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Analysis of Fire History and Management Concerns at Pohakuloa Training Area

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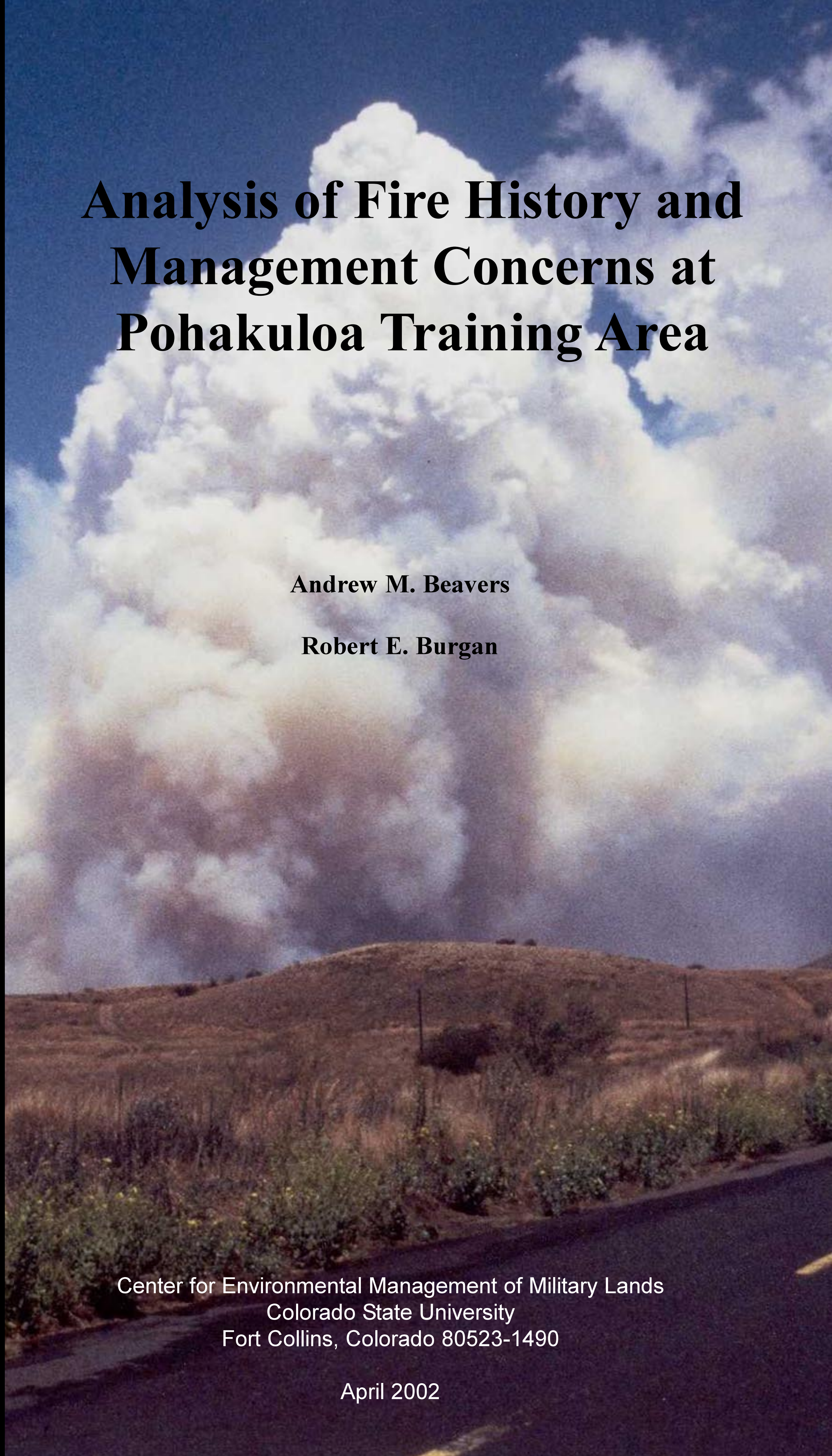

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Introduction

The Hawaiian archipelago is home to seven U.S. Army installations, six of which are on the island of Oahu. The seventh, Pohakuloa Training Area (PTA), is located on the Big Island of Hawaii and encompasses 44,045 ha (108,792 acres) in the saddle between Mauna Loa and Mauna Kea volcanoes. It is the Army's largest training area in the Pacific.

