WILDLAND FIRE MANAGEMENT PLAN

HAKALAU FOREST NATIONAL WILDLIFE REFUGE
KONA FOREST UNIT

2002

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WILDLAND FIRE MANAGEMENT PLAN
HAKALAU FOREST NWR
KONA FOREST UNIT

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EXECUTIVE SUMMARY

When approved, this document will become the Fire Management Plan for the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge (NWR). Major components include:

- updated policy for fire suppression at the Kona Forest Unit of Hakalau Forest NWR..
- compliance with objectives from the 1989 Strategy Statement (CCP scheduled for completion in 2 008).
- format changes under the direction of the Fire Management Handbook (Release Date 6/1/00).

This plan is written to provide guidelines for appropriate suppression activities at the Kona Forest Unit. Prescribed burning will, at this time, be limited to pile burns. However, more extensive prescribed burning may be used in the future to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research. Any prescribed burning not detailed in this Plan will require an amendment to the Plan and additional compliance requirements.

INTRODUCTION

This document will establish a Fire Management Plan for the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge. This plan will meet the requirements of the National Environmental Protection Act (NEPA), the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA). A Categorical Exclusion and associated Environmental Action Statement was completed for this FMP (Appendix E). Compliance with the Endangered Species Act was made through a "no effect" determination by the project leader.

This plan is written as an operational guide for managing the Unit's wildland fire program. It defines levels of protection needed to ensure safety, protect facilities and resources, and restore and perpetuate natural processes, given current understanding of the complex relationships in natural ecosystems. It is written to comply with a service-wide requirement that refuges with burnable vegetation develop a fire management plan (620 DM 1).

This plan will cover all wildland fires. Having an approved plan will mitigate safety and operational issues, and provide for effective and efficient actions. The Unit's primary fire concerns are the many resource values including numerous endangered species and habitat. Suppressing wildland fires will protect the thousands of acres of native rainforest habitat and ensure adjacent lands are not adversely affected. Prevention and suppression of fires will also protect fragile native ecosystems that have not evolved with fire.

All Kona Forest Unit firefighters are not dedicated as full time fire staff and have other primary duties. Staff numbers at the Unit vary between three to six and may be rated for arduous firefighting. These positions do not require fire fighting experience and most have not had any hands on fire experience. Fortunately, Hawaii Volcanoes National Park (HAVO) has a full time dedicated fire staff and is located three hours away by vehicle and thirty minutes by air. In addition, other cooperators within the Big Island Wildfire Coordinating Group are available to suppress wildland fires on the Unit (Cooperative Agreement with the Hawaii County Fire Department; Appendix D). Fire management oversight will be conducted by the Regional Office Fire staff in Portland, OR.

COMPLIANCE WITH USFWS POLICY

The fragile nature of the native Hawaiian vegetation and its associated fauna were a primary consideration in the establishment of the Kona Forest Unit of Hakalau Forest NWR in 1997. The Unit was established for the purpose of protecting and restoring endangered forest bird populations, mainly the Hawaiian crow (*Corvus hawaiiensis*), and their habitat.

Exotic species introductions, logging and ungulate grazing have led to significant declines of native plant and animal populations within the Hawaiian Islands. Grazing by domestic and feral ungulates and the introduction of invasive non-native flora and fauna have resulted in degradation of the native rainforest. Four major management strategies will be employed to protect and restore rainforest habitats at the Kona Forest Unit of Hakalau Forest NWR -- fire management, reforestation efforts, elimination or control of predator and feral ungulate populations, and nonnative plant control.

The Kona Forest Unit of Hakalau Forest NWR was established in 1997 under the authority of the Endangered Species Act to preserve and protect five species of endangered forest birds and their rainforest habitat (Figure 1). Although much of the Refuge is highly disturbed due to its history as a cattle ranch and koa logging area, it still contains relatively intact native rainforest including some of the last montane, mesic koa-` hi`a (*Acacia koa-Metrosideros polymorpha*) forests in the world. Forested portions of the Refuge contain some of the highest densities of native forest birds in the State of Hawai`i (Scott *et al.* 1986), as well as numerous rare and endangered plant species (Stone *et al.* 1987).

While most of the 5,300 acre Refuge is closed canopy forest, over one hundred years of cattle grazing, logging and human activity have converted about 1,800 acres of upper elevation forest into a semi-open woodland with the understory dominated by introduced grasses. In closed canopy sections of the Refuge, disturbance from cattle (*Bos taurus*), feral pigs (*Sus scrofa*), and rats (*Rattus rattus*) have reduced populations of native understory plants and pushed some plants to the brink of extinction.

At this time no Refuge Master Plan nor Comprehensive Conservation Plan exists for the Refuge. A Conceptual Management Plan for the Kona Forest Unit of Hakalau Forest National Wildlife Refuge was developed in 1997 (U.S. Fish and Wildlife Service 1997) that identifies the overall goal of the Refuge, a set of objectives supporting the goal of the refuge, and general strategies addressing each objective.

The Department Manual, DM 910 (USDI 1997) states the following regarding wildland fires:

> AWildfires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildfires within the Department will be classified either as wildfire or as prescribed fires.
>
> Wildfires, whether on lands administered by the Department or adjacent thereto, which threaten life, man-made structures, or are determined to be a threat to the natural resources or the facilities under the Department's jurisdiction, will be considered emergencies and their suppression given priority over normal Departmental programs.
>
> Bureaus will give the highest priority to preventing the disaster fire - the situation in which a wildfire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area. However, no wildfire situation, with the possible exception of

threat to human survival, requires the exposure of firefighters to life threatening situations. Within the framework of management objective and plans, overall wildfire damage will be held to the minimum possible giving full consideration to (1) an aggressive fire prevention program; (2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the Department among themselves or with other qualified suppression organizations.

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.

P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.

31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Protection Act of September 20, 1922 (42 Stat.857; 16 USC 594) authorizes the Secretary of Interior to protect from fire, lands under the jurisdiction of the Department directly or in cooperation with other federal agencies, states, or owners of timber.

The Economy Act of June 30, 1932 authorizes contracts for services with other federal agencies.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities. Authority for interagency agreements is found in AInteragency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture@ (1996).

The Disaster Relief Act of May 22, 1974 (88 Stat 143; 42 USC 5121) authorizes federal agencies to assist state and local governments during emergency or major disaster by direction of the President.

The National Wildlife Refuge System Administrative Act of 1966 as amended (80 Stat927; 16 USC 1601) defines the National Wildlife Refuge System as including wildlife refuges, areas for the protection and conservation of fish and wildlife which are threatened with extinction, wildlife ranges, game ranges, wildlife management areas and waterfowl production areas.

The Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat 1535; 15 USC 2201) provides for reimbursement to state or local fire services for costs of firefighting on federal property.

Wildfire Suppression Assistance Act of 1989 (Public Law 100-428, as amended by Pub L 101-11, April 7, 1989)

The Department Manual (Interior), Part 910 DM1, Wildland Fire Suppression Management (March 29, 1990) defines Department of Interior fire management policies.

FIRE MANAGEMENT OBJECTIVES

The overall objectives for fire management at the Kona Forest Unit are to promote a program to ensure firefighter and public safety, aimed at reducing human-caused fires, and to ensure appropriate suppression response capability to meet expected wildland fire complexity. Specific fire management objectives are:

- $ Promote a fire management program and control all wildland fires.
- $ Protect life, property, and resources from wildland fires while considering resource values at risk. The Kona Forest Unit of the Hakalau Forest NWR was established for the purpose of protecting and restoring endangered forest bird populations and their habitat.
- $ Use appropriate suppression tactics and strategies that minimize long-term impacts of suppression actions.
- $ Utilize pile burning to safely and efficiently remove debris from resource management activities and reduce hazardous fuels.

DESCRIPTION OF UNIT

The Kona Forest Unit is located approximately 20 miles south of Kailua-Kona on the western slope of Mauna Loa (Figure 1). The 5,300 acre unit is located in the Hookena and Kalahiki land divisions in the south Kona region of the Big Island of Hawaii. The Kona Forest Unit with the main unit comprise Hakalau Forest National Wildlife Refuge, the lone refuge under the Big Island National Wildlife Refuge Complex.

The Unit lies between the elevations of 2,000 and 6,000 feet (Figure 2) with a moderate slope between 10 and 20 percent covering a majority of the Unit, and slopes of less than 10 percent within the upper elevations (State of Hawaii 1992). The soils are comprised of a thin layer of organic humus overlying weathered basalt of relatively recent ‘a’a and pahoehoe lava flows (Soil Conservation Service 1973, Armstrong and Bier 1983), which creates extremely well-drained substrates. The vegetative communities vary from dry to mesic to wet, dependent upon elevation, rainfall, and historic volcanism. The lower portions of the Refuge (2,000- to 2,500-foot elevations) are dominated by a mixture of nonnative and native trees, shrubs, and grasses. The most common native tree in this lower elevation is ‘ohi’a. Common introduced species include guava (*Psidium guajava*), strawberry guava (*Psidium cattleianum*), Albizia spp., and christmasberry (*Schinus terebinthifolius*). Above the 2,500-foot elevation, nonnative flora are less prevalent, and the forest community is dominated by an overstory of ‘ohi’a and an understory of native trees, shrubs, and hapu’u tree ferns (*Cibotium* spp.). Between 4500- and 6,000-foot elevations, a diverse native forest community is prominent, and characterized by an canopy comprised of koa and ‘ohi’a trees, and an understory of native shrubs and hapu’u. Small openings carpeted with nonnative grasses occur in some of these upper elevations.

Lava tubes or caves on the Unit have been partially surveyed and support rare and unusual species of plants and animals adapted for life in subterranean ecosystems (Howarth unpubl. obs.). These microhabitats have been subjected to minimal disturbance due to being inaccessible to domestic and feral ungulates.

The terrain is rugged and four-wheel drive vehicle roads are limited to a few north-south and east-west accesses. In general, these roads have been maintained and well constructed to minimize erosion and facilitate drainage. There are few areas which become impassable following heavy rains.

CULTURAL RESOURCES

The Service has not conducted detailed archaeological surveys on the Unit. Preliminary inspection of records by the State Historic Preservation Office reveal no sites listed in the National Register of Historic Sites; therefore, to date, no permanent settlements are thought to occur within the Unit, nor are any features expected to be present. Site-specific surveys will be conducted prior to any land-altering activities on the Unit.

FISH AND WILDLIFE

Kona Forest Unit was established to protect and manage endangered forest bird populations and their habitat, and contribute to the survival and recovery of the endangered Hawaiian crow, ‘alala. This native forest supports some of the last remaining ‘alala in the wild. The Unit’s diverse assemblage of avifauna, is comprised of 31 bird species, including 12 endemic (of which five are endangered), one indigenous, and 18 introduced species. Other endangered bird species that occur on the Unit include Hawaii akepa (*Loxops coccineus coccineus*), Hawaii creeper (*Oreomystis mana*), ‘akiapola’au (*Hemignathus munroi*), and Hawaiian hawk or ‘io (*Buteo solitarius*) (Appendix L).

The Unit also contains populations of several species of native forest birds that are not endangered at the present time, but are considered to be in decline. These species include the Hawaiian owl or pueo (*Asio flammeus sandwichensis*), ‘elepaio (*Chasiempis sandwichensis*), ‘apapane (*Himatione sanguinea*), ‘amakihi (*Hemignathus virens*), and ‘i’iwi (*Vestiaria coccinea*; Scott *et al.* 1986, Pratt *et al.* 1987).

The endangered Hawaiian hoary bat or ‘ope’ape’a (*Lasiurus cinereus semotus*) also occurs on the Unit in addition to many other potential sensitive species (*e.g.*, invertebrates, plants) that may exist within lava-formed caves.

Figure 1: Vicinity Map of Hakalau Forest NWR and its Kona Forest Unit

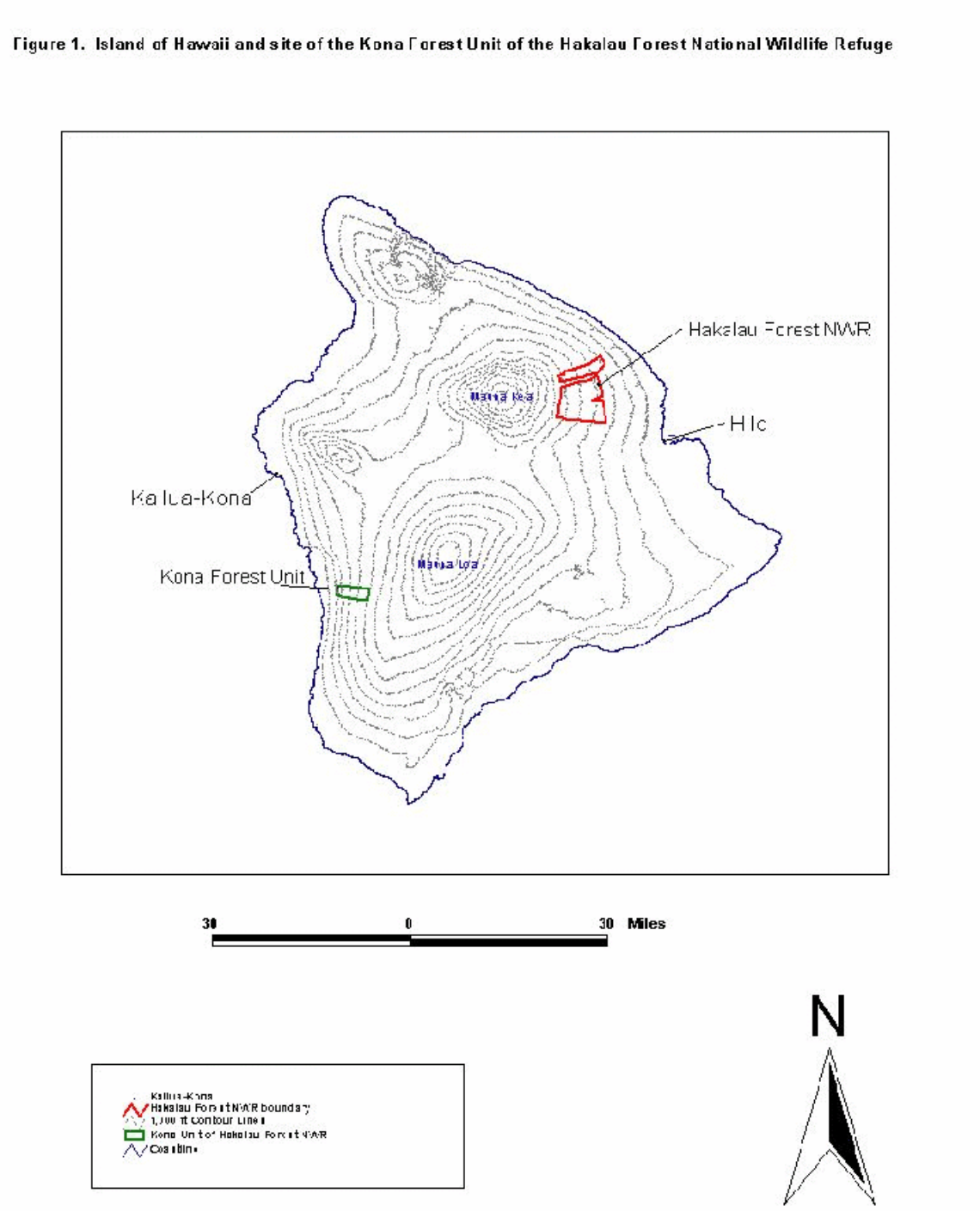
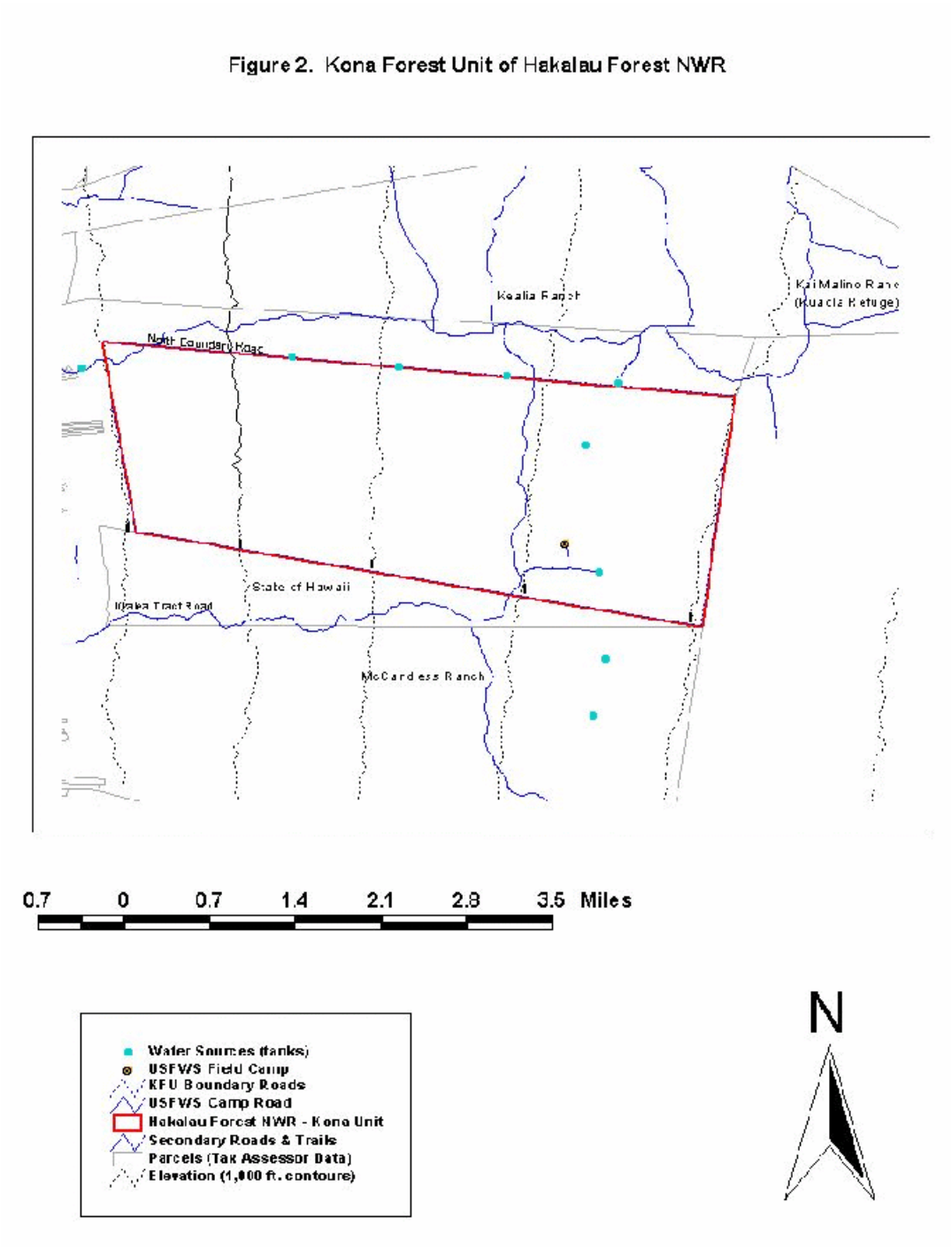


