.
Bucket Drops: The dropping of fire retardants or suppressants from specially designed buckets slung below a helicopter.

Buffer Zones: An area of reduced vegetation that separates wildlands from vulnerable residential or business developments. This barrier is similar to a greenbelt in that it is usually used for another purpose such as agriculture, recreation areas, parks or golf courses.
Bump-up Method: A progressive method of building a fire line on a wildland fire without changing relative positions in the line. Work is begun with a suitable space between workers. Whenever one worker overtakes another, all workers ahead move one space forward and resume work on the uncompleted part of the line. The last worker does not move ahead until completing his or her space.
Burn Out: Setting fire inside a control line to widen it or consume fuel between the edge of the fire and the control line.
Burning Ban: A declared ban on open air burning within a specified area, usually due to sustained high fire danger.
Burning Conditions: The state of the combined factors of the environment that affect fire behavior in a specified fuel type.
Burning Index: An estimate of the potential difficulty of fire containment as it relates to the flame length at the most rapidly spreading portion of a fire's perimeter.
Burning Period: That part of each 24-hour period when fires spread most rapidly, typically from 10:00 a.m. to sundown.

C
Campfire: As used to classify the cause of a wildland fire, a fire that was started for cooking or warming that spreads sufficiently from its source to require action by a fire control agency.
Candle or Candling: A single tree or a very small clump of trees which is burning from the bottom up.
Carrier Fuel: Fuels that allow a fire to spread and "carry" through the forest. These are generally lighter fuels such as conifer needles, leaves, cured grass and small twigs.
Catface: General term used to describe the triangular wound found at the base of a tree and often caused by fire. From one to many fire scar lesions caused by individual fire events can be found within the catface.
Chain: A unit of linear measurement equal to 66 feet or approximately 20 meters.
Closure: Legal restriction, but not necessarily elimination of specified activities such as smoking, camping or entry that might cause fires in a given area.
Cold Front: The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, the result may be cloudiness, precipitation, and thunderstorms. If both air masses are dry, no clouds may form. Following the passage of a cold front in the Northern Hemisphere, westerly or northwesterly winds of 15 to 30 or more miles per hour often continue for 12 to 24 hours.
Cold Trailing: A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand for heat to detect any fire, digging out every live spot and trenching any live edge.
Command Staff: The command staff consists of the information officer, safety officer and liaison officer. They report directly to the incident commander and may have assistants.
Complex: Two or more individual incidents located in the same general area which are assigned to a single incident commander or unified command.
Conduction: The movement of heat from one molecule to another.

Contain a fire: A fuel break around the fire has been completed. This break may include natural barriers or manually and/or mechanically constructed line.
Control a fire: The complete extinguishment of a fire, including spot fires. Fireline has been strengthened so that flare-ups from within the perimeter of the fire will not break through this line.
Control Line: All built or natural fire barriers and treated fire edge used to control a fire.
Cooperating Agency: An agency supplying assistance other than direct suppression, rescue, support, or service functions to the incident control effort; e.g., Red Cross, law enforcement agency, telephone company, etc.
Coyote Tactics: A progressive line construction duty involving self-sufficient crews that build fire line until the end of the operational period, remain at or near the point while off duty, and begin building fire line again the next operational period where they left off.
Creeping Fire: Fire burning with a low flame and spreading slowly.
Crew Boss: A person in supervisory charge of usually 16 to 21 firefighters and responsible for their performance, safety and welfare.
Crown Fire (Crowning): The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.
Curing: Drying and browning of herbaceous vegetation or slash.

D
Dead Fuels: Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), drybulb temperature and solar radiation.
Debris Burning: A fire spreading from any fire originally set for the purpose of clearing land or for rubbish, garbage, range, stubble or meadow burning.
Defensible Space: An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss of life, property, or resources. In practice, "defensible space" is defined as an area of a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.
Deployment: *See* **Fire Shelter Deployment.**
Detection: The act or system of discovering and locating fires.
Direct Attack: Any treatment of burning fuel, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.
Dispatch: The implementation of a command decision to move a resource or resources from one place to another.
Dispatcher: A person employed who receives reports of discovery and status of fires, confirms their locations, takes action promptly to provide people and equipment likely to be needed for control in first attack and sends them to the proper place.
Dispatch Center: A facility from which resources are directly assigned to an incident.
Division: Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span-of-control of the operations chief. A division is located within the Incident Command System organization between the branch and the task force/strike team.
Dozer: Any tracked vehicle with a front-mounted blade used for exposing mineral soil.
Dozer Line: Fire line constructed by the front blade of a dozer.