Figure 1: The State of Hawaii and the location of Pohakuloa Training Area.

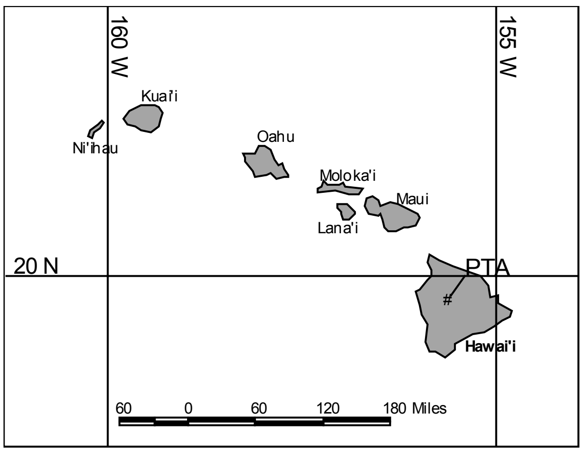
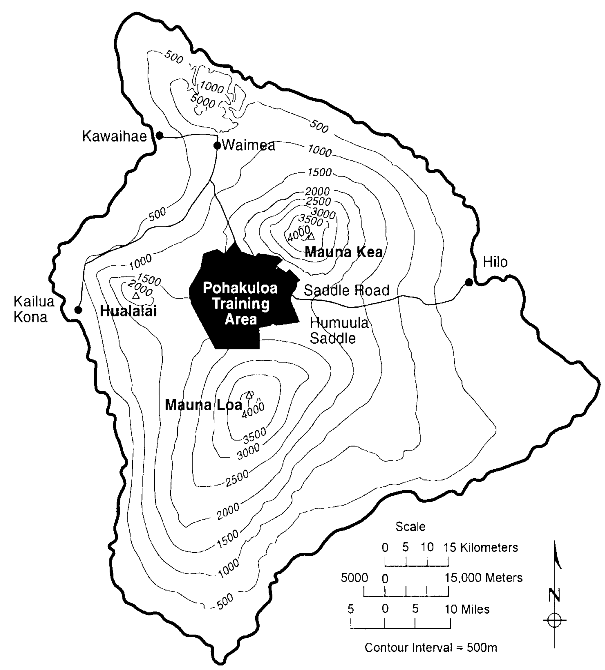


Figure 2: The Island of Hawaii illustrating the location of Pohakuloa Training area in relation to the major topographic features and landmarks.



From Shaw and Castillo 1997.

PTA has been used by the United States Armed Forces for live-fire training since the 1940's. The magnitude of the installation allows brigade sized exercises utilizing units of up to 5,000 troops, which is not possible at any other Pacific training facility (Ecosystem Management Plan 1998). The large size also supports training with all arms assigned to the U.S. Army Pacific, including long-range weapons systems such as artillery and guided missiles.

Inherent in the maintenance of military readiness is the threat of wildfire. Most of the weapons used by the military are potential ignition sources. While much of PTA is barren lava, and therefore immune to fire, the areas that are vegetated harbor a high density of threatened and endangered plant and animal populations, prompting the designation of a number of ecosystems within PTA as some of the rarest in the world (Preliminary Draft BA 1999, PTA Environmental

Assessment 1997). Fires of any magnitude in these areas would represent a significant biological loss. The tables in Appendix 2 list rare plants and animals that occur at PTA.

Because of the importance of the endangered species populations and the potential threat posed by military activities, the Army has entered into consultations with the United States Fish and Wildlife Service (USFWS) in accordance with Section 7 of the Endangered Species Act of 1973. Part of the mitigation plan requires the Army to provide a more effective wildfire management program. This report includes information about PTA's fire history, vegetation and fuels, and pre-suppression fire management recommendations. This information is the result of collaboration between the U.S. Department of Agriculture (USDA) Forest Service (FS) Pacific Southwest Research Station (PSW), Colorado State University (CSU) Center for Ecological Management of Military Lands (CEMML), and the U.S. Army Hawaii (USARHAW).

General Description

Pohakuloa Training Area lies on a plain between the two largest volcanoes on the island of Hawaii. Topography is generally flat to gently sloping, with the exception of a number of cinder cones located throughout the area (see Map 1). Low and high points within PTA boundaries are 1265 m (4149 ft) and 2713 m (8897 ft) in elevation respectively, though Mauna Loa and Mauna Kea, both greater than 4000m (13,123 ft) in elevation, are close by.