Figure 2: Unit Map of the Kona Forest Unit



VEGETATION

The vegetative communities vary from dry to mesic to wet, dependent upon elevation, rainfall, and historic volcanism. The lower portions of the Unit (2,000- to 2,500-foot elevations) are dominated by a mixture of nonnative and native trees, shrubs, and grasses. The most common native tree in this lower elevation is ‘ohi’a. Common introduced species include guava (*Psidium guajava*), strawberry guava (*Psidium cattleianum*), *Albizia* spp., and christmasberry (*Schinus terebinthifolius*). Above the 2,500-foot elevation, nonnative flora are less prevalent, and the forest community is dominated by an overstory of ‘ohi’a and an understory of native trees, shrubs, and hapu’u tree ferns (*Cibotium* spp.). Between 4500- and 6,000-foot elevations, a diverse native forest community is prominent, and characterized by a canopy comprised of koa and ‘ohi’a trees, and an understory of native shrubs and hapu’u. Small openings carpeted with nonnative grasses occur in some of these upper elevations (Figures 3 and 4).

PHYSICAL RESOURCES

The Unit lies between the elevations of 2,000 and 6,000 feet (Figure 2) with a moderate slope between 10 and 20 percent covering a majority of the Unit, and slopes of less than 10 percent within the upper elevations (State of Hawaii 1992). The soils are comprised of a thin layer of organic humus overlying weathered basalt of relatively recent ‘a’a and pahoehoe lava flows (Soil Conservation Service 1973, Armstrong and Bier 1983), which creates extremely well-drained substrates.

Lava tubes or caves on the Unit have been partially surveyed and support rare and unusual species of plants and animals adapted for life in subterranean ecosystems (Howarth unpub. obs.). These microhabitats have been subjected to minimal disturbance due to being inaccessible to domestic and feral ungulates.

STRUCTURES AND FACILITIES

Currently Kualoa Refuge (Kai Malino Ranch) owns and maintains a water system along the north boundary of the Unit with a series of 10,000- to 85,000-gallon tanks which interconnect at the 5200-foot elevation with two 10,000-gallon redwood tanks. These are the only permanent structures on the Unit.

Figure 3: Kona Forest Unit Vegetation Communities.

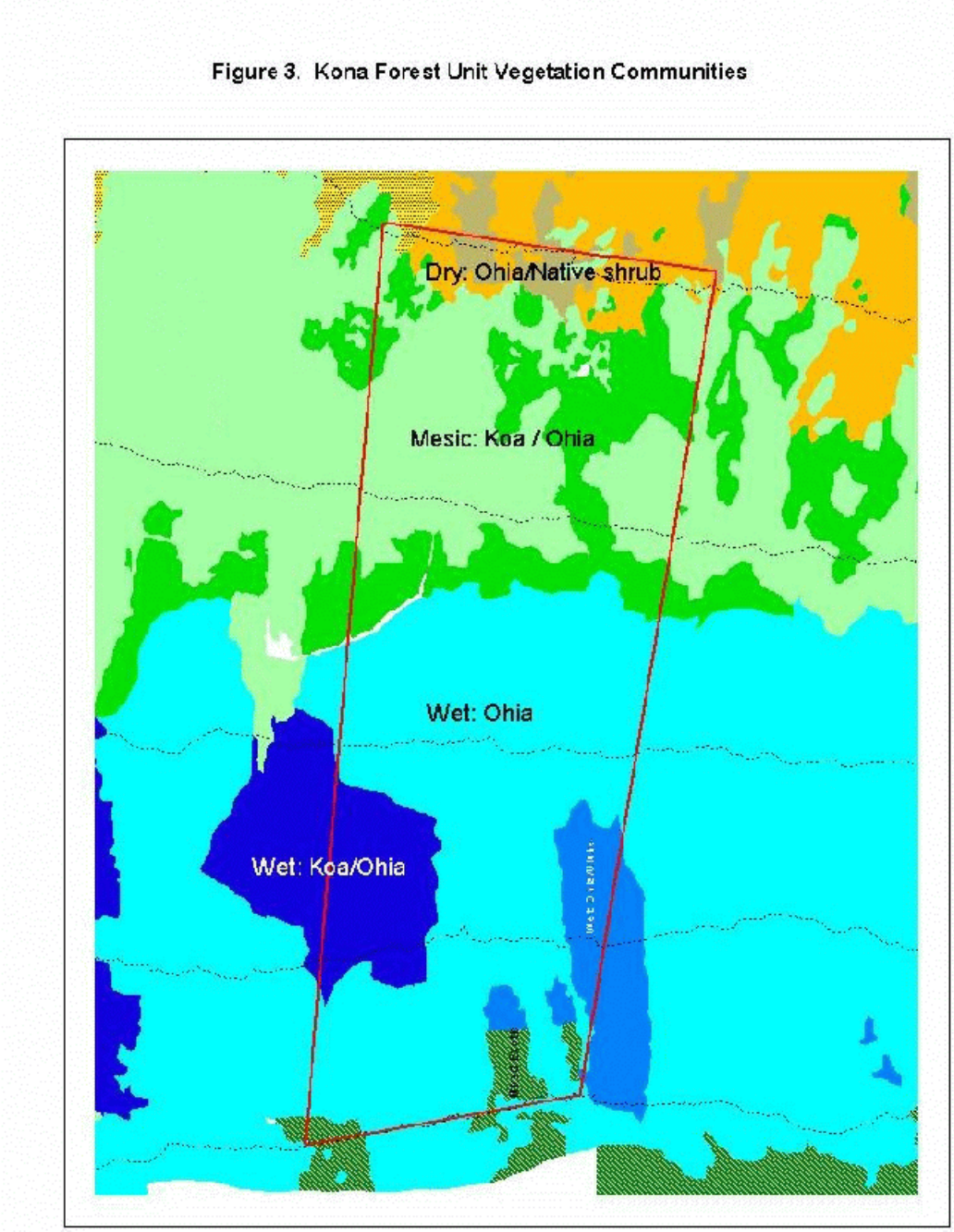
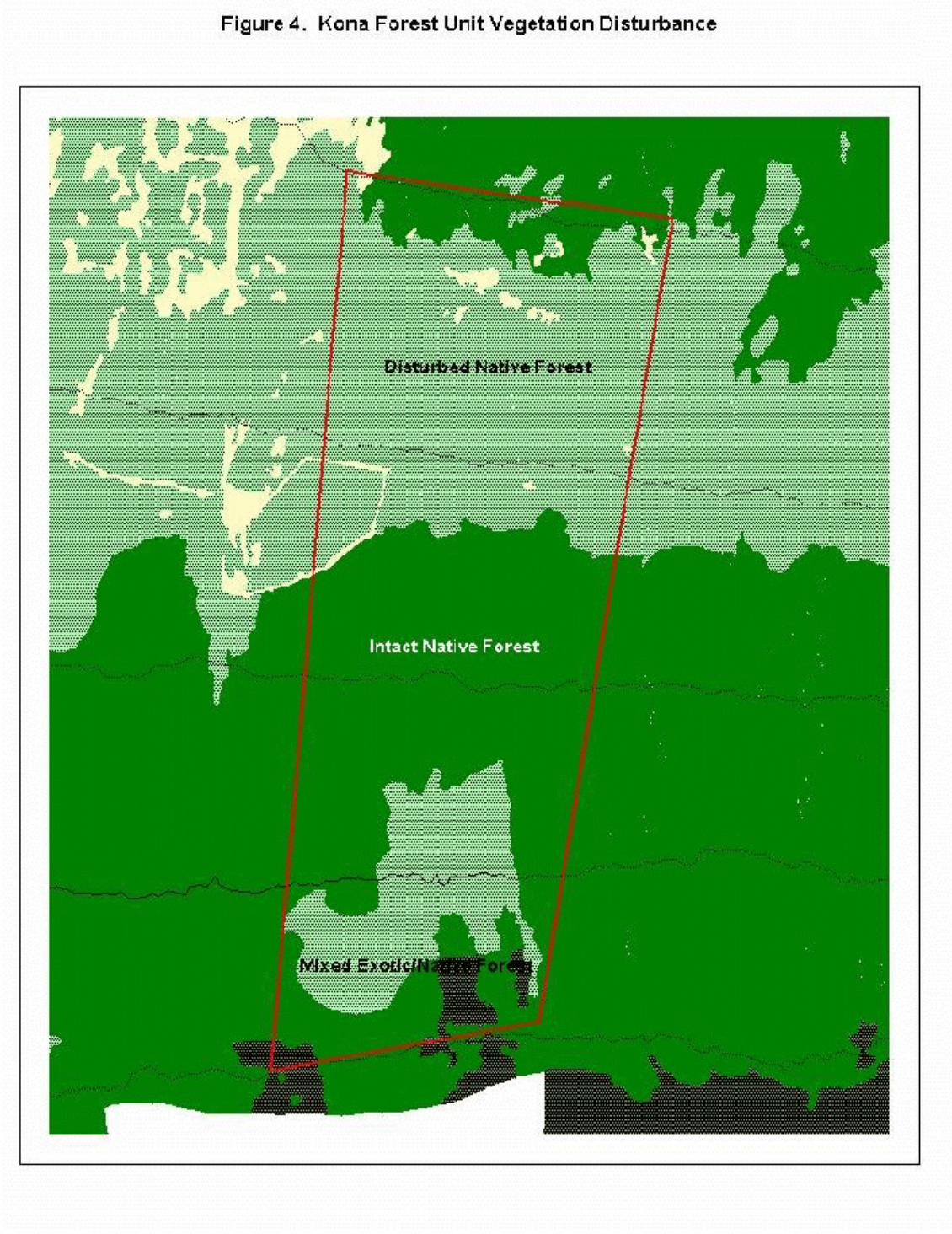


Figure 4: Kona Forest Unit Vegetation Disturbance.



WILDLAND FIRE MANAGEMENT SITUATION

HISTORIC ROLE OF FIRE

Fire appears to be a relatively infrequent, low intensity disturbance in native Hawaiian ecosystems, and was probably occasionally ignited by lava flows or lightning strikes (Mueller-Dombois and Lamoureux 1967; Mueller-Dombois 1981; Smith and Tunison 1992). Ecologists have concluded that natural fire has not played a significant ecological or evolutionary role in most native Hawaiian ecosystems.

Wildland fires are a serious threat, especially to the mesic forests that occur above the 5,000-foot elevation. After cattle were removed from the area, wildfires fueled by nonnative fountain grass decimated the dry forests north of Pu'uwaa'waa in 1960, 1969, 1995, and 1998 (Tomich 1971, Stephl 1995; pers. obs.). Landowners adjacent to the Unit are concerned about the increased potential for fire after the reduction in the number of domestic and feral ungulates for habitat management purposes. A cooperative effort with land managers in the area will be necessary to reduce and manage the fire risk and actively suppress fires.

No known fires have occurred on the Kona Forest Unit. In November 1997 to January 1998, a wildland fire occurred on Kealia Ranch, approximately three miles north of the Unit boundary. The cause of the fire is unknown; however, an intense lightning storm in the area two days prior to the fire indicates a possible natural ignition. The long-term underground smouldering nature of the fire impressed upon staff and adjacent landowners the potential for natural fires to occur and the difficulty in suppressing this type of fire. Approximately 20 acres were burned, primarily koa, mamane, and naio trees and nonnative kikuyu grass (*Pennisetum clandestinum*).

RESPONSIBILITIES

The Kona Forest Unit of Hakalau Forest NWR does not have a dedicated fire management staff. Fire management responsibilities fall under the direction of the **Regional Fire Management Officer**. Locally, this responsibility is coordinated through the Refuge **Maintenance Supervisor**. The Complex Manager is responsible for planning and implementing the fire management program on the Refuge. The Regional Fire Management Officer (FMO) located in Portland, OR is responsible for fire management program oversight. The Maintenance Supervisor is assigned fire management responsibilities as a collateral duty. Pre-suppression planning and work is accomplished by Refuge staff in accordance with national and regional fire management direction under guidance from the Regional FMO. Emergency fire management actions will be handled by Refuge staff according to training and incident qualifications. The Regional FMO will be immediately notified of all emergency actions. Additional information and direction is included in the Fire Dispatch Plan (Appendix C). Primary wildland fire management responsibilities are:

Complex Manager

- Is responsible for implementation of all fire management activities within the Big Island National Wildlife Refuge Complex and will ensure compliance with Department and Service policies.
- Selects the appropriate management responses to wildland fire.
- Approves any Prescribed Fire Burn Plan.