Drip Torch: Hand-held device for igniting fires by dripping flaming liquid fuel on the materials to be burned; consists of a fuel fount, burner arm and igniter. Fuel used is generally a mixture of diesel and gasoline.
Drop Zone: Target area for air tankers, helitankers, and cargo dropping.
Drought Index: A number representing net effect of evaporation, transpiration and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers.
Dry Lightning Storm: Thunderstorm in which negligible precipitation reaches the ground. Also called a dry storm.
Duff: The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles and leaves and immediately above the mineral soil.

E
Energy Release Component (ERC): The computed total heat released per unit area (British thermal units per square foot) within the fire front at the head of a moving fire.
Engine: Any ground vehicle providing specified levels of pumping, water and hose capacity.
Engine Crew: Firefighters assigned to an engine. The Fireline Handbook defines the minimum crew makeup by engine type.
Entrapment: A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."
Environmental Assessment (EA): EAs were authorized by the National Environmental Policy Act (NEPA) of 1969. They are concise, analytical documents prepared with public participation that determine if an Environmental Impact Statement (EIS) is needed for a particular project or action. If an EA determines an EIS is not needed, the EA becomes the document allowing agency compliance with NEPA requirements.
Environmental Impact Statement (EIS): EIS's were authorized by the National Environmental Policy Act (NEPA) of 1969. Prepared with public participation, they assist decision makers by providing information, analysis and an array of action alternatives, allowing managers to see the probable effects of decisions on the environment. Generally, EIS's are written for large-scale actions or geographical areas.
Equilibrium Moisture Content: Moisture content that a fuel particle will attain if exposed for an infinite period in an environment of specified constant temperature and humidity. When a fuel particle reaches equilibrium moisture content, net exchange of moisture between it and the environment is zero.
Escape Route: A preplanned and understood route firefighters take to move to a safety zone or other low-risk area, such as an already burned area, previously constructed safety area, a meadow that won't burn, natural rocky area that is large enough to take refuge without being burned. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).
Escaped Fire: A fire which has exceeded or is expected to exceed initial attack capabilities or prescription.
Extended Attack Incident: A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander.

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

F

Faller: A person who fells trees. Also called a sawyer or cutter.
Field Observer: Person responsible to the Situation Unit Leader for collecting and reporting information about an incident obtained from personal observations and interviews.
Fine (Light) Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.
See also **flash fuels.**
Fingers of a Fire: The long narrow extensions of a fire projecting from the main body.
Fire Behavior: The manner in which a fire reacts to the influences of fuel, weather and topography.
Fire Behavior Forecast: Prediction of probable fire behavior, usually prepared by a Fire Behavior Officer, in support of fire suppression or prescribed burning operations.
Fire Behavior Specialist: A person responsible to the Planning Section Chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather and topography.
Fire Break: A natural or constructed barrier used to stop or check fires that may occur, or to provide a control line from which to work.
Fire Cache: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.
Fire Crew: An organized group of firefighters under the leadership of a crew leader or other designated official.
Fire Cycle:
1. A fire-return interval calculated using a negative exponential (or Weibull) distribution, applied using current age-class structure on the landcape.
2. Length of time required to burn an area equal in size to a specified area.
Fire Event: A single fire or series of fires within an area at a particular time.
Fire Extent: The area burned per time period or event.
Fire-Free Interval: Time between two successive fire events at a given site or an area of a specified size.
Fire Frequency: The return interval or recurrence interval of fire in a given area over a specific time.
Fire Front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.
Fire Intensity: A general term relating to the heat energy released by a fire.
Fireline: A linear fire barrier that is scraped or dug to mineral soil.
Fire Load: The number and size of fires historically experienced on a specified unit over a specified period (usually one day) at a specified index of fire danger.