Bedrock is composed of pāhoehoe and a'ā lava flows from Mauna Loa and Mauna Kea. Unlike pāhoehoe flows which are smooth, pillow-like formations that often contain lava tubes, a'ā flows are composed of broken and jagged igneous rock that is extremely difficult to navigate. Neither type of lava can be safely driven on by wheeled vehicles, and both will quickly tear up hoses, boots, and other equipment, making fire fighting operations difficult.

Many of the soils are in their early formative stages, and because of this and low precipitation they have developed only rudimentary soil horizons. A large portion of the installation, particularly the eastern edge and within the impact area, is barren lava or only sparsely vegetated. These areas comprise the most poorly developed soils, while areas on the western and northern ends of PTA contain some of the deepest soils. Localized ash and cinder deposits also exist throughout the installation.

Weather is dominated by the strength of trade winds blowing through the saddle, and the effects of Mauna Loa and Mauna Kea. Precipitation is sparse (37.4 cm or 14.74 inches annually) and is supplemented by fog drip produced during periods of foggy weather (PTA Environmental Assessment 1997, 1997). As in many arid environments, plant response often depends more on the timing of the precipitation than the total amount (Bern, 1995). Winds are generally out of the east in the mornings until orographic winds from the west overpower the trades in the early afternoon. This wind shift from easterly to westerly winds depends largely on the strength of the trades and the amount of cloud cover blocking radiative heating of the ground. During the transition period, winds are unpredictable in strength and direction. It is not uncommon for winds to shift 180 degrees over very short periods of time or distance. Average annual 20 ft. wind speeds at Bradshaw Army Airfield from 1996 to 1998 were 10.7 mph (Fujioka and Haught, unpublished data) with very little variation from month to month (average monthly max=11.85 mph in December, average monthly min=9.72 mph in June). Temperatures at PTA also show very little variation throughout the year, though reports of snow occur periodically. The average annual temperature from 1996 to 1998 was 17.7 degrees Celsius (63.8 degrees Fahrenheit). The average monthly maximum was 19.6 degrees C in July (67.2 degrees F) and the average monthly minimum was 15.3 degrees C in February (59.6 degrees F).

Vegetative cover varies from barren lava to dense shrub and forest ecosystems but is collectively classified as Subalpine Dryland (Bern 1995). The vegetation found in a given area is largely a function of the age of the lava flow on which it grows. The earliest successional species are mosses, lichens, the tree *Metrosideros polymorpha* Gaud. (‘ōhi‘a), and the shrubs *Dodonaea viscosa* and *Styphelia taeiameia* F. v. Muell. [Pūkiawe (Shaw and Castillo 1997)], though alien species are disrupting natural succession in many areas. Federally listed endangered plant species occur throughout the installation, occupying sites as barren as the mouths of lava tubes and cracks within the lava as well as densely vegetated areas (see Map 1). The Palila bird (*Loxioides bailleui*) and several other T&E vertebrate species are also found within the boundaries of PTA.

One of the most serious threats to the continuance of a viable population of these T&E species is wildfire. Fires not only kill individuals through the direct effects of burning, they destroy habitat and provide conditions favorable to colonization of exotic fire-adapted plant species, most notably *Pennisetum setaceum* (Forssk.) Chiov. (fountaingrass), a highly invasive alien grass originating from North Africa. In the past decade, two large fires have burned in the Kipuka Kalawamauna, an area notable for its high density of endangered species, and *P. setaceum* now dominates the westernmost portion of this area (personal observation).

Fire Effects on Hawaiian Ecosystems

Non-human caused fires in Hawaii have always been uncommon due to a lack of ignition sources and the relatively moist environment that covers the majority of the islands (Mueller-Dombois 1981, Smith and Tunison 1992). Lightning is infrequent and is usually accompanied by precipitation, and dry lightning is extremely rare. Lava-ignited fires do not burn enough area in comparison to the area covered by the flow itself to be of any significance (Vogl 1969).