Deputy Complex Manger

- Coordinates Complex programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, presuppression projects, and fire effects monitoring.

- $ Ensures that the fire management program has access to Refuge and Complex resources when needed.
- $ Ensures that Refuge Managers and Complex staff consider the fire management program during refuge related planning and project implementation.
- $ Acts as the primary Refuge Resource Management Specialist during fire management planning and operations.

Kona Forest Unit Refuge Manager

- $ Is responsible for implementation of all fire management activities within the Complex Unit and will ensure compliance with Department and Service policies.
- $ Selects the appropriate management responses to wildland fire.
- $ Approves any Prescribed Fire Burn Plan for the Unit.

Wildlife Biologist

- $ Coordinates through Kona Forest Unit Refuge Manager to provide biological input for the fire program with the Maintenance Supervisor.
- $ Assists in design and implementation of fire effects monitoring.
- $ Participates, as requested, in presuppression projects, fire suppression, and rehabilitation according to level of training.

Regional Fire Management Officer (FMO)

- $ Responsible for all fire-related planning and implementation for the Complex.
- $ Coordinates fire related training.
- $ Coordinates with cooperators to ensure adequate resources are available for fire operational needs.
- $ Is responsible for implementation of this Plan.
- $ Submits budget requests and monitors FIREBASE funds.
- $ Maintains records for all personnel involved in suppression and presuppression activities, detailing the individual's qualifications and certifications for such activities.
- $ Updates all fire qualifications for entry into the Fire Management Information System.

Maintenance Supervisor

- $ Integrates biological Unit objectives into all fire management planning and implementation.
- $ Solicits program input from the RM and Biologist.
- $ Supervises presuppression project planning.
- $ Is responsible for preparation of fire reports following the suppression of wildland fires and for presuppression projects requiring such..
- $ Prepares an annual report detailing fire occurrences and presuppression activities undertaken in each calendar year. This report will serve as a post-year's fire management activities review, as well as provide documentation for development of a comprehensive fire history record for the Complex.
- $ Nominates personnel to receive fire-related training, as appropriate.
- $ The Maintenance Supervisor will respond to incidents on the Refuge to assist cooperators in the management of incidents on or threatening the Refuge.

Incident Commander

Incident Commanders (of any level) use strategies and tactics as directed by the Refuge Manager/ Project Leader and WFSA where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix H) will be provided to each Incident Commander prior to

assuming responsibility for an incident. Major duties of the Incident Commander are given in NWCG Fireline Handbook, including:

- $ Brief subordinates, direct their actions and provide work tools.
- $ Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- $ Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.
- $ Order resources to implement the management objectives for the fire.
- $ Inform appropriate dispatch of current situation and expected needs.
- $ Coordinate mobilization and demobilization with dispatch and the Collateral FMO.
- $ Perform administrative duties; *i.e.*, approving work hours, completing fire reports for command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.
- $ Assure aviation safety is maintained to the highest standards.

Initial attack teams

Initial attack teams may consist of a combination of experienced firefighters, those on their first fire, and well-qualified leadership. Teams will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

The Refuge consists of Hakalau Unit (the original refuge) and the Kona Forest Unit, and is the sole Refuge in the Big Island NWRC. Hakalau Forest NWR personnel are available to assist with fire management activities for the Kona Forest Unit. Their current suppression large equipment consists of a 200-gallon slip-on pumper unit mounted on a 4X4 vehicle and a D-4 bulldozer (with limited capability). Various other equipment, such as 4x4 vehicles, trash pump, hand-tools and a 400-gallon portable water trailer are located at Hakalau Forest NWR.

Currently, the Kona Forest Unit has a 4x4 type 6 light engine capable of delivering 300 gallons of water. It is capable of injecting foam and carries a small amount of hand tools and supplies. The Refuge is in the process of acquiring fire equipment for suppression capability, including a ten-person cache consisting of hand-tools, personal protective equipment, field packs, backpack pumps, chainsaws, trash pump, and first aid supplies. Various other equipment such as portable pumps, portable water trailer, and bulldozers will be funded in the future.

The Big Island NWRC personnel available for fire management assignments are listed in the Annual Dispatch Plan (See Appendix C). The dispatch plan includes name, position, qualifications and experience of suppression and prescribed fire personnel.

Employees participating in any wildland fire activities on U.S. Fish and Wildlife Service or cooperators lands will meet fitness requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

Exceptions to fitness requirements on initial attack activity are available from the Regional Fire Management Coordinator per guidelines in Chapter 1.5 of the Fire Management Handbook (USFWS 2000).

INTERAGENCY OPERATIONS

Cooperative agreements with various federal, state and local agencies generally provide that resources of each agency are available to assist in initial attack efforts. These agreements have detailed payment among cooperators, list of response areas, communications frequencies, and have been reviewed by a contract specialist and/or solicitor.

The Kona Forest Unit of Hakalau Forest NWR will use the Incident Command System (ICS) as a guide for fireline organization. Qualifications for individuals is per DOI Wildland Fire Qualifications and Certification System, part of NIIMS and the National Wildland Fire Coordination Group (NWCG) Prescribed Fire Qualification Guide. Depending on fire complexity, some positions may be filled by the same person.

The **Hawaii County Fire Department** has responsibility for preventing, controlling and extinguishing fires throughout the Island. The nearest Fire Station is located in Captain Cook, which is almost one and a half hours from the Unit, so considerable time is required for their response. They do however have a helicopter capable of responding within minutes to assess the situation and conduct bucket work. A cooperative agreement is in place and is updated every five years (Appendix D).

The **State Division of Forestry and Wildlife** (DOFAW) has responsibility for suppressing fires that occur on state lands that they manage. The Chief Forester has indicated a willingness to assist fire suppression efforts on the refuge as needed. State assistance is also available under the Mutual Aid Agreement between DOFAW and the Hawaii County Fire Department whereby DOFAW has agreed to assist the Fire Department with suppression and extinguishment of wildland fires occurring throughout the County.

Hawaii Volcanoes National Park (HAVO) has a full-time fire crew responsible for suppression and pre-suppression activities in the 230,000 acre park. They also assist other smaller National Park Units on the Big Island. Recent communications (Minassian 2001) indicate a willingness to respond to emergency suppression activities and as sister DOI agency requires no Memorandom Of Agreement to provide resources. HAVO is located in Volcano, almost three hours away from the Unit. A small initial attack crew, ferried by helicopter, could be on-scene in an hour.

Pohakuloa Training Area (PTA) also has a full time fire staff ready to respond to fires on the Refuge. Their chief responsibility is to protect structures and endangered species habitat at the military training area. They are located at mile marker 33 on Saddle Road, two hours away from the Unit.

In 2000, all of these agencies as well as the Hawaii County Civil Defense formed the **Big Island Wildfire Coordinating Group** (BIWCG). The purpose for this group is to coordinate the programs of the participating wildland fire agencies on the Big Island of Hawaii and provide a forum for leadership, cooperation, and the exchange of information. One of the products of this group was the creation of a Memorandum Of Understanding to acquire assistance during an emergency (Appendix F).

PROTECTION OF SENSITIVE RESOURCES

Heavy equipment use will be limited to protect rainforest habitat. The Complex Manager, Kona Forest Unit Manager or designee approval is required to use dozers, tractors, or other heavy equipment, except in cases where there are immediate threats to life or property.

Falling trees greater than eight feet tall should not be done to limit reduction of endangered species habitat. The Complex Manager, Kona Forest Unit Manager or designee approval is required to fall trees, except in cases where trees are burning or there are immediate threats to life or propoerty.

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and Incident Commanders to ensure that cultural resources are protected from fire and fire management activities. The "Request For Cultural Resource Compliance" form (Appendix G) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of 1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

- Minimum impact fire suppression tactics will be used to the fullest extent possible.
- Resource Advisors will inform fire suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
- Foam use will be limited in areas known to harbor surface artifacts.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified (*i.e.*, as soon as feasible).
- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.
- When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

WILDLAND FIRE ACTIVITIES

Fire program management describes the operational procedures necessary to implement fire management at the Kona Forest Unit of Hakalau Forest NWR. Program management includes fire prevention, preparedness, emergency preparedness, fire behavior predictions, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, and documentation.

Initial attack actions would be carried out by Hawaii County Fire Department or Refuge staff. Hawaii County personnel are able to respond with slip-ons within 3 hours. Their MD500D helicopter can be on scene in 20 minutes and begin immediate bucket work. Unit engine resources can respond immediately with a qualified Engine Operator as allowed by Service regulations. However, this applies only to incidents on Service lands. Beyond one burn period, a qualified Engine Boss is required even during mop-up. If a qualified Engine Boss is not available, one may be requested from HAVO. HAVO personnel can respond in thirty minutes by helicopter.

The fire season for the Unit is usually tied to short term dry weather events which can happen at any time of the year. Depending on the specific weather of any particular year the seasons may be shorter or longer, may start earlier or last longer, and there is a possibility that there may be more than one season. The recent acquisition of a remote automated weather station (RAWS), combined with historic weather data will facilitate the implementation of the National Fire Danger Rating System (NFDRS). Establishing baseline weather data will enable the Unit to identify periods of high fire danger and also to request severity funding. The recent elimination of cattle grazing on the Unit has increased fuel loadings of non-native grass species to present a wildland fire situation that has not previously existed. It is a concern that unplanned ignitions in this current grassland situation will cause severe mortality to existing and planted native vegetation.

FIRE MANAGEMENT STRATEGIES

All unplanned wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources using appropriate management strategies.

Although resource impacts of suppression alternatives must always be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter safety, public safety, and protection of the resources.

Critical protection areas, such as endangered species habitat and the limited Unit facilities will receive priority consideration in fire control planning efforts. In all cases, the primary concerns of fire suppression personnel shall be safety, and if needed, all individuals not involved in the suppression effort may be evacuated.

Suppression strategies should be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon the natural and cultural resources. Minimum impact suppression tactics (MIST) will be employed to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction will be conducted in such a way as to minimize long-term impacts to resources.

Heavy equipment such as crawlers, tractors, or dozers will not be used within the Unit boundaries unless their use is necessary to prevent a fire from destroying facilities or historic resources. The use of any heavy equipment requires approval from the Refuge Manager or Delegate in any forested area. Falling

trees greater than eight feet tall requires approval from the Project Leader, Refuge Manager or delegate.

Sites impacted by fire suppression activities or by a fire will be rehabilitated as necessary, based on an approved course of action for each incident.

PREPAREDNESS

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (initial attack, extended, and expanded), equipment inventory, personnel qualifications, and training. The preparedness objective is to have a well trained and equipped fire management organization to manage all fire situations within the Unit. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

Extended drought conditions monitored by weather readings will be used to implement a step-up plan. Burn indices will be used to warrant the level of preparedness, including shutting down the public access program. Should El Niño conditions set up, drought conditions may require severity or emergency preparedness authorization to hire additional personnel.

Hazardous fuel reduction is conducted to prevent wildland fires from spreading into endangered species habitat. Grasses will be periodically removed either mechanically or chemically in areas of high use by personnel and vehicles (*e.g*., temporary field camps, access routes). There are no permanent structures located within the Unit boundaries.

Historical weather analysis

The annual fire weather cycle on the Unit is not well understood. The collection of additional data will be necessary to evaluate weather condition trends. The only data available, to date, is from five weather stations (at 2,000- to 6,000-ft. elevations) located on neighboring private land, McCandless Ranch, south of the Unit (Appendix N ,Tables 4, 5, 6). These stations gather temperature, relative humidity, and rainfall data. There is a need to collect appropriate weather data for the next several years to establish historical patterns for potential NFDRS benefits. Three years of data is the minimum with which to establish historical patterns; however at least ten years of data is ideal.

The climate at the Kona Forest Unit is characterized by moderate temperatures and generally wet conditions. The Unit experiences differences in temperature due to elevation as well as diurnal/nocturnal fluctuations. Weather gauges established at five different elevations (2,000 to 6,000 feet) on McCandless Ranch have provided data from April 1995 through November 1997. Based on these data, the mean annual temperature ranges from 67.6EF (19.8EC) at 2,000' to 54.1EF (12.3EC) at 6,000'.

Rainfall is highly variable throughout the year and between years; the wettest months are generally March through September. Rainfall is also influenced by elevation. In 1996, monthly rainfall averaged 5.8 inches (147.6 mm) at 2,000' and 2.72 inches (69.1 mm) in the dryland forest at 6,000'. During that year the total annual rainfall ranged from 69.7 inches (1770.8 mm) at 2,000' to 32.7 inches (829.65 mm) at 6,000'.

Humidity is highest around 4,000' (85-95%) and distinctly lower at 6,000' (55%-88%). Typically, humidity is lowest during the mid-morning hours and highest during late afternoon and early evening.

Fire Prevention

An active fire prevention program may be conducted in conjunction with other agencies to protect human

life and property, and prevent damage to cultural or physical resources. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards.

The scarcity of unplanned ignitions at the Kona Forest Unit of Hakalau Forest NWR is due primarily to its normally damp conditions and remote location. Few visitors from the public receive access to the Unit. Refuge staff are warned of the possibility of wildland fire from Refuge activities under certain weather conditions.

During periods of extreme or prolonged fire danger, emergency restrictions regarding Refuge operations, or area closures may become necessary. Such restrictions, when imposed, will usually be consistent with those implemented by cooperators. The Refuge staff will recommend when such restrictions are necessary. Closures will be authorized by the Refuge Manager.

Staffing Priority Levels

This output of the National Fire Danger Rating System can assist in readiness decision making. Normally as fire danger increases, incremental preparedness actions are increased along with appropriate staffing. However, the Unit does not have full time fire staff so precautions would be in the area of preparing and positioning equipment. Otherwise, all preparedness actions outlined in section 3.1 of the Fire Management Handbook will guide the commitment of resources. The burning index (BI) is the basis to rank fire danger and reflects the difficulty in controlling a new fire start. Staffing levels 4 and 5 may require severity or emergency preparedness authorization to hire additional personnel. Communication with the Regional FMO will be maintained.

Training

Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildfire Coordinating Group (NWCG). The Kona Forest Unit of Hakalau Forest NWR will conform strictly to the requirements of the wildland fire management qualification and certification system and USFWS guidelines.

Basic wildland fire training refreshers are offered annually for red-carded firefighters and records kept in a centralized database. Additional training is available from cooperating agencies in pump and engine operation, power saws, firefighter safety, fire weather and fire behavior, helicopter safety and prescribed fire objectives and activities. On-the-job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The Maintenance Supervisor in conjunction with the Regional FMO will coordinate fire training needs with those of other refuges and cooperating agencies.

The Unit supports the development of individual Incident Command System (ICS) overhead personnel from among qualified and experienced Refuge staff for assignment to overhead teams at the local, regional, and national level.

Firefighters will not be given assignments if knowledge and skills are not first obtained. To utilize equipment such as a Type 6 light engine, one must obtain training and experience. An exemption has been requested from the Regional Fire Management Coordinator to allow an Engine Operator to manage an engine during suppression operations on the Unit (Appendix J).

Fire suppression is an arduous duty. On prescribed fires, personnel may be required to shift from

implementation/monitoring activities to suppression. Poor physical condition of crew members can endanger safety and lives during critical situations. Personnel performing fire management duties will maintain a high level of physical fitness. This requires successful completion of a fitness pack test. Personnel must complete a three mile hike with a 45 pound pack in less than 45 minutes to complete arduous duty qualification.

Supplies and Equipment
The Kona Forest Unit of Hakalau Forest NWR maintains a small fire cache at the Unit Office (Appendix M). Currently, Kona Forest Unit has a 4x4 Type 6 light engine capable of delivering 300 gallons of water. It is capable of injecting foam and carries a small amount of hand tools and supplies. The Refuge is in the process of acquiring fire equipment for suppression capability, including a ten-person cache consisting of hand tools, personal protective equipment, field packs, backpack pumps, chainsaws, trash pump, and first aid supplies. Various other equipment such as portable pumps, portable water trailer, and bulldozers will be funded in the future.