Fire Management Plan (FMP): A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.
Fire Names: The normal procedure or protocol is that a fire is named by the Incident Commander. The name is usually taken from some local geological feature.
Fire Predictability: A measure of variation in fire frequency expressed as a range, standard deviation or standard error.
Fire Perimeter: The entire outer edge or boundary of a fire.
Fire Predictability: A measure of variation in fire frequency expressed as a range, standard deviation or standard error.
Fire Regime: The combination of fire frequency, predictability, intensity, seasonality and size characteristics of fire in a particular ecosystem.
Fire-Return Interval: The number of years between two successive fire events at a specific site or an area of a specified size.
Fire Rotation: The length of time necessary to burn an area the size of a specific area (for example a watershed).
Fire Season:
1. Period(s) of the year during which wildland fires are likely to occur, spread and affect resource values sufficient to warrant organized fire management activities.
2. A legally enacted time during which burning activities are regulated by state or local authority.
Fire Severity: The effect of fire on plants. It is dependant on intensity and residence of the burn. An intense fire may not necessarily be severe. For trees, severity is often measured as percentage of basal area removed.
Fire Shelter: An aluminized tent offering protection by means of reflecting radiant heat and providing a volume of breathable air in a fire entrapment situation. Fire shelters should only be used in life-threatening situations as a last resort.
Fire Shelter Deployment: The removing of a fire shelter from its case and using it as protection against fire.
Fire Storm: Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirls.
Fire Triangle: Instructional aid in which the sides of a triangle are used to represent the three factors (oxygen, heat, fuel) necessary for combustion and flame production; removal of any of the three factors causes flame production to cease.
Fire Use Module (Prescribed Fire Module): A team of skilled and mobile personnel dedicated primarily to prescribed fire management. These are national and interagency resources, available throughout the prescribed fire season, that can ignite, hold and monitor prescribed fires.
Fire Weather: Weather conditions that influence fire ignition, behavior and suppression.
Fire Weather Watch: A term used by fire weather forecasters to notify using agencies, usually 24 to 72 hours ahead of the event, that current and developing meteorological conditions may evolve into dangerous fire weather.
Fire Whirl: Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris and flame. Fire whirls range in size from less than one foot to more than 500 feet in diameter. Large fire whirls have the intensity of a small tornado.

Firefighting Resources: All people and major items of equipment that can or potentially could be assigned to fires.
Fireline Intensity: The rate of heat release along a unit length of fireline, measured in kW m-1.
Flame Height: The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.
Flame Length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.
Flaming Front: The zone of a moving fire where the combustion is primarily flaming. Behind this flaming zone combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front. Also called fire front.
Flanks of a Fire: The parts of a fire's perimeter that are roughly parallel to the main direction of spread.
Flanking Fire: Fire that is moving perpendicular to the wind.
See also **Heading** and **Backing Fire.**
Flare-up: Any sudden acceleration of fire spread or intensification of a fire. Unlike a blow-up, a flare-up lasts a relatively short time and does not radically change control plans.
See also **Blow-up**.
Flash Fuels: Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, that ignite readily and are consumed rapidly when dry.
See also **Fine Fuels.**
Foam: Water in which a surfactant has been added at the pump. Foam insulates fuels against heat, increases the penetration of water into fuels and decreases evaporation.
Foehn Wind: A dry wind associated with windflow down the lee side of a plateau or mountain range and with adiabatic warming. Also called Santa Ana (southern California), Mono or North Wind (north and central California), East Wind (western Washington and Oregon) or Chinooks (east side of Rockies).
Forb: A plant with a soft, rather than permanent woody stem, that is not a grass or grass-like plant.
Fuel: Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs and trees, that feed a fire.
See also **Surface Fuels.**
Fuel Bed: An array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.
Fuel Loading: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.
Fuel Model: Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.
Fuel Moisture (Fuel Moisture Content): The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees Fahrenheit.
Fuel Reduction: Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.
Fuel Type: An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

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

G

General Staff: The group of incident management personnel reporting to the incident commander. They may each have a deputy, as needed. Staff consists of operations section chief, planning section chief, logistics section chief and finance/administration section chief.
Geographic Area: A political boundary designated by the wildland fire protection agencies, where these agencies work together in the coordination and effective utilization of fire management resources.
Ground Fire (or surface fire): Fire burning on the ground or through the understory and not reaching into the canopy.
Ground Fuel: All combustible materials below the surface litter, including duff, tree or shrub roots, punchy wood, peat and sawdust, that normally support a glowing combustion without flame.