Human colonization brought with it the introduction of fire as an agricultural tool and as a side effect of other activities. Effects on most native plant species are not well understood, but anecdotal evidence suggests that areas that are disturbed by fire tend to be overwhelmed afterwards by highly aggressive non-native invaders. There are many possible reasons for this, though the most likely explanation is that the exotics have evolved in ecosystems in which they were surrounded by competitors, herbivores, and disturbance regimes that pressured them to develop characteristics that allow them to respond to fire with more vigor than species that have evolved in non-fire prone areas, such as the natives of Hawaii. The exotics are from highly competitive ecosystems that are subject to frequent fire and heavy grazing and therefore have developed a strong ability to resprout from belowground organs and/or germinate quickly from seed (Pyke 1987, Freifelder et al. 1998). When released into an environment in which many ecological niches are vacant or filled with comparatively poorly fire-adapted species, the exotics flourish.

These species are tenacious and do not easily give up ground once they have taken it. Molasses Grass (*Melinis minutiflora* Beauv.) has been shown to not only establish itself after fire, but to continue increasing its dominance after the disturbance for years or even decades to the exclusion of most woodland species (Freifelder et al. 1998) such as *Metrosideros polymorpha* and *Sophora chrysophylla* (māmane). *Melinis* does this largely by restricting the amount of light that penetrates its canopy to 1% of incident radiation thereby starving competitors for energy (Hughes and Vitousek 1993, Skerman and Riveros 1990, Smith 1985). Because it responds so vigorously after fire, its canopy is established long before competing species can develop the height to penetrate it.

Many of the effects of this type of invasion are obvious. The conversion of native grasslands and forests to monotypic exotic grasslands has had a major impact on the structure and function of the Hawaiian ecosystem (Hughes and Vitousek 1993, Freifelder et al. 1998). However, some effects are less evident. Changes in microclimate temperature, windspeed, and fuel moisture between seasonally dry woodland and converted grasslands were studied by Freifelder et al. (1998). As expected, they found that the windspeed increased when the woodland canopy was removed. However, there was no significant difference in fuel moisture and there was an unexpected decrease in temperature in the grassland. This unanticipated result is attributed to the high light penetration that is allowed by the woodland canopy heating up the forest floor combined with the protection from the wind provided by the tree cover. However, because fire spread is most influenced by wind in grasslands, the ultimate result of these microclimate changes was an order of magnitude increase in simulated fire rate of spread and a 40-fold increase in area burned after one hour in the grassland over the woodland. In the worst case simulation, the projected rate of spread in the grassland was 25 times that of the woodland. This is significant, as the conversion of dry woodlands to exotic grasslands has been prevalent in the last century (Janzen 1988).

It is suspected that microclimate changes attributed to the conversion of woodlands to grasslands has influenced the precipitation regime, particularly on the western (dry) sides of all the islands, resulting in further impact from drought and a further reinforcement of the woodland to grassland conversion process. Such climate change has been documented on larger scales in the Amazon Rainforests of Brazil (Giambelluca et al. 1997, Nobre et al. 1991, Lean and Warrilow 1989). However, the scale at which deforestation is occurring in the Amazon is many orders of magnitude larger than in Hawaii. There is some uncertainty as to whether the same mechanisms that are at work in the large expanses of Amazonia can work at the small scales of Hawaii.

Biogeochemical cycles are effected as well. With every fire, a substantial amount of nitrogen (N) is volatilized. In the typically nutrient poor soils of the Big Island (Vitousek et al. 1993), this is a significant loss to the ecosystem. Ley and D’Antonio (1998) demonstrated that exotic grass invasion in Hawaii results in a decrease in N fixation activity compared to tropical woodlands, potentially reducing the overall amount of available N in the ecosystem for the long term. However, their finding seems to conflict with previous work by Asner and Beatty (1996) who maintain that, overall, grassland plots had larger inorganic N pools and higher ammonification and nitrification rates than neighboring shrublands. Asner and Beatty concluded that the increase in N availability that they found could provide the additional nutrients necessary to allow additional exotic species that are not as well adapted to low N pools to invade these sites. The conclusions of both these authors suggest that changes in nitrogen cycling in Hawaii could be detrimental to the continued existence of native species.

As demonstrated above, fire in Hawaiian ecosystems has a variety of impacts, virtually all of which are negative from the perspective of conserving native ecosystems and controlling future fires. The effect on individual species is largely unknown. However, a few natives are known to possess some fire adaptive traits. Because fire has become a common feature of the landscape, it is important to understand its effects on the local flora and fauna.

A few native species have been observed to benefit from occasional fires. These species are considered to be fire tolerant which should not be confused with fire resistant. During a fire the aboveground portion of a fire tolerant plant is usually killed and survival occurs through resprouting or regeneration from seed. Fire resistant species possess features, such as thick or