Additional equipment and supplies are available through cooperators and the local NPS cache. Options exist to request additional personnel and equipment through the Dispatch Plan which describes various cooperators (Appendix C). The contact list is also found in the Dispatch Plan.

DETECTION
Although 26 miles away from Kailua-Kona, the Unit is clearly visible from the city. Residents have often reported wildland fires on the adjacent Kealia Ranch to the County Fire Department. Flames and smoke are also visible to aircraft which pass along information to the Federal Aviation Administration (FAA).

The Captain Cook Fire Station which is 10 minutes away has jurisdiction for the Unit's district. They are aware of the Unit's existence and have copies of the Unit's Dispatch Plan.

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All wildland fires will be suppressed. However, detection shall include an estimation of fire cause. Moreover, human-caused fires may require an investigation and report by law enforcement personnel. For serious human-caused fires, including those involving loss of life, a qualified arson investigator will be requested.

COMMUNICATIONS
The Unit maintains a VHF radio system that includes a repeater and a dozen handheld radios. Each firefighter will be in radio communication. The slip-on unit and light engine from the Kona Forest Unit have mobiles as well. The Unit does not have a dispatcher who documents radio traffic. Dead spots exist throughout the Unit requiring in most instances the use of the repeater. Crews working in the same vicinity should have no problems using the simplex channel. The Unit utilizes several different makes of radios. The recent requirement to purchase digital capable equipment means that each radio is programmed differently. However, each radio has an individual legend of channel and frequency mounted on the unit to eliminate confusion. Communication is also facilitated by the use of cell phones which can be carried into the field. Frequencies and phone numbers are listed in the Dispatch Plan (Appendix C). Suppression efforts will be coordinated through the use of radios and cell phones, although radios will be primary form of communication on fire incidents.

Crews from HAVO have Unit frequencies already programmed in their radios. Responding crews from the County will be provided FWS radios when on Service lands to facilitate communication. The Refuge does not currently have permission to use County Fire Department tactical frequencies. Any additonal

resources requested will be provided with an appropriate number of radios. Formal agreements to share frequencies during emergency situations are being created through the Big Island Wildfire Coordinating Group (Appendix F).

PRE-ATTACK PLAN

Upon discovery of a fire, all subsequent actions will be based on the following:

1. The Incident Commander (IC) will locate, size-up, and coordinate suppression actions. The IC will complete
2. Provide for public safety.
3. Considering the current and predicted fire conditions, the Incident Commander will assess the need for add beginning of each burning period.
4. The Incident Commander will assess the need for law enforcement personnel for traffic control, investig
5. Document decisions and complete the fire report (DI-1202).
6. Should a wildland fire move into an extended attack a Delegation of Authority will be invoked. Once a

FIRE MANAGEMENT UNITS

Due to staff limitations, small land management parcels, long response times, valuable resources, and values at risk on neighboring lands, this plan does not recommend wildland fire managed for resource benefit as an option on the Unit. Wildland fires will be suppressed using the appropriate suppression response.

Fire Management Units (FMUs) are areas on a Refuge or Unit which have common wildland fire management objectives and strategies, are manageable units from a wildland fire standpoint, and can be delineated based on natural or manmade fuel breaks. The Kona Forest Unit will be managed as one fire unit within Hakalau Forest NWR. Although there are four distinct vegetation communities, the overall objective is to reforest the area with native vegetation. Native Hawaiian rainforest vegetation did not evolve with fire and is adversely affected by it. Maintenance of existing rainforest or recovering degraded rainforest units does not require the use of fire as a management tool. For this reason, suppression of all unplanned ignitions with control at minimum acreage will be employed over the entire Unit.

Endangered, Threatened, or Sensitive Species

The Kona Forest Unit of Hakalau Forest NWR is managed primarily for endangered forest bird populations and their habitat, contributing to the survival and recovery of the endangered Hawaiian crow (*Corvus hawaiiensis*), ‘alala (Appendix L). This native forest supports some of the last remaining ‘alala in the wild. The Unit’s diverse assemblage of avifauna is comprised of 31 bird species, including 12 endemic (of which five are endangered), one indigenous, and 18 introduced species. Other endangered bird species that occur on the Unit include Hawaii akepa (*Loxops coccineus coccineus*), Hawaii creeper (*Oreomystis mana*), ‘akiapola’au (*Hemignathus munroi*), and Hawaiian hawk or ‘io (*Buteo solitarius*).

The Unit also contains populations of several species of native forest birds that are not endangered at the present time, but are considered to be in decline. These species include the Hawaiian owl or pueo (*Asio flammeus sandwichensis*), ‘elepaio (*Chasiempis sandwichensis*), ‘apapane (*Himatione sanguinea*), ‘amakihi (*Hemignathus virens*), and ‘i’iwi (*Vestiaria coccinea*) (Scott *et al.* 1986,Pratt *et al.* 1987).

The endangered Hawaiian hoary bat or ‘ope’ape’a (*Lasiurus cinereus semotus*) also occurs on the Refuge. Many other potential sensitive species (*e.g.*, invertebrates, plants) may exist within lava-formed caves.

A diversity of native plant species occurs on the Unit, including ‘ie’ie (*Freycinetia arborea*), ‘olapa

(*Cheirodendron trigynum*), ‘oha kepau (*Clermontia* spp.), ‘oha (*Cyanea* spp.), mamaki (*Pipturus albidus*), pilo (*Coprosma* spp.), ‘akala (*Rubus hawaiiensis*), lama (*Diospyros* spp.), manono (*Gouldia terminalis*), sandalwood (*Santalum* spp.), and ho’awa (*Pittosporum hosmeri*) (USFWS 1997).

Fuel Types
The Unit will be managed as one fire management unit. Although there are distinct vegetation communities, the overall objective is to allow natural reforestation where possible and to actively reforest other areas. Native Hawaiian rainforest vegetation in the Kona Forest Unit did not evolve with fire and is adversely affected by it. Maintenance of existing rainforest or recovering rainforest units do not require fire. For this reason, suppression of all unplanned ignitions with control at minimum acreage will be employed over the entire Unit.

There are three major fuel types found on the Unit: intact rainforest, rainforest with little native understory, and open nonnative grassland. The National Fire Danger Rating System (U.S. Department of Agriculture, 1982) corresponds to the following Unit fuel types and models:

- Rainforest: Model 5, poor burning properties, 2500 acres or 47% of Unit
- Rainforest with little understory: Model 2, spread primarily in grass and litter, 2000 acres or 38% of Unit
- Open grassland: Model 3, rate of spread under the influence of wind, 800 acres or 15% of Unit.

Fire Behavior
The lack of fire knowledge because there have been no known fires on the Unit makes it difficult to describe normal and extreme fire years. Experience gained from prescribed burns at the Hakalau Unit of Hakalau Forest NWR indicates that under drought conditions fire behavior could be expected to range from a fast running fire with six to ten foot flame lengths in open grassland to a slow smoldering creeping fire in the intact rainforest. Fire behavior will vary depending upon recent weather events and current conditions. An established weather station installed on the Unit in March 2002 will monitor and provide data to correlate weather conditions (temperature, humidity, wind direction, and wind speed), identify drought conditions, and aid in determining high fire danger periods.

SUPPRESSION TACTICS
Wildland fires will be suppressed in a prompt, safe, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions from initial attack to final suppression. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the IC assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization.

There will be only one Incident Commander responsible to the Refuge Manager. The Incident Commander will designate all overhead positions on fires requiring extended attack. Reference should be made to a Delegation of Authority (Appendix H).

Since the objectives of fire management at the Kona Forest Unit are related to protection of life and property through suppression while protecting resources, an appropriate strategy will be utilized for each incident.

Suppression Conditions
A number of actions are taken after a fire is reported including calling appropriate Refuge staff and the County Fire Department dispatch to request initial attack forces. The Regional FMO is informed and updated regularly. Additional resources will be requested from Hawaii Volcanoes National Park. However, during periods of high to extreme fire danger, they may or may not respond, especially if they have crews fighting fires in the park or elsewhere. Any initial attack resources not meeting NWCG standards will be relieved after qualified resources arrive on scene. The County helicopter which will be carded by the Office of Aircraft Safety (OAS), however, can be requested to continue aerial operations. Depending on the size of the fire, additional OAS aircraft may be ordered.

As Refuge staff gather equipment and supplies, the Incident Commander will size up the fire using personal observations as well as reports from other personnel. Additional resources are identified and ordered in accordance with the Dispatch Plan (Appendix C).

Full suppression actions apply to this Unit, requiring aggressive containment and control of all wildland fires. Certain guidelines have been developed to assist with this strategy to protect the Unit from unnecessary damage. Heavy equipment and falling trees is restricted due to cultural, wildlife, and safety concerns. Unless life or property is in imminent danger, consultation with the Refuge Manager or designee prior to their use is necessary. This decision is based on the fact that the rainforest habitat is home to five endangered bird species, the endangered hoary bat, and five endangered plant species and on the cultural significance found in the potential historic sites and archeological features on the Unit. Issues of restrictions should be discussed with cooperators. Changes and areas of concerns should be documented.

Aircraft should avoid rainforest habitat as much as possible, especially during endangered forest bird breeding season which runs from December through May. Flights over the forest should be 500' above ground level if not actively suppressing a fire. Chainsaws are allowed without approval to fall trees less than eight feet tall or trees that are burning. Dozers require Complex Manager, Refuge Manager or designee approval except when life and/or property are threatened. Dozers will be restricted to the open pasture habitat and attempts should be made to stay on old dozer lines in degraded forest.

Wildland Fire Situation Analysis
For fires that cannot be contained in one burning period, a Wildland Fire Situation Analysis (WFSA) must be prepared. In the case of a wildland fire, the Incident Commander, in conjunction with the FMO, will prepare the WFSA. A sample WFSA can be found in Appendix K. Approval of the WFSA resides with the Complex Manager or Unit Refuge Manager. The purpose of the WFSA is to allow for a consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all Refuge staff and the IC. Notices should be posted to warn visitors that trails may be closed, traffic control will be necessary where smoke crosses roads, etc. Where wildland fires cross roads, the burned area adjacent to the road should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. Rehabilitation efforts will concentrate on the damages done by suppression activities rather than on the burned area itself.

Aircraft Operations
Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) approved. The Dispatch Plan (Appendix C) contains a list of current OAS vendors.

Efforts are being made to certify the County of Hawaii helicopter for use by Refuge personnel. All aircraft should avoid flying over rainforest habitat to the greatest extent possible, especially during the breeding season, to minimize impact to endangered bird species.

Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases for landing areas. Clearing for new helispots should be avoided whenever possible. Improved helispots will be rehabilitated following the fire.

As in all fire management activities, safety is a primary consideration. Qualified aviation personnel will be assigned to all flight operations.

REHABILITATION AND RESTORATION

There are two types of fire rehabilitation, suppression and burned area. Suppression rehabilitation restores and repairs property and resources from direct suppression activity damage (*i.e.*, cut fences, dozer lines, and campsites). Burned area rehabilitation and stabilization restores resources and property damaged or otherwise impacted from the fire (*i.e.*, burned waterlines, denuded hillsides).

In the event of a wildland fire, rehabilitation of fire suppression damage should be accomplished immediately. An appropriate time is within 7 days after the fire is controlled unless the Regional Fire Coordinator grants an extension. Funding for suppression rehabilitation is from the specific fire cost account as established by the FMO. The Incident Commander, as agreed to by the Complex Manager or Refuge Manager, will initiate suppression rehabilitation. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

- $ Backfill control lines, scarify, and seed*.
- $ Install water bars and construct drain dips on control lines to prevent erosion.
- $ Restore natural ground contours that were altered.
- $ Remove all flagging, equipment and litter.
- $ Completely restore camping areas and improved helispots.
- $ Revegetation to restore sensitive impacted areas due to suppression actions*.

*If revegetation or seeding is necessary, only locally procured seeds of native plant species will be used.

A written suppression rehabilitation plan may be appropriate on larger incidents. Contractors or equipment may be hired to accomplish specialized work.

If Burned Area Emergency Stabilization and Rehabilitation (BAER) is required to reduce the effects of a wildland fire, then the Unit should request appropriate funding through the BAER fund. The Service representative at the National Interagency Fire Center administers the BAER fund. A rehabilitation and restoration survey, plan, and request must be prepared and submitted according to agency guidelines. Smaller incidents may only need simple plans prepared by Refuge staff. Larger incidents with extensive rehabilitation efforts should employ a BAER Team. A BAER Team is composed of personnel who specialize in key disciplines of resource management and are experts in BAER Plan preparation. A formal request for a BAER Team should be made in consultation with the Incident Management Team as soon as it appears damage may be significant. Instructions for BAER Team mobilization can be found in the National Wildfire Coordinating Group mobilization guide. Delays in making a request may hinder

funding approval and magnify the damage. Once a BAER Team is employed, the Project Leader or a representative should provide guidance to the BAER team leader with expectations. The Project Leader, Biologist, and FMO will review all BAER Plans. The final plan will be submitted to the Region for review prior to submission to the Washington Office. Direction on BAER guidelines can be found in the Service Fire Management Handbook section 5.1.

REQUIRED REPORTING

The IC will be responsible for documenting decisions and completing the fire report (*e.g*., ICS-214, DI-1202). The FMO will be responsible for any additional required reports.

FIRE INVESTIGATION

Fire management personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the Incident Commander.

Prompt and efficient investigation of all suspicious fires will be carried out. However, fire management personnel should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel and services of other agencies may be utilized to investigate wildland fire arson or fire incidents involving structures. All fire investigations should follow the guidelines outlined in 4.1-2 of the Fire Management Handbook (2000). A fire investigator can be ordered through Hawaii County Fire Department.

HAZARD FUEL REDUCTION

Hazard fuel is that vegetation which presents a risk of ignition and sustaining spread of a wildland fire in relationship to a threat to some value. Hazard fuel reduction is both a fire prevention activity and a wildland fire protection measure. The objectives of this activity are:

- $ Reduce the hazard risk to Refuge structures and facilities from an approaching wildland fire.
- $ Reduce the risk of fire spreading to the wildland from a fire originating in a Refuge owned structure or facility.
- $ Provide defensible space and safety to personnel at those facilities during a wildland fire.
- $ Meet federal, state and local fire hazard reduction ordinances.

Hazard Fuel Reduction Strategies

Strategies include mechanical treatment of hazard fuels and debris disposal. Mechanical treatment is accomplished by hand cutting and mowing. Structures containing flammable liquids (propane, gasoline, or oil) require vegetation be removed to bare soil at a radius of 50 feet.

Debris must be disposed of to complete hazard mitigation. Debris disposal may be accomplished by scattering, chipping or pile burning. The quantity of vegetation, diameter size, crew availability, and logistical support will dictate the method used. If scattering of cut vegetation is used, an evaluation of the overall fuel loading needs to be considered so as to not add to the hazard fuel problem.

Pile Burning Guidelines

When planning to depose of debris by pile burning, specific guidelines must be followed in order to provide for safety and reduce escape potential. General guidelines for pile burning are the same as for prescribed burning . Service guidelines are found in the FWS Fire Management Handbook, Section 2.

This section of the Kona Forest Unit of Hakalau Forest NWR Fire Management Plan is for the purpose of outlining the steps to take when conducting pile burning only. No prescribed burning of standing vegetation will be conducted. References to a burn plan and burn boss are only for the purpose of pile burning.

Pile burning will be used to dispose of cut vegetation resulting from Unit activities such as annual hazard reduction around structures. At times trees may fall which will require debris removal. The most economical and expedient method is through burning of the piled vegetation on site. Pile burning is typically rated as complexity level 3 due to the low risk of escape, limited control forces, and time of year conducted. Safety concerns are still present even at the low complexity level. Careful consideration must be given to smoke management, escape potential and resource benefit when planning and rating the pile burn. The complexity of each pile burn will be evaluated using the NWCG Prescribed Fire Complexity Rating System Guide.