H

Haines Index: An atmospheric index used to indicate the potential for wildland fire growth by measuring the stability and dryness of the air over a fire.
Hand Line: A fireline built with hand tools.
Hazard Reduction: Any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.
Head of a Fire: The side of the fire having the fastest rate of spread.
Heading Fire: Fire that is moving with the wind.
See also **Backing** and **Flanking Fire.**
Heavy Fuels: Fuels of large diameter such as snags, logs and large limb wood, that ignite and are consumed more slowly than flash fuels.
Helibase: The main location within the general incident area for parking, fueling, maintaining and loading helicopters. The helibase is usually located at or near the incident base.
Helispot: A temporary landing spot for helicopters.
Helitack: The use of helicopters to transport crews, equipment and fire retardants or suppressants to the fire line during the initial stages of a fire.
Helitack Crew: A group of firefighters trained in the technical and logistical use of helicopters for fire suppression.
Holding Actions: Planned actions required to achieve wildland fire use or prescribed fire management objectives. These actions have specific implementation timeframes for fire use actions but can have less sensitive implementation demands for suppression actions. Also, the name of a musical group made up of NPS Fire employees.
Holding Resources: Firefighting personnel and equipment assigned to do all required fire suppression work following fireline construction but generally not including extensive mop-up.
Hose Lay: Arrangement of connected lengths of fire hose and accessories on the ground, beginning at the first pumping unit and ending at the point of water delivery.
Hotshot Crew: A highly trained fire crew used mainly to build fireline by hand.
Hotspot: A particular active part of a fire.
Hotspotting: Reducing or stopping the spread of fire at points of particularly rapid rate of spread or special threat, generally the first step in prompt control, with emphasis on first priorities.

I

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

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

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

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

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

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

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

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

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

Inversion: Under high pressure and stable air conditions, warm air may cap cooler air, forming an inversion that traps smoke in valley bottoms, particularly at night.

J

Jackpot: A pocket of heavy fuels (e.g., downed logs) that may flare up in an area where the fuel load is otherwise low.

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

Jump Spot: Selected landing area for smokejumpers.

Jump Suit: Approved protection suit work by smokejumpers.

K

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

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

L

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

Large Fire:

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

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

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

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

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

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

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

Lost Ignition: A natural ignition that was suppressed. Some agencies may re-ignite a lost ignition at a more convenient, later date to salvage a natural process.

Lookout: A member of a fire crew whose job is to monitor local weather conditions and to identify and report potential dangers resulting from a change in fire behavior or weather. A lookout may also refer to a fire watch tower or to the employees stationed there whose job is to detect fire starts.

M

Mass Transfer: As used in the fire literature, the movement of heat by burning firebrands.

Master Fire Chronology: A chronology of all documented fire dates in a designated area determined by crossdating.

Mean Fire-Return Interval: (or mean fire-free interval, or mean fire interval) Arithmetic average of all fire-return intervals for a specific site for a specific interval of time.

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

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

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

Modular Airborne Firefighting System (MAFFS): A manufactured unit consisting of five interconnecting tanks, a control pallet and a nozzle pallet, with a capacity of 3,000 gallons,

designed to be rapidly mounted inside an unmodified C-130 (Hercules) cargo aircraft for use in dropping retardant on wildland fires.
Mop-up: To make a fire safe or reduce residual smoke after the fire has been controlled by extinguishing or removing burning material along or near the control line, felling snags or moving logs so they won't roll downhill.
Multi-Agency Coordination (MAC): A generalized term which describes the functions and activities of representatives of involved agencies and/or jurisdictions who come together to make decisions regarding the prioritizing of incidents, and the sharing and use of critical resources. The MAC organization is not a part of the onscene ICS and is not involved in developing incident strategy or tactics.
Mutual Aid Agreement: Written agreement between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel and equipment.