Pile Burn Plan

The Burn Boss will conduct a field reconnaissance of the proposed pile burn location with the Refuge Manager to discuss objectives, special concerns, and gather all necessary information to write the burn plan. After completing the reconnaissance, the Burn Boss will write the Pile Burn Plan.

All pile burning will have a Pile Burn Plan. The Pile Burn Plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The project area, objectives, and constraints will be clearly outlined. No piles will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed. Pile Burn Plans will follow the format found in the FWS Fire Management Handbook , Section 2.2. Pile burning is considered a complexity level 3 burn and should use the plan format contained in Appendix I. Each burn plan will be reviewed by the Complex Manager, Refuge Manager, Maintenance Supervisor, FMO, and Burn Boss. The Complex Manager or the Refuge Manager has the authority to approve the burn plan.

Pile Burning Strategies and Personnel

Pile burning will only be executed by qualified personnel. Pile burning requires, at a mininimum, a Type III Burn Boss. The Burn Boss will fill all required positions to conduct the burn with qualified personnel. All personnel listed in the burn plan must be available for the duration of the pile burn or it will not be initiated.

Weather and fuel moisture conditions must be monitored closely in the project area to determine when the prescription criteria are metor exceeded. A belt weather kit may also be utilized to augment monitoring.

The Pile Burn Plan requires the following items to be completed prior to ignition:

- contingency plan
- complexity analysis
- review and approval signatures
- go/no go checklist
- weather forecast

When pertinent prescription criteria are within the acceptable range, the Burn Boss will select an ignition date based on current and predicted weather forecasts. A thorough briefing will be given by the Burn Boss on the day of the burn and specific assignments and placement of personnel will be discussed. An updated spot weather forecast will be obtained on the day of ignition and all prescription elements will be

re-checked to determine if all elements are still within the approved ranges. If all prescription elements are met, a test fire will be ignited to determine on-site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the burn will be rescheduled. If conditions are satisfactory, the burn will continue as planned.

If the burn pile escapes the predetermined burn area, all further ignition will be halted except as needed for suppression efforts. Suppression efforts will be initiated as discussed in the pre-burn briefing. The FMO will be notified immediately of any control actions on a prescribed burn. If the burn exceeds the initial suppression efforts, the burn will be declared a wildland fire and suppressed using guidelines established in the burn plan. A WFSA will be completed and additional personnel and resources ordered as determined by the Incident Commander. If the fire continues to burn out of control, additional resources based on the contingency plan will be called from the local cooperating agencies via the servicing dispatch. A management overhead team may be requested to assume command of the fire if necessary. Each Pile Burn Plan will detail the contingency plan with identified resources for suppression. This plan will serve as the incident action plan during the initial attack phase of an escape.

Monitoring and Evaluation

During pile burns, monitoring can serve as a precursor to invoking suppression action by determining if the burn is in prescription, assessing its overall potential, and determining the effects of the pile burn. Pile burning does not usually require extensive monitoring. Weather, fire behavior, and smoke management are elements that require monitoring. The Burn Boss will assume responsibility for coordinating and implementing this section. Personnel may be assigned specific tasks such as weather monitoring to document these elements and keep the Burn Boss informed of conditions. Special situations or projects may dictate more extensive monitoring and evaluation.

Required Reports

All forms will be completed as outlined by the Pile Burn Plan. Accomplishments, costs, fire report (DI-1202), weather data, and first order fire effects monitoring are the responsibility of the Burn Boss. The Burn Boss may prepare a final report on the project for the Refuge Manager as requested. Information should include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, number of work hours, and final cost of the burn.

AIR QUALITY / SMOKE MANAGEMENT GUIDELINES

The Kona Forest Unit of Hakalau Forest NWR is in a rather remote location with the closest urban community approximately five miles west of the Unit (*e.g*., Hookena, Kealia). These locations may be impacted by smoke for a short period of time, but smoke is dispersed quickly through the action of the normal trade winds.

FIRE RESEARCH

Soon after the Hakalau Forest NWR Maulua fire in 2000, plots were set up to monitor recovery. No data have been collected yet. The Unit may participate in joint research projects outside the Unit to better understand local fuels and fire effects. At the moment, all research related activities are funded through base operations.

PUBLIC SAFETY

The Kona Forest Unit is dedicated to ensuring the safety of each visitor and to all residents and property adjacent to the Unit's boundary. However, firefighter and public safety take precedence over property and resource protection during any fire management activity. For public safety, the fire scene will remain clear of unauthorized people. The responsibility for managing public safety lies with the Incident Commander.

The slip-on unit, the Type 6 light engine, as well as other Unit vehicles responding to a fire have first aid kits of varying size. If medical emergencies arise, an evacuation plan will be implemented utilizing the services of the Hawaii County Fire/Rescue unit. Under most scenarios, the fire department will be kept appraised of all wildland fire.

PUBLIC INFORMATION AND EDUCATION

Educating the public of the importance of fire as an uncommon process in Hawaiian ecosystems is important to increasing public understanding and support for the fire management program. Although fires are occasionally started by lightning or lava (natural ignition sources), it did not play an evolutionary role in the ecosystem, and sometimes was probably even detrimental. The Unit will use the most appropriate and effective means to explain the overall fire and smoke management program. The Big Island Wildfire Coordinating Group will be instrumental in educating the public of fire effects on native ecosystems as well as wildland/urban interface issues. Other agencies such as the State Division of Forestry and Wildlife are very proactive on fire prevention. When deemed necessary, interpretive presentations will address the fire management program and explain the role of fire in the environment.

The public information program will be developed as follows:

1. The fire management program may be incorporated into visitor contacts. Particular attention will be given when fires are conspicuous from roads or visitor use areas.
2. News releases will be distributed to the media as appropriate.
3. The public information outlets of neighboring and cooperating agencies and the regional office will be provided with all fire management information.
4. The fire management program will be discussed in informal talks with all employees , volunteers, residents, and neighbors.

As outlined in the prevention section, emergency closures or restrictions may become necessary during periods of extreme or extended fire danger.

FIRE CRITIQUES AND ANNUAL PLAN REVIEW

FIRE CRITIQUES

Fire reviews will be documented and filed with the final fire report. The FMO will retain a copy for the Unit files.

ANNUAL FIRE SUMMARY REPORT

The Maintenance Supervisor will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

ANNUAL FIRE MANAGEMENT PLAN REVIEW

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan. The Fire Management Plan will also be updated as major policy changes and land acquisitions are made. Minor changes such as phone number corrections and personnel changes, can be made at the Unit level and attached to the plan during this yearly review process without involvement of the Regional Office staff.

CONSULTATION AND COORDINATION

The following agencies, organizations and/or individuals were consulted in preparing this plan:

Donna Ball, Wildlife Biologist, Big Island NWRC, Hilo, HI.

Roddy Baumann, Prescribed Fire Specialist, Region 1, USFWS, Portland, OR.

James P. Glynn, Deputy Complex Manager, Big Island NWRC, Hilo, HI.

John Jeffrey, Supervisory Wildlife Biologist, Big Island NWRC, Hilo, HI.

Glenn Klingler, Wildlife Biologist, Kona Forest Unit, Honaunau, HI.

Amanda McAdams, Fire Ecologist, Region 1, USFWS, Portland, OR.

Jack Minassian, Fire Management Officer, Hawaii Volcanoes National Park, HI.

James M. Roberts, Fire Planner, Region 1, USFWS, Portland, OR.

Linda Watters, Assistant Refuge Supervisor, Region 1, USFWS, Portland, OR.

APPENDICES

APPENDIX A. REFERENCES

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APPENDIX B: DEFINITIONS

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A - 3 acre or less.
Class B - more than 3 but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. 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 procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net

benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention. Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation. Actions to (1) limit the adverse effects of suppression on soils, watershed, or other values, or (2) mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire A wildland fire that threatens or involves structures.

DISPATCH PLAN

HAKALAU FOREST NATIONAL WILDLIFE REFUGE
KONA FOREST UNIT

When a report of smoke or fire on the Unit is received, get as much information from the caller or messenger as possible:

Location of smoke or fire?

Location of caller?

Name and telephone number or contact point of the caller or messenger?

Color of smoke?

Size of fire?

Type of fuel (What is burning)?

Character of the fire (Active, smoldering, etc.)?

Is anyone fighting the fire? How many personnel? Equipment?

Did they see anyone in the vicinity or vehicles leaving the area?

Is the fire site accessible by a vehicle (4X4)?

What are the weather conditions at the fire?

1. Notify the Refuge Manager, David Ledig at the Refuge Office in Honaunau (808-328-7366) or cellular number (808-960-0312), or at his residence (808-331-1879).

2. Notify Maintenance Supervisor Andy Kikuta at the Complex office in Hilo (808-933-6915) or at the Hakalau Forest NWR cabin (808-895-2055), or at his residence (808-959-2656 unl). **Assignments will be made at this time to notify other personnel and agencies.**

3. Notify other Refuge personnel at the Refuge office (808-328-7366) or at their residence via telephone or radio.

Jeff Burgett	808-960-0311 cellular
	808-329-0672 home
John Klavitter	808-960-0309 cellular
	808-331-1433 home

Portable radio frequency: 164.625 MHz

4. The Refuge Manager or Maintenance Supervisor will notify personnel at the Complex office in Hilo (808-933-6915), including the Refuge Complex Manager, Dick Wass (home 808-935-7027), and Deputy Refuge Manager, Jim Glynn (home 808-959-0196).

5. Notify Hawaii County Fire Department Dispatch (808-961-8336) to determine if they are aware of the situation.

1. Notify adjacent landowners:

		Kai Malino Ranch: Joe Sant
(Kuaola Refuge)	Bill Rosehill	wk 808-328-2389, hm 808-326-2108
McCandless Ranch:	Cynthia Salley	wk 808-328-8246 or home 808-328-9313
	Keith Unger	wk 808-328-8246 or home 808-334-1083 or pager 808-925-2600
Kealia Ranch:	Sara Moore	wk 808-328-8777 or home 808-328-8522
	Paul Kane	wk 808-328-2662 or pager 808-331-4253

2. If needed, contact Pohakuloa Fire Department (808-969-2441) for assistance. Recent communication with Zurn (September 2000) indicates a willingness to respond with a Type 6 light engine crew.

3. If needed, the Refuge Manager or Fire Management Officer will request assistance from Hawaii Volcanoes National Park (HAVO), Jack Minassian, FMO: 808-985-6042, or the Hawaii County Fire Department (911). This determination will be made by the Refuge Manager based on information given by the caller. The National Park is a sister DOI agency and will lend assistance during emergencies. Recent communication with Minassian (March 2000) confirms this willingness to respond.

4. The Refuge Manager/Maintenance Supervisor will call the Fire Department (808-961-8336) to update them of the situation and status, to determine if assistance is required.

5. If the fire is located in the upper portion of the Unit and therefore accessible by vehicle, the Refuge Manager/Maintenance Supervisor will dispatch qualified Refuge staff to mount an initial attack using the equipment stored in the fire cache at the Kona Forest Unit Office. Only current red-carded firefighters may be on the fire line. Non-carded staff may be utilized in support functions. The Refuge Manager/Maintenance Supervisor will make these determinations.

6. If needed the Refuge Manager/Maintenance Supervisor will charter an OAS certified helicopter to conduct a reconnaissance flight. All air operations will be conducted under DOI policies.

OAS Carded Helicopters (as of October 2001):

Volcano Heli-Tours, Big Island	808-961-3355 bus 808-935-4588 hangar 808-925-3333 pager 808-959-2674 res (unl)	David Okita
Safari Aviation	808-246-0670	Paul Daryl Daniel Malavenda Joseph Rice
Blue Hawaiian Helicopters	808-871-8844	Jeffrey Anderson Ralph Dwyer Michael Montgomery
Tropical Helicopters	808-325-5943	Calvin Dorn
Cherry Helicopters, Inc.	808-293-2570	Joseph Allen Gregory Mattson
Windward Aviation, Maui	808-877-3368 bus 808-572-3639 res	Don Shearer Richard Baldwin Steven Madewell Torbjorn Corell
Inter-Island Helicopters, Kauai	808-335-5009 bus	Ken D'Attilio Edward Wagner Perry Kriniti
Pacific Helicopter Tours, Maui	808-871-9771	Howard Esterbrook Eric Pacheco Gary Freeman Uli Bergmann

7. The Refuge maintains a six person cache at the Refuge office consisting of hand tools, personal protective equipment, field packs, fedcos, chain saws, class A foam, and first aid supplies. Other firefighting resources include a 300 gallon light engine, trash pump, and 1000 gallon folding tank. Hakalau Unit resources include a 200 gallon slip-on unit which can respond in four hours.

Fire Management Team

Name	Position	Qualifications	Experience	Red Card	Date of Last Pack Test
Kona Forest Unit:					
David Ledig	Refuge Manager	S130,190,110	Rx, Wildfire	Yes	9/6/00
Jeff Burgett	Wildlife Biologist	S130,190		Yes	2/24/00
John Klavitter	Wildlife Biologist	S130,190		Yes	9/6/00
Hakalau Forest NWR:					
Dick Wass	Refuge Manager	S130,190,390	Rx	Yes	9/6/00
Jim Glynn	Deputy Refuge Manager	S110,130,190,390, Fire Ecology,I220	Rx, Wildfire	No(Field)	9/6/00
Jack Jeffrey	Biologist	S130,190	Rx	Yes	9/6/00
Donna Ball	Biologist	S130,190	Rx	No	
Baron Horiuchi	Horticulturist	S130,190		No	
Andy Kikuta	Maintenance Supervisor	S130,190,390,211, S212,336,PFPI,RxB3	Rx, Wildfire	Yes	9/6/00
Wayne Ortiz	Maintenance Worker(Leader)	S130,190	Rx, Wildfire	Yes	9/6/00
Steven Heusser	Maintenance Worker	S130,190	Wildfire	Yes	9/6/00

13. Other personnel to be involved if necessary:

Jerry Leinecke, Complex Leader, Hawaii/Pacific Islands
NWR Complex Office: (808) 541-1201 Residence: (808) 395-6227
Jon Giffin, State Division of Forestry & Wildlife: (808) 974-4221

Andy Anderson, Regional Fire Management Officer, Pacific Islands
(503) 231-6175 business, or (360) 666-5031 residence,(503) 805-1312(cell)

Interagency Coordination Center, South Zone, Riverside, CA (714) 276-6721

Keith Unger, Manager, McCandless Ranch, Honaunau. Office: (808) 328-8246;
Residence: (808) 334-1083; Pager (808) 925-2600; Cellular (808) 936-1654.

Joe Santimer, Manager, Kai Malino Ranch (Kualoa Refuge), Captain Cook, HI. Office: (808) 328-2389; Cellular phone: (808) 936-4196.

Paul Kane, Manager, Kealia Ranch, Captain Cook, HI. Office: (808) 328-8777;
Pager: (808) 331-4253; Residence: (808) 328-9228.
Sara Moore, Manager, Kealia Ranch, Captain Cook, HI. Office: (808) 328-8777; Residence: (808) 328-8522.

Peter Simmons, Land Manager, B.P. Bishop Estate, Hilo, HI: (808)7 76-1104

Walter K. Dehmer, Kealakekua Development Corporation, Captain Cook, HI. Office: (808) 328-1188.

Paul Ducasse, Chief Ranger, Hawaii Volcanoes National Park: (808) 985-6003

Tim Tunison, Chief Resources Management, Hawaii Volcanoes National Park: (808) 985-6085

Fire Cache, Hawaii Volcanoes National Park: (808) 985-6044

Ken Zurn, Fire Chief, Pohakuloa Training Area: (808) 969-2441, (808) 961-9190 res.

Warren Hahlbeck, Firefighter, Pohakuloa Training Area: (808) 969-2441

Donna Stovall, Refuge Manager, Oahu Refuges: (808) 637-6330, (808) 625-8685

George Fisher, Dozer Operator, Oahu Refuges: (808) 637-6330, (808) 637-6422 res.

Pam Ensley, Fire Management Coordinator, Region 1: (503) 231-6174(bus), (360) 835-7004(res), (503) 781-7978(cell)

Roddy Baumann, Prescribed Fire Specialist, Region 1: (503) 231-2075(bus), (360) 573-9444(res), (503) 784-8348(cell).

COOPERATIVE AGREEMENT

Between the

HAKALAU FOREST NATIONAL WILDLIFE REFUGE
US FISH AND WILDLIFE SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

and the

HAWAII COUNTY FIRE DEPARTMENT

THIS COOPERATIVE AGREEMENT is made and entered into between the U.S. Fish and Wildlife Service, an executive agency of the United States Department of the Interior, hereinafter referred to as the "Service" and the Hawaii County Fire Department hereinafter referred to as the "Cooperator", pursuant to 31 USC 6305, Using Cooperative Agreements.

The Fish and Wildlife Service enters this Cooperative Agreement in accordance with the Fire Protection Act of September 20, 1922 pursuant to 42 Stat. 857 and 16 USC 594 and in accordance with the Reciprocal Fire Protection Act of May 27, 1955 pursuant to 69 Stat. 66, 67 and 42 USC 1856, 1856a, and b. The Cooperator enters this Agreement pursuant to the authority provided by the regulations governing the Hawaii County Fire Department.

PURPOSE AND OBJECTIVES

The Cooperative Agreement is made for the purpose and objective of providing funds for supporting firefighting services provided by the Hawaii County Fire Department on lands within the boundaries of Hakalau Forest National Wildlife Refuge and to provide a public benefit through U.S. Fish and Wildlife Service support and assistance.

RECITALS

WHEREAS, the U.S. Fish and Wildlife Service is an agency of the Federal Government primarily responsible for the welfare and protection of lands and wildlife within the boundaries of the Hakalau Forest National Wildlife Refuge and:

WHEREAS, it is the desire of the Service to provide maximum protection to the Refuge, its lands, wildlife, personnel and facilities from fire and:

WHEREAS, it is the desire of the Cooperator to provide protection for its lands, citizens and buildings within Hawaii County from fire and:

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual" on fire management is "...to protect and enhance habitat for fish and wildlife production and diversity and to protect and enhance natural ecosystems on these (refuge) lands."

DEFINITIONS

1. Refuge Lands: Lands administered and/or protected by the Hakalau Forest National Wildlife Refuge/U.S. Fish and Wildlife Service; these lands constitute the Refuge's jurisdictional area.

2. Fire District: Lands protected by the Hawaii County Fire Department; these lands constitute the Cooperator's jurisdictional area.

3. Wildland Fire: An unplanned ignition that requires suppression action.

4. Boundary Fire: A fire burning astride a boundary between lands protected by two or more agencies or, due to conditions on the ground in the fire area, believed to be burning astride a boundary.

5. Protecting Agency: The party with responsibility for suppression of wildland fires within their jurisdictional area.

6. Supporting Agency: The party without responsibility for suppression of wildland fires on a particular property that is furnishing support and assistance to the protecting agency.

AGREEMENT

IT IS HEREBY AGREED as follows:

I. COOPERATIVE PROJECT

The cooperative project to be accomplished under this Agreement is the suppression of wildland fires on Service lands, *i.e.* Hakalau Forest National Wildlife Refuge.

II. TERM OF AGREEMENT

This Agreement shall become effective upon being executed by both parties and shall continue in effect until September 30,1997. It shall be considered as automatically extended for one (1) year each October 1 thereafter, until September 30, 2002. Rates will be negotiated and signed by amendment 60 days prior to fiscal year end for the following fiscal year.

III. TRANSFER OF FUNDS

Payments will be made by Treasury check upon receipt of the products described in Attachment A, and a properly executed invoice based on actual expenses for fire suppression, control and mop-up. Submittal

of the work products and billings should be made to the following address:

U.S. Fish and Wildlife Service
Hakalau Forest National Wildlife Refuge
32 Kinoole Street Suite 101
Hilo, HI 96720

IV. MUTUAL COOPERATION

Each party agrees to cooperate with the other to accomplish the purpose and objectives of the Cooperative Agreement, and in fulfilling its obligations as herein provided.

V. SPECIFIC OBLIGATION OF THE PARTIES

A. Service's Obligation

The Service shall furnish the Cooperator with the following assistance to accomplish the cooperative project:

1. Provide available staff and equipment to suppress fires on Service lands at the request of the Cooperator Fire Chief or his designee.

2. Delegate command authority to the Cooperator Fire Chief or his designee during wildfire suppression activities by the Cooperator on Service lands.

3. Provide advice to the Cooperator Fire Chief relative to best access routes to the fire, location of roads and natural features that might serve as fire breaks, location of water sources on or near the Refuge, fuel types on the Refuge, areas with particular resource value and deserving of special protection, etc.

1. Reimburse the Cooperator and assist State agencies for firefighting services at the rates set forth in Attachment A.

B. Cooperator's Obligation

The Cooperator shall furnish the following to accomplish the cooperative project:

1. Respond immediately upon notification by any individual or agency of a wildland fire on Service lands.

2. Provide, as available, the manpower, equipment and expertise for suppression of wildland fires on Service lands under the direction of the Cooperator Fire Chief and in cooperation with the Refuge Manager.

3. Request suppression assistance from state and federal agencies for large fires on Service lands if the Cooperator is unable to provide sufficient manpower and equipment to extinguish the fire.

1. At the first indication of a wildland fire (or other emergency) on Service lands, provide

immediate notification to the Refuge Manager at the telephone number listed below.

VI. PROJECT OFFICERS

The Service's Project Officer shall be:

Richard C. Wass, Refuge Manager
Hakalau Forest National Wildlife Refuge
32 Kinoole Street Suite 101
Hilo, HI 96720
Telephone: 933-6915 (office) 935-7027 (home)

The Cooperator's Project Officer shall be:

Lloyd Narimatsu, Battalion Chief
Hawaii County Fire Department
466 Kinoole Street
Hilo, HI 96720
Telephone: 961-8373

VII. SPECIAL TERMS AND CONDITIONS

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provided herein.

3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.

4. Copies of fire reports shall be mutually provided to the other agency(ies) involved in the fire suppression as soon as possible following the fire action.

5. The Service will reimburse the Cooperator for actual suppression costs, at the rates specified per Attachment A.

VIII. TERMINATION

This Agreement may be terminated by either party giving the other at least 30 days written notice in advance. Termination shall not relieve either party of obligations left outstanding under the terms of this agreement.

IX. GENERAL PROVISIONS

Office of Management and Budget (OMB) Circulars applicable to State, Local and Tribal Governments, A-102 (Admin), A-87 (Costs) and A-128 (Audits) are hereby incorporated by reference. Copies are available upon request.

X. AMENDMENTS

Amendments to the Agreement may be proposed by either party and shall become effective upon being reduced to a written instrument executed by both parties.

IN WITNESS WHEREOF, each party hereto has caused this Cooperative Agreement to be executed by an authorized official on the day and year set forth opposite their signature.

U.S. FISH AND WILDLIFE SERVICE

By:_____ Date:_____
Contracting Officer
U.S. Fish and Wildlife Service
Eastside Federal Complex
911 NE 11th Avenue
Portland, Oregon 97232-4181

By:_____ Date:_____
Assistant Regional Director-Refuges
U.S. Fish and Wildlife Service
Eastside Federal Complex
911 NE 11th Avenue
Portland, Oregon 97232-4181

COOPERATOR

By:_____ Date:_____
Mayor, County of Hawaii
25 Aupuni St.
Hilo, Hawaii

Recommend Approval:

_____ Date:_____
Chief, Hawaii County Fire Department

Approved as to Form and Legality:

_____ Date:_____
Deputy Corporation Counsel

ATTACHMENT A

SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Hawaii County Fire Department for services as listed below paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the Station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

A. False alarms and fires suppressed prior to arrival: $90.00 per unit per hour.

A. Actual suppression activities: $150.00 per unit per hour.

A. Mop-up, overhaul, fire watch and other specifically authorized post suppression activities: $120.00 per unit per hour.

A. Helicopter support to include reconnaissance, staff transport, and bucket drops: $650/hr.

APPENDIX E: ENVIRONMENTAL ACTION STATEMENT

Department of the Interior
U.S. Fish and Wildlife Service

ENVIRONMENTAL ACTION STATEMENT

CATEGORICAL EXCLUSION FOR THE WILDLAND FIRE MANAGEMENT PLAN for KONA UNIT OF HAKALAU FOREST NWR of the BIG ISLAND NATIONAL WILDLIFE REFUGE COMPLEX

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and have determined that the following proposed action is categorically excluded from NEPA documentation requirements (e.g., preparation of an EA or EIS) consistent with guidance provided in 516 DM 2, Appendix 1 and 516 DM 6, Appendix 1.4.

Proposed Action

The proposed action is to implement the Wildland Fire Management Plan for Hakalau Forest NWR of the Big Island National Wildlife Refuge Complex. The Kona Forest Unit of Hakalau Forest National Wildlife Refuge was established for the purpose of protecting and restoring endangered forest bird populations and their habitat. Reforestation and elimination of exotic plants such as guava and christmas berry, and feral ungulates are among the management goals of the Refuge that relate to fire management. The basic fire management strategy for the Refuge is to suppress wildland fires since they are not believed to have played a significant ecological or evolutionary role in most native Hawaiian ecosystems and have negative impacts on the native biological communities.

Refuge Manager Date

APPENDIX F: BIG ISLAND WILDFIRE COORDINATING GROUP

Big Island Wildfire Coordinating Group Charter

I. MISSION STATEMENT:
The Big Island Wildfire Coordinating Group (BIWCG) was established to coordinate the programs of the participating wildland fire agencies on the Big Island of Hawai'i, to provide a forum for leadership, cooperation and the exchange of information, to further interagency cooperation, communications and coordination, and to implement directions and standards for incident management activities. By pooling the resources of the various agencies, the combined strength and efforts would afford the people of the Big Island more extensive and effective protection of lives, property, natural and cultural resources.

II. OBJECTIVES:
- A Provide leadership and a coordinated direction to wildland fire management programs on the island of Hawai'i';
- A Provide a forum for the exchange of ideas and the development of consistent policies;
- A Foster cooperation, avoid wasteful duplication, and facilitate maximum efficiency in wildland fire management programs through coordinated planning and the utilization of shared resources;
- A Establish and maintain an interagency approach to wildland fire management programs through the development and nurturing of interagency bonding and facilitation of a high degree of professionalism, trust, and mutual assistance among wildland fire management agencies;
- A Identify issues, establish priorities, develop alternatives, and recommend a unified course of action to respective agency administrators.

III. MEMBERSHIP:
The BIWCG membership will be composed of the lead fire manager or his/her designee from each of the following agencies located on the Big Island:

Hawaii County Fire Department
Hawaii County Civil Defense Agency
Dept. of Land & Natural Resources -Division of Forestry and Wildfire
National Park Service
U.S. Fish & Wildlife Service
U.S. Army
Dept. of Transportation -Airports Div., Hawaii District.

The BIWCG is composed of the designated Member Representatives of the signatories to this Charter. Each agency will have one vote. They serve until replaced by their member organization. Individual Member Representatives are their organization's authoritative source of information and operational commitment to this Charter's purpose and objectives. They are responsible to ensure that respective organization policy and procedures are maintained and administrators are informed. Members communicate agency policies to the BICWG to facilitate development of consistent and similar policies of the group. They coordinate BIWCG recommendations for their organization's acceptance and implementation. Member Representatives or an 'Acting' participate in meetings and work efforts of the BIWCG and serve as its officers where appropriate.
Associate Members: It is recognized that there are various groups, organizations and individuals that share the goals of BIWCG. Interested parties shall apply for Associate Membership and will be voted

upon, requiring 2/3 approval of the voting membership. Associate Members do not have voting privileges.

IV. MEETINGS:
The BIWCG will meet quarterly. The committee members may deem more frequent meetings necessary. The Chairperson with consensus of the group will establish meeting dates and times. Issues that require a vote will be decided upon by a 2/3 majority.

V. OFFICERS:
The BIWCG will establish officers to facilitate the accomplishment of its work. The positions to be filled are 1) Chair, 2) Vice-Chair, and 3) Secretary.

The Chair, Vice-Chair, and Secretary will serve for l-year terms on a rotational basis. The Vice-Chair shall advance to the office of the Chair and the Secretary shall advance to the office of the Vice-Chair. The group shall then vote upon the position of the Secretary. The cycle shall be so that all members have the opportunity to fill the officer positions.

VI. DUTIES & RESPONSIBILITIES OF THE OFFICERS:
Chair: The Chair is responsible for calling the meeting, setting the agenda, and running the meeting. The term of office is One year or upon permanent vacancy of the Chair.

Vice-Chair: The Vice-Chair will assume the duties of the Chair during any absence of the Chair and will be the next Chair. The term of office is one year.

Secretary: The Secretary shall ensure that the minutes of the meetings are recorded, edited, filed, and distributed to the members and their respective agencies.

The Secretary and Chair will determine the extent of support at each meeting (i.e. note- taking, recorder, portable computer, facilitator, audio-visual equipment, guest speaker, etc.)

Working Committees: The BIWCG will identify issues and concerns of mutual interest and task out assignments to specific working committees. The BIWCG will provide direction, oversight, and coordinating group minutes to the working committees.

Specific working committees may be formed to deal with such areas as training, logistics coordination, incident management team selection and management, and equipment standardization. Other working committees will be formed as needed.

Working committees may define Task Groups, which may have one or more responsibilities. The group, upon completion of the task, shall dissolve unless additional tasks, i.e. project implementation/ monitoring, are assigned.

Working committee members will elect a Chair. Minutes of the meeting will be taken and distributed. Committee Chair or their representatives are encouraged to attend the BIWCG meetings.

VII. FINANCIAL:
Participation in activities sanctioned or sponsored by the BIWCG is at individual member organization expense. When funding of BIWCG sponsored projects are needed from more than one of its members,

those organizations should share the costs as appropriate. Cost sharing is encouraged subject to individual member funding availability and to internal legal requirements and fiscal controls.

VIII. GENERAL PROVISIONS:

1) The parties hereto, in writing, may terminate the instrument in whole, or in part, at any time before the date of expiration. Any party may withdraw from the Group by giving 30 days written notice.

2) This instrument in no way restricts the Cooperators from participating in similar activities with other public or private agencies, organizations, and individuals.

3) Pursuant to Section 22, Title 41, United States Code, no member of, or Delegate to, Congress shall be admitted to any share or part of this instrument, or any benefits that may arise therefrom.

4) This instrument is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between the parties to this instrument will be handled in accordance with applicable laws, regulations, and procedures including those for Government procurement and printing. Such endeavors will be outlined in separate agreements that shall be made in writing by representatives of the parties and shall be independently authorized by appropriate statutory authority. This instrument does not provide such authority. Specifically, this instrument does not establish authority for noncompetitive award to the cooperator of any contract or other agreement. Any contract or agreement for training or other services must fully comply with all applicable requirements for competition.

5) Modifications within the scope of this instrument shall be made by the issuance of a mutually executed modification prior to any changes being implemented.