N
National Environmental Policy Act (NEPA): NEPA is the basic national law for protection of the environment, passed by Congress in 1969. It sets policy and procedures for environmental protection and authorizes Environmental Impact Statements and Environmental Assessments to be used as analytical tools to help federal managers make decisions.
National Fire Danger Rating System (NFDRS): A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.
National Wildfire Coordinating Group (NWCG): A group formed under the direction of the Secretaries of Agriculture and the Interior and comprised of representatives of the U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, National Park Service, U.S. Fish and Wildlife Service and Association of State Foresters. The group's purpose is to facilitate coordination and effectiveness of wildland fire activities and provide a forum to discuss, recommend action or resolve issues and problems of substantive nature. NWCG is the certifying body for all courses in the National Fire Curriculum.
Nomex ®: Trade name for a fire resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters.
See also **Aramid**.
Normal Fire Season:
1. A season when weather, fire danger and number and distribution of fires are about average.
2. Period of the year that normally comprises the fire season.

O
Operations Branch Director: Person under the direction of the operations section chief who is responsible for implementing that portion of the incident action plan appropriate to the branch.
Operational Period: The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational periods can be of various lengths, although usually not more than 24 hours.
Overhead: People assigned to supervisory positions, including incident commanders, command staff, general staff, directors, supervisors, and unit leaders.

P

Pack Test: Used to determine the aerobic capacity of fire suppression and support personnel and assign physical fitness scores. The test consists of walking a specified distance, with or without a weighted pack, in a predetermined period of time, with altitude corrections.
Paracargo: Anything dropped, or intended for dropping, from an aircraft by parachute, by other retarding devices or by free fall.
Peak Fire Season: That period of the fire season during which fires are expected to ignite most readily, to burn with greater than average intensity and to create damages at an unacceptable level.
Personnel Protective Equipment (PPE): All firefighting personnel must be equipped with proper equipment and clothing in order to mitigate the risk of injury from, or exposure to, hazardous conditions encountered while working. PPE includes, but is not limited to: 8-inch high-laced leather boots with lug soles, fire shelter, hard hat with chin strap, goggles, ear plugs, aramid shirts and trousers, leather gloves and individual first aid kits.
Preheating: An increase in the flammability of fuels due to exposure to heat and convective wind ahead of a fire.
Preparedness: Condition or degree of being ready to cope with a potential fire situation.
Prescribed Fire: Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.
Prescribed Fire Plan (Burn Plan): This document provides the prescribed fire burn boss information needed to implement an individual prescribed fire project.
Prescription: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social or legal considerations.
Prevention: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact and reduction of fuel hazards.
Project Fire: A fire of such size or complexity that a large organization and prolonged activity is required to suppress it.
Pulaski: A combination chopping and trenching tool, which combines a single-bitted axe-blade with a narrow adze-like trenching blade fitted to a straight handle. Useful for grubbing or trenching in duff and matted roots. Well-balanced for chopping.

R
Radiant Burn: A burn received from a radiant heat source.
Radiant Heat Flux: The amount of heat flowing through a given area in a given time, usually expressed as calories/square centimeter/ second.
Rappelling: Technique of landing specifically trained firefighters from hovering helicopters; involves sliding down ropes with the aid of friction-producing devices.
Rate of Spread: The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.
Reburn: The burning of an area that has been previously burned but that contains flammable fuel that ignites when burning conditions are more favorable; an area that has reburned.

Red Card: Fire qualification card issued to fire rated persons showing their training needs and their qualifications to fill specified fire management and support positions in large fire suppression or incident organization.
Red Flag Warning: Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern.
Rehabilitation: The activities necessary to repair damage or disturbance caused by wildland fires or the fire suppression activity.
Relative Humidity (Rh): The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.
Remote Automatic Weather Station (RAWS): An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is re-transmitted to an earth-receiving station for use in the National Fire Danger Rating System.
Resources: Personnel, equipment, services and supplies available, or potentially available, for assignment to incidents. The natural resources of an area, such as timber, crass, watershed values, recreation values and wildlife habitat.
Resource Management Plan (RMP): A document prepared by field office staff with public participation and approved by field office managers that provides general guidance and direction for land management activities at a field office. The RMP identifies the need for fire in a particular area and for a specific benefit.
Resource Order: An order placed for firefighting or support resources.
Retardant: A substance or chemical agent which reduced the flammability of combustibles.
Run (of a fire): The rapid advance of the head of a fire with a marked change in fireline intensity and rate of spread from that noted before and after the advance.
Running: A rapidly spreading surface fire with a well-defined head.

S
Safety Zone: An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuel breaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of a blowup in the vicinity.
Scratch Line: An unfinished preliminary fireline hastily established or built as an emergency measure to check the spread of fire.
Severity Funding: Funds provided to increase wildland fire suppression response capability necessitated by abnormal weather patterns, extended drought, or other events causing abnormal increase in the fire potential and / or danger.
Single Resource: An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.
Size-up: To evaluate a fire to determine a course of action for fire suppression.
Slash: Debris left after logging, pruning, thinning or brush cutting; includes logs, chips, bark, branches, stumps and broken understory trees or brush.
Sling Load: Any cargo carried beneath a helicopter and attached by a lead line and swivel.
Slop-over: A fire edge that crosses a control line or natural barrier intended to contain the fire.

Smokejumper: A firefighter who travels to fires by aircraft and parachute.
Smoke Management: Application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.
Smoldering Fire: A fire burning without flame and barely spreading.
Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.
Spot Fire: A fire ignited outside.
Spot Weather Forecast: A special forecast issued to fit the time, topography and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely and specific than zone forecasts.
Spotter: In smokejumping, the person responsible for selecting drop targets and supervising all aspects of dropping smokejumpers.
Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.
Staging Area: Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three-minute available basis. Staging areas are managed by the operations section.
Stand Replacement Fire: A fire of such intensity and severity that nearly all the trees in a stand are killed. Forests succeeding a stand replacing fire are generally composed of trees that quickly re-establish and are consequently evenly aged.
Strategy: The science and art of command as applied to the overall planning and conduct of an incident.
Structure Fire: Fire originating in and burning any part or all of any building, shelter or other structure.
Strike Team: Specified combinations of the same kind and type of resources, with common communications, and a leader.
Strike Team Leader: Person responsible to a division/group supervisor for performing tactical assignments given to the strike team.
Structure Fire: Fire originating in and burning any part or all of any building, shelter or other structure.
Suppressant: An agent, such as water or foam, used to extinguish the flaming and glowing phases of combustion when directly applied to burning fuels.
Suppression: All the work of extinguishing or containing a fire, beginning with its discovery.
Surface Fire: A fire burning along the surface without significant movement into the understory or overstory, with flame length usually below 1 m.
Surface Fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.
See also **Fuel**.
Swamper:
1. A worker who assists fallers and/or sawyers by clearing away brush, limbs and small trees. Carries fuel, oil and tools and watches for dangerous situations.
2. A worker on a dozer crew who pulls winch line, helps maintain equipment, etc., to speed suppression work on a fire.

T

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

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

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

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

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

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

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

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

U

Uncontrolled Fire: Any fire which threatens to destroy life, property or natural resources, and either is not burning within the confines of firebreaks, or is burning with such intensity that it cannot be readily distinguished with ordinary tools commonly available.

Underburn: A fire that consumes surface fuels but not trees or shrubs.

See also **Surface Fuels**

Understory Fire: A fire burning in the understory, more intense than a surface fire with flame lengths of 1-3 m.

V

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

Vegetation Type: A standardized description of the vegetation in which a fire is burning. The type is based on the dominant plant species and the age of the forest and indicates how moist a site may be and how much fuel is likely to be present.

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

W

Water Repellency: The resistance to soil wettability, which can be increased by intense fires.

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

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

Wet Line: A line of water, or water and chemical retardant, sprayed along the ground that serves as a temporary control line from which to ignite or stop a low intensity fire.
Wildland Fire: Any nonstructure fire, other than prescribed fire, that occurs in the wildland.
Wildland Fire Implementation Plan (WFIP): A progressively developed assessment and operational management plan that documents the analysis and selection of strategies and describes the appropriate management response for a wildland fire being managed for resource benefits.
Wildland Fire Situation Analysis (WFSA): A decision-making process that evaluates alternative suppression strategies against selected environmental, social, political and economic criteria. Provides a record of decisions.
Wildland Fire Use: The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outlined in Fire Management Plans.
Wildland Urban Interface: The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.
Wind Vectors: Wind directions used to calculate fire behavior.