IX. PRINCIPAL CONTACTS:

Mr. Bruce Butts, HI County Civil Defense Agency
920 Ululani St.
Hilo, HI 96720
Tel: (808) 935-0031

Mr. Jack Minassian, National Park Service
Hawaii Volcanoes National Park
PO Box 52
Hawaii National Park, HI 96718
Tel: (808) 985-6042

Mr. Andy Kikuta, U.S. Fish and Wildlife Service
32 Kinoole St.
Hilo, HI 96720
Tel: (808) 933-6915
Mr. Gayland Enriques
Attn: APVG-GTG. Stop 215
Bldg. 1150
Schofield Barracks, HI 96857-5000
Tel: (808) 655-2284

Mr. Steve Bergfeld, Division of Forestry & Wildlife
19 E. Kawili St.
Hilo, HI 96720
Tel: (808) 974-4227

Mr. Wayne Ching, Division of Forestry & Wildlife
1151 Punchbowl St., Rm.325
Honolulu, HI 96813
Tel: (808) 587-4173

Mr. Steve Iwamoto, Hawaii County Fire Dept.
777 Kilauea Ave. Rm. 6
Hilo, HI 96720
Tel: (808) 961-8348

Chief Kenneth Zurn, Pohakuloa Fire Dept.
Bldg. T-390, PO Box 4607
Hilo, HI 96720
Tel: (808) 969-2441

X. ADOPTION OF POLICY:

It is important that the BIWCG's recommendations receive formal agency review, acceptance, and distribution for implementation. Operational changes, which do not include policy changes or costs, may be implemented directly through their appropriate channels. The respective agency administrator will approve items, which require policy changes, modifications, or costs.

APPROVAL:

IN WITNESS WHEREOF, the parties hereto have executed this agreement.

_____ Date: _____
Edward Bumatay
Fire Chief
Hawaii County Fire Dept.

_____ Date: _____
William G. Davis
Administrator
Hawaii County Civil Defense

_____ Date: _____
John J. Reynolds
Pacific West Regional Director
National Park Service

_____ Date: _____
Anne Badgley
Region 1 Regional Director
U.S. Fish and Wildlife Service

_____ Date: _____
Gilbert Coloma-Agaran
Chairman
Dept. of Land & Natural Resources

_____ Date: _____
Sammy C. Houseberg
Director, Installation Fire and Safety Office
U.S. Army, Hawaii

MEMORANDUM OF UNDERSTANDING

Between the

HAWAII COUNTY FIRE DEPARTMENT

HAWAII COUNTY CIVIL DEFENSE AGENCY

DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE

NATIONAL PARK SERVICE

U.S. FISH AND WILDLIFE SERVICE

U.S.ARMY

AND

DEPARTMENT OF TRANSPORTATION
AIRPORTS DIVISION, HAWAII DISTRICT

I. Introduction

Fire management in Hawaii continues to be a matter of concern to the public and to the Hawaii County Fire Dept., Hawaii County Civil Defense Agency, Department of Land and Natural Resources-Division of Forestry and Wildlife, National Park Service, U.S. Fish and Wildlife Service, U.S. Army, and Department of Transportation- Airports Division, Hawaii District, hereafter called the "agencies". Considerable progress has been made in fire suppression and fire use by all the agencies. Cooperation in all aspects of fire suppression has benefited all agencies. Because fire recognizes no boundaries, programs must lead to more productive cooperation and efficient operations between these agencies.

II. Authority

There are numerous Federal, State and County laws that allow each agency head to enter into Memorandum of Understanding with other agencies.

III. Objective

A. To provide a basis for cooperation between the agencies on all aspects of fire suppression and as authorized in non-fire emergencies.
B. To facilitate the exchange of personnel, equipment, supplies, and services between the agencies.

IV. Program Coverage

The agencies agree to cooperate in the full spectrum of fire suppression activities and as authorized in non-fire emergencies to achieve agency goals. Cooperative efforts shall be provided for to facilitate efficient use of personnel, supplies, equipment, aviation services and other resources. Activities may include, but are not limited to:

A. Prevention of human-caused fires;
B. Training of personnel to common standards;
C. Pre-suppression activities;
D. Suppression of fires;
E. Rehabilitation of areas burned by wildfire;
F. Exchange of technology and database;
G. Fire research.

V. Statement of Work

A. Agency representatives shall coordinate information on available personnel, equipment, and supplies as necessary.

A. That any agency may, when it deems it necessary, request assistance of the other agency: and upon receipt of such request, or upon its own initiative, the other agency shall assist the requesting agency with whatever personnel and equipment it may have available at the time; however, in no instance shall the responding agency be under a duty to assist the requesting agency when the personnel and equipment available to it are, or would thereby be, rendered insufficient to meet the actual or realistically potential needs of the community or area served by the agency.

A. An agency is expected to take prompt initial action, with or without request, unless otherwise provided for, on fires within zones of mutual interest. Where one agency takes initial action in the protective unit of the other, the initial attack agency shall continue to fight the fire until relieved by an officer of the other agency.

B. When fires burn or threaten lands of more than one agency, officials to suppress the fire will conduct joint planning.

C. Agencies permit the use of its respective radio communication frequencies to all signatory agencies of this MOU.

D. Agencies shall not bill for services rendered by the signatory agencies of this MOU.

E. That each agency shall be separately liable to all third parties who may have a legal or equitable claim against the agency arising out of its tortuous misconduct while engaged in the performance of its duties.

F. Each agency shall make direct settlement from its own funds for all liabilities it incurs under this MOU.

VI. General Provisions

This MOU will take effect on the date of the last signature. The MOU shall remain in effect for a period of 5 years, and may be extended and amended by mutual MOU at any time. Any signatory agency may terminate their participation in this MOU by written notice to all other signatories. The remaining signatories may continue the provisions of this MOU.

VII. Required Clauses

During the performance of this MOU, the participants agree to abide by the terms of Executive Order 11246 on non-discrimination and will not discriminate against any person because of race, color, religion, sex, or national origin.

No member or delegate to Congress, or resident Commissioner shall be admitted to any share or part of this MOU, or to any benefit that may arise therefrom, but this provision shall not be construed to this MOU if made with a corporation for its general benefit.

VIII. Waiver

Each party to this MOU does hereby expressly waive all claims against the other party for compensation for any loss, damage, personal injury or death occurring in consequence of the performance of this MOU.

IX. Approval

IN WITNESS WHEREOF, the parties hereto have executed this MOU:

_____ Date: _____
Edward Bumatay
Fire Chief
Hawaii County Fire Dept.

_____ Date: _____
William G. Davis
Administrator
Hawaii County Civil Defense

_____ Date: _____
John J. Reynolds
Pacific West Regional Director
National Park Service

_____ Date: _____
Anne Badgley
Region 1 Regional Director
U.S. Fish and Wildlife Service

_____ Date: _____
Gilbert Coloma-Agaran
Chairman
Dept. of Land and Natural Resources

_____ Date: _____
Sammy C. Houseberg
Director, Installation Fire and Safety Office
U.S. Army, Hawaii

_____ Date: _____
Kazu Hayashida
Director of Transportation, Hawaii

APPENDIX G: REQUEST FOR CULTURAL RESOURCE COMPLIANCE

REQUEST FOR CULTURAL RESOURCE COMPLIANCE

U.S. Fish and Wildlife Service, Region 1

Project Name:					**Program:** (Partners, Refuges, JITW, WSECP, etc.)	
State: CA, ID, HI, NV, OR, WA		**EcoRegion:** CBE, IPE,KCE, NCE			**FWS Unit:** **Org Code:**	
Project Location:	**County**	**Township**	**Range**	**Section**	**FWS Contact:** Name, Tel#, Address	
USGS Quad:					**Date of Request:**	
Total project acres/linear ft/m:		**APE Acres / linear ft/m (if different)**			**Proposed Project Start Date:**	

MAPS Attached	**Check below**		
Copy of portion of USGS Quad with project area marked clearly **(required)**			Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)**
Photocopy of aerial photo showing location **(if available)**			Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)**

Directions to Project: (if not obvious)	
Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?
Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.

Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area?

DELEGATION OF AUTHORITY

Region 1, U.S. Fish and Wildlife Service

Hakalau Forest National Wildlife Refuge

_____, you are assigned as Incident Commander of the _____ Incident, on the Kona Forest Unit of Hakalau Forest National Wildlife Refuge. You have full authority and responsibility for managing the fire suppression operation on this incident within the framework of legal statute, current policy, broad direction, and the Wildland Fire Situation Analysis (WFSA). Your primary responsibility is to achieve complete control of the fire by organizing and directing the fire suppression organization in an effective, efficient, and economical manner.

You should be guided in your duties by the fire job descriptions relating to Incident Commander, as found in the Fireline Handbook. Strongly consider long-term ecosystem health, and the effects of suppression actions in the development of appropriate suppression responses. These issues are to be addressed and documented in the WFSA.

You are accountable to the Complex Manager _____ of the Hakalau Forest National Wildlife Refuge, who is the Line Officer. _____, may serve as the Line Officer Designee for this incident.

You will immediately notify me in person in the event of:
(1) a serious injury or fatality,
(2) threat to private property,
(3) if the incident exceeds the limits of the selected alternative of the WFSA.

Much of the Kona Forest Unit of Hakalau Forest National Wildlife Refuge is home to endangered species. Your job as Incident Commander is critical, as you must minimize damage to the habitats, as well as provide for fire fighter safety. Minimum environmental suppression tactics shall be used, commensurate with forecasted and threatened resource values. Unless there are immediate threats to life and/or property, you must receive approval from the Complex Manager or Designee to use heavy equipment (dozers, tractors, etc.) or fall any unburned trees greater than eight feet tall.

You are to be guided by the Wildland Fire Situation Analysis, approved by _____, Project Leader.

The Resource Advisor assigned to your incident will be _____.

_____ Date: _____
, Complex Manager

APPENDIX I: SAMPLE PILE BURN PLAN

Debris Pile Burn Plan

Refuge:_____

Project Name:_____

Location:_____Township_____Range___ Section_____

Lat_____Long_____

Checklist:

1. EA optional.
2. Resource objectives.
3. Less than 1 ton per pile, completely dried.
4. Minimum resources (equipment & personnel) required are present.
5. Weather parameters established.
6. Low potential for escape. Good clearance.
7. No fire behavior prediction required.
8. Can be written to be valid up to 3 years per site, with annual review.
9. Burn day required.
10. Less than (<) one acre in size.
11. Complexity level should rate as level 3.
12. Intended for administrative sites, campgrounds, occupancy trespass, etc.

Debris & Pile Burn Plan
(continued)

Note: This plan is intended for burning debris and piles (activity fuels) from Refuge operations such as fuel break construction and hazard reduction. This plan format should only be used outside of declared fire season for the area considered. THIS PLAN IS FOR COMPLEXITY LEVEL 3 PILE BURNING.

Refuge:_____

Project Name:_____

Prepared By:_____ Date Prepared:_____

Reviewed By:_____ Date Reviewed:_____

Refuge Manager Approval:_____ Date:_____

Environmental Assessment Met (where documented):_____

_____

Estimated Cost: $ _____ 1202:_____ Funding Code:_____

Project Area Description (Attach Map of Burn Area)

General Location:_____

_____

Legal Description: T._____ R._____ S._

Burn Objectives:_____

_____

Number, Species, and Size of Piles:_____

_____

Adjacent Fuel Description:_____

_____

Debris & Pile Burn Plan
(continued)

Weather Forecasts: The Pile Burn Boss is responsible for weather being taken every hour while burning to ensure prescription compliance. Contact the Emergency Communications Center (ECC) for weather forecasts and burn day designation. Contact ECC by radio when ignition is starting, giving legal description of area burning; and when burning is over, giving number of acres or piles burned.

Prescription:

Season of Burn (Fall, Spring, Summer, Winter):_____

	Acceptable Range	Desired
Air Temperature		
Relative Humidity(%)		
Wind Speed		
Fuel Moisture		
1 Hour T.L.		
10 Hour T.L.		
100 Hour T.L.		
Adjacent Live Fuel Moisture Low/High		

Wind Direction Preferred: _____

Acceptable:_____ Unacceptable:

Debris & Pile Burn Plan
(continued)

Smoke Management

Permitting Agency:_____

Total Tons Per Acre Emissions:_____

Distance and Direction from Smoke Sensitive Area(s):_____

Necessary Transport Wind Direction(s):_____

Visibility Hazard(s) (*i.e.*, roads, airports, etc.):_____

Actions to Reduce Visibility Hazard(s):_____

Can Residual Smoke Be a Problem?_____

Other Considerations:_____

Special Constraint(s)/Consideration(s):_____

_____

_____

Firing Technique:_____

_____

_____

Holding Force Instructions:_____

_____

Mop Up Instructions_____

_____

Debris & Pile Burn Plan
(continued)

Contact Plan (Who will notify the following and when):_____

_____

_____

Key People:_____

Local Landowners:_____

_____

Private Land Within Proposed Burn (Identify on Map):_____

Fire Protection Agencies:_____

Dispatcher:_____

Public Affairs Officer:_____

News Releases to Local Papers and News Media:_____

Debris & Pile Burn Plan
(continued)

Safety Plan

All line employees involved in the actual burning of standing and/or piled fuels will have on their person and use as necessary the following protective clothing:

1. Hard hat
2. Goggles
3. Gloves
4. Fire resistant pants
5. Fire resistant shirt
6. Fire shelter
7. Laced boots as used in fire suppression

Employees involved in a project with an assignment not related to actual burning should have with them all of the above safety equipment and be so equipped if their unplanned duties expose them to line work and/or the actual burning.

Each burning plan will designate fire safety responsibility. This designation should include the following considerations:

1. Escape routes
2. Safety areas
3. Closest recognized burn treatment facility and specific methods of travel to burn center or hospital

Hospitals

Center Name	Address	Travel Time Air/Ground	Phone	Helipad Yes/No	Burn Center Yes/No

Debris & Pile Burn Plan
(continued)

Medical Emergency Procedures

1. Give First Aid at scene.
2. Contact Hawaii County Fire Department
3. Make transportation arrangements.

Comments:_____

_____

_____

_____

Debris & Pile Burning Checklist

(A "NO" response to any item means STOP!)

1. Are all fire prescriptions met?
2. Has dispatch been notified?
3. Is it a permissive burn day?
4. Is fire weather forecast favorable?
5. Are all personnel required in the burn plan on site?
6. Have all personnel been briefed on the burn plan requirements?
7. Have all personnel been briefed on safety hazards, escape routes and safety orders?
8. Is all the required equipment in place and in working order?
9. Are all personnel aware of mop up requirements before abandonment?
10. Are all answers to all the above questions "Yes"?

If all ten questions have been answered "Yes", you may proceed with lighting.

APPENDIX J: EXEMPTION REQUEST

BIG ISLAND NATIONAL WILDLIFE REFUGE COMPLEX
32 KINOOLE STREET, SUITE 101
HILO, HI 96720
Telephone (808)933-6915 Fax (808)933-6917

Memorandum

October 18, 2001

To: Pam Ensley, Regional Fire Management Coordinator

From: Richard C. Wass, Complex Manager

Subject: Engine Operator Exemption

As per the Fire Management Handbook Section 1.5 (6/8/01), I am requesting that, within the Big Island National Wildlife Refuge Complex, an Engine Operator be permitted to run an engine in the absence of a qualified Engine Boss. I understand that this is Service policy only, applies only to fires located on Refuge lands, and that a qualified Engine Boss must be present for any assists to our interagency cooperators.

Upon detection of any wildland fire on Refuge lands, assistance will be requested from interagency cooperators. This assistance, however, often does not arrive on scene for 3 hours or more. These requirements outlined in the Fire Management Handbook provide us with the appropriate flexibility to manage wildland fires on Refuge lands until assistance does arrive.

I would appreciate your concurrence with this issue, so that we may continue to operate our engines safely, effectively, and in full compliance of Service standards.

If you have any questions, please feel free to contact Andy Kikuta or me at 808-933-6915.

/s/
Richard C. Wass

Concurred By: _____ _____
Pam Ensley Date
Regional Fire Management Coordinator

APPENDIX K: SAMPLE WFSA

WILDLAND FIRE SITUATION ANALYSIS

13. Jurisdiction: **US Fish and Wildlife Service**	14. Geographic Area:
15. Unit: Kona Unit of Hakalau Forest National Wildlife Refuge	16. WFSA Number of .
17. Fire Name:	18. Incident Number:
19. Accounting Code:	
20. Date/Time prepared / / @ : .	
21. Attachments	
-Complexity Analysis X -Risk Assessment/Analysis X Probability of success Consequences of Failure -Maps -Decision Tree -Fire Behavior Projections X -Calculations of Resource Requirements -Other	

OBJECTIVES AND CONSTRAINTS

1.Objectives (Must be specific and measurable) These objectives must be considered in the development of alternatives in III, below. Suppression objectives must relate to the Unit resource management objectives.
a. Safety (These must receive the highest priority) -Public -Firefighter
b. Economic (May include closure, which could impact the public through transportation, communication and resource values)
c. Environmental (e.g. management objectives for wildlife habitat, water quality, etc.)
d. Social (May include local attitudes towards fire that might affect decisions on the fire)
e. Other (e.g. legal or administrative constraints needing consideration such as fire encroaching onto other jurisdictions)
2.Constraints (e.g. environmentally and culturally sensitive areas, irreparable damage to resources, and economic

constraint)

ALTERNATIVES

	A.	B.	C.
Wildland Fire Strategy	e.g. Allow fire to play a natural role	e.g. Aggressive attack	
Narrative			
Resources Needed Hand Crews Engines Dozers Air Tankers Helicopters			
Final Size			
Est. Contain/ Control Date			
Costs			
Risk Assessment -Probability of success -Consequence of failure			
Complexity			
Attach maps for each alternative			

EVALUATION OF ALTERNATIVES

	A.	B.	C.
Evaluation Process			
Safety Firefighter Aviation Public			
Sum of safety values			
Economic Forage Improvements Recreation Water Wildlife Other			
Sum of economic values			
Environmental Air Visual Fuels T&E Species Other			
Sum of environmental values			
Social			

Employment Public Concern Cultural Other			
Sum of social values			
Other			
Sum of other values			
TOTAL			

ANALYSIS SUMMARY

	A.	B.	C.
Compliance with Objectives Safety Economic Environmental Social Other			
Pertinent Data Final fire size Complexity Suppression cost Resource values			

Probability of success			
External/Internal Influences			

VI. DECISION

The Selected Alternative is: .

Rationale:

Agency Administrator's Signature Date/Time

VII. DAILY REVIEW

			PREPAREDNESS LEVEL	INCIDENT PRIORITY	RESOURCE AVAILABILITY	WEATHER FORECAST	FIRE BEHAVIOR PREDICTIONS	WFSA VALID
Date	Time	By						

VIII. FINAL REVIEW

The elements of the selective alternative were met on:

Date Time:

By:

Agency Administrator

APPENDIX L: THREATENED AND ENDANGERED SPECIES

Table 1. Endangered vertebrates at Kona Forest Unit of Hakalau Forest National Wildlife Refuge.

Common Name	**Scientific Name**	**Currently Known on Kona Forest Unit?**	**Federal Status**
Akiapolaau	*Hemignathus munroi*	Yes	Endangered
Hawaii akepa	*Loxops c. coccineus*	Yes	Endangered
Hawaii creeper	*Oreomystis mana*	Yes	Endangered
Hawaiian hawk, io	*Buteo solitarius*	Yes	Endangered

Hawaiian crow	*Corvus hawaiiansis*	Yes	Endangered
Hawaiian hoary bat, apeapea	*Lasiurus cinereus semotus*	Yes	Endangered

Table 2. Rare endemic plants of the Kona Forest Unit of Hakalau Forest National Wildlife Refuge.

Common name	**Scientific name**	**Currently Known on Kona Forest Unit?**	**Federal Status**
-none-	*Asplenium fragile* var. *insulare*	Yes	Endangered
‘Oha wai	*Clermontia lindseyana*	No, known from area	Endangered
Haha	*Cyanea hamatiflora* ssp. *carlsonii*	No, known from area	Endangered
Haha	*Cyanea marksii*	Yes	Species of Concern
Haha	*Cyanea stictophylla*	No, known from area	Endangered
Ha‘iwale	*Cyrtandra menziesii*	No, known from area	Species of Concern
‘Aiea	*Nothocestrum breviflorum*	Yes	Endangered
-none-	*Phyllostegia vestita*	No, known from area	Species of Concern
-none-	*Phyllostegia velutina*	No, known from area	Endangered
-none-	*Phyllostegia floribunda*	Yes	Candidate
Popolo ku mai	*Phytolacca sandvicensis*	No, known from area	Species of Concern
Po‘e	*Portulacca sclerocarpa*	No, known from area	Endangered
‘Akala	*Rubus macrei*	No, known from area	Species of Concern
-none-	*Sanicula sandwichensis*	No, known from area	Species of Concern
-none-	*Silene hawaiiensis*	No, known from area	Threatened
-none-	*Stenogyne macrantha*	No, known from area	Species of Concern

Mohihi	*Stenogyne scrophularioides*	No, known from area	Species of Concern
‘Anunu	*Sicyos macrophyllus*	1958 record	Candidate
Maua	*Xylosma crenatum*	No, known from area	Endangered

APPENDIX M: EQUIPMENT INVENTORY

Table 3. Equipment Inventory for the Kona Forest Unit of Hakalau Forest National Wildlife Refuge.

Location	Item	Quantity	Source
Fire Cache	Fire shelter	2	Fire
Fire Cache	Fire shelter, practice	1	Fire
Fire Cache	Hard hat	1	Fire
Fire Cache	Belt weather kit	3	Fire
Fire Cache	Goggles	3	Fire
Fire Cache	First aid kit, personal	3	Fire
Fire Cache	Fireline pack	2	Fire
Fire Cache	water bottle	7	Fire
Fire Cache	pants, 8x34	1	Fire
Fire Cache	pants, 30x34	1	Fire
Fire Cache	pants, 34x34	1	Fire
Fire Cache	headlamp	1	Fire
Fire Cache	face/neck shroud	1	Fire
Fire Cache	shirt, small	2	Fire
Fie Cache	shirt, medium	4	Fire
Fire Cache	shirt, large	2	Fire
Fire Cache	Silvex foam, 5 gal	5	Fire
Fire Cache	flapper	5	Fire
Fire Cache	pulaski	2	Fire
Fire Cache	1.5" hose, cotton	7	Fire
Fire Cache	fittings/valves	many	Fire
Fire Cache	radio chest harness	1	Fire
Garage	frog pond, 1000 gal	1	Fire
Garage	2" pump	1	DRMO
Garage	chainsaw, Stihl 039	1	1261
Garage	chainsaw, Stihl 025	1	Fire

APPENDIX N: MONTHLY TEMPERATURE, RELATIVE HUMIDITY, AND RAINFALL DATA

Table 4. Minimum and maximum temperatures (degrees Celsius) recorded at five weather stations at different elevations on McCandless Ranch, South Kona, Hawaii.

	2000'		3000'		4000'		5000'		6000'	
Month	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
Apr 1995	14.3	21.6	13.2	19.3	11.3	17.8	8.8	16.9	5.7	14.9
May	15.3	21.6	14.1	19.4	11.8	18.0	9.9	17.2	5.3	16.1
June	16.8	21.8	14.3	18.9	12.5	17.7	10.4	16.8	6.2	15.6
July	17.0	22.9	13.8	19.6	11.4	17.6	10.0	17.2	8.2	16.6
August	16.5	22.6	13.0	19.1	10.6	17.4	9.7	17.3	8.1	17.5
Sept	16.8	22.9	13.2	20.0	10.8	17.2	9.1	16.9	7.3	17.1
October	16.2	23.5	12.7	20.6	9.5	17.1	8.3	17.0	6.7	16.7
Nov	15.6	23.7	12.4	20.1	9.2	17.4	8.4	17.7	7.8	17.9
Dec	14.2	23.8	10.4	19.6	7.7	17.5	6.3	17.3	6.4	17.8
Jan 1996	14.5	21.3	10.8	17.3	8.9	15.8	7.1	14.4	7.8	14.9
February	13.2	19.9	9.6	18.4	7.8	13.65	6.5	13.9	5.8	13.9
March	14.2	22.6	9.8	18.5	6.8	15.9	6.2	16.6	5.2	14.6
April	16.4	23.8	12.0	19.0	9.3	18.6	8.2	16.9	6.1	15.3
May	18.6	24.7	13.7	20.2	11.0	18.4	9.3	18.1	8.5	18.3
June	18.2	24.0	14.5	19.5	12.1	18.1	9.9	16.6	8.2	14.4
July	18.9	23.1	15.4	20.5	14.1	20.1	10.0	16.9	9.7	18.3
August	17.9	24.0	16.3	22.3	14.5	21.0	10.8	18.4	9.4	18.5
Sept	16.2	23.5	17.3	23.0	14.4	20.4	11.1	16.0	8.5	16.6
October	17.8	24.0	16.0	22.8	15.6	22.4	10.5	18.8	8.8	18.4
Nov	17.9	23.9	16.0	21.9	16.0	22.0	11.2	18.5	9.5	17.6
Dec	14.3	23.4	13.4	21.2	11.7	20.7	8.9	16.8	7.1	16.9
Jan 1997	13.5	23.3	12.8	22.0	11.8	21.5	7.8	18.9	6.5	18.8
February	14.0	21.5	12.3	20.0	11.3	19.1	6.9	15.4	5.7	14.7
March	15.1	22.1	14.1	21.7	13.0	19.9	8.8	17.8	7.9	16.2
April	15.9	22.0	14.9	21.6	13.4	19.9	10.1	17.1	7.4	15.9
May	17.2	23.4	16.3	23.0	14.3	21.2	10.7	19.2	6.6	17.7
June	18.7	23.0	18.1	22.5	16.4	21.1	12.6	18.5	10.1	16.9
July	18.3	22.7	18.3	23.2	16.7	22.2	13.5	19.5	9.9	17.8
August	19.1	24.3	19.6	24.6	16.7	22.9	12.7	20.5	9.6	18.7
Sept	19.9	24.5	19.0	24.1	16.0	22.9	13.7	20.0	10.6	18.4
October	19.0	24.6	18.0	23.9	16.9	23.0	12.6	20.1	9.6	18.4
Nov	18.5	25.3	17.9	24.8	17.8	23.5	11.1	20.3	9.6	19.9

Table 5. Minimum and maximum relative humidity (%) recorded at five weather stations at different elevations on McCandless Ranch, South Kona, Hawaii.

	2000'		3000'		4000'		5000'		6000'	
Month	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
Apr 1995	73.6	90.6	79.7	89.6	74.6	84.1	73.8	98.7	65.1	91.6
May	87.6	98.1	92.8	96.0	89.3	94.8	81.2	93.3	67.8	97.3
June	78.3	89.0	80.7	86.7	84.7	91.1	82.8	93.7	67.5	92.5

July	72.0	85.0	74.8	80.8	89.5	94.6	82.2	95.8	81.1	88.2
August	72.9	85.7	75.5	81.4	89.5	95.4	85.4	95.8	58.2	67.9
Sept	71.3	85.2	71.1	81.0	89.9	94.8	85.0	96.1	80.8	87.9
October	66.4	84.9	66.6	80.8	87.4	94.9	81.5	95.9	61.6	87.9
Nov	69.5	85.2	69.9	82.3	86.5	94.7	75.2	96.1	50.0	88.5
Dec	60.8	87.1	63.0	81.4	81.5	94.7	68.0	95.9	41.1	86.9
Jan 1996	65.5	80.4	67.8	76.7	83.9	89.3	73.1	89.8	53.0	84.4
February	64.2	79.1	68.0	75.7	85.4	86.8	79.2	92.5	52.4	83.4
March	64.0	86.4	63.1	80.9	81.9	96.0	79.9	96.5	47.7	90.6
April	66.7	86.5	68.7	81.8	86.7	96.1	71.2	87.1	64.2	91.9
May	71.1	85.3	70.5	82.5	87.8	97.4	70.5	87.9	55.0	89.9
June	77.1	85.6	79.4	83.4	93.8	98.6	78.6	88.1	57.4	75.9
July	80.8	89.0	79.8	82.6	95.3	98.8	76.2	86.7	64.4	91.0
August	78.3	86.1	74.1	81.3	88.7	95.5	72.7	86.2	62.8	90.4
Sept	81.2	86.9	77.6	82.0	92.2	95.0	79.0	88.4	69.4	88.1
October	74.8	85.5	71.7	81.1	87.9	94.8	72.2	88.3	60.8	89.7
Nov	75.7	85.1	73.5	79.4	90.3	95.0	75.3	88.4	59.1	89.1
Dec	66.4	92.4	60.4	76.4	78.7	93.2	63.4	89.5	48.7	89.7
Jan 1997	64.7	91.6	58.2	77.1	77.2	93.7	58.2	89.2	35.9	86.9
February	64.0	85.3	55.9	71.1	80.3	88.5	65.3	83.0	54.6	82.4
March	75.8	90.2	70.5	79.9	90.4	95.6	70.3	88.8	62.1	89.9
April	79.5	91.0	75.6	82.3	92.0	96.0	77.5	88.4	60.6	89.3
May	78.9	90.3	73.2	82.3	88.3	95.1	72.3	86.6	60.8	89.2
June	84.3	90.3	80.4	83.2	92.8	95.4	83.8	89.9	74.5	90.0
July	79.1	88.9	77.8	82.0	92.3	96.3	85.2	93.6	69.2	93.7
August	84.4	92.4	78.5	83.2	91.6	95.5	79.6	92.6	63.1	91.7
Sept	91.7	96.6	81.6	83.3	91.3	94.1	85.7	93.0	73.9	90.5
October	83.6	93.2	78.1	83.9	91.1	94.9	83.4	94.0	69.6	91.3
Nov	82.8	92.6	76.7	83.6	88.4	96.0	73.3	90.3	60.5	92.0

Table 6. Total monthly rainfall (mm) recorded at five weather stations at different elevations on McCandless Ranch, South Kona, Hawaii. Data provided by C. Atkinson, USGS Biological Resources Division.

Month	2000'	3000'	4000'	5000'	6000'
April 1995	145.4	157.1	103.8	77.05	48.4
May	146.7	129.2	88.5	44.7	16.7
June	157.2	138.2	111.1	85.2	51.0
July	135.5	112.7	83.6	60.6	37.1
August	213.6	224.2	144.4	85.9	64.0
September	186.9	197.1	110.3	56.3	30.9
October	47.5	49.3	26.6	24.33	16.2
November	68.3	54.3	25.8	19.23	14.2

December	42.9	32.5	41.8	11.85	5.65
January 1996	117.0	117.2	117.7	90.3	82.4
February	50.0	75.6	73.3	60.3	40.0
March	165.3	152.0	143.7	165.0	140.9
April	74.1	47.7	55.7	35.5	24.05
May	59.6	74.7	75.6	64.3	33.4
June	209.6	138.0	94.94	72.3	44.9
July	193.8	194.2	180.5	162.1	70.2
August	152.9	121.8	88.9	45.6	29.8
September	434.3	348.8	256.0	137.9	110.0
October	91.0	72.5	76.3	39.1	17.4
November	144.8	115.7	114.1	96.6	72.2
December	78.4	227.7	211.7	234.9	164.4
January 1997	107.9	69.0	81.1	92.5	106.2
February	36.4	34.9	81.1	92.5	106.2
March	227.2	300.4	316.3	250.1	162.1
April	74.3	138.2	118.9	101.7	64.3
May	196.1	313.0	189.3	77.9	59.1
June	346.9	414.4	334.7	211.4	174.6
July	205.4	191.0	166.9	116.5	85.1
August	106.9	119.4	73.5	34.3	29.2
September	508.6	370.0	182.3	69.2	70.4
October	204.5	158.3	19.5	89.4	57.1
November	91.4	89.4	52.1	49.0	45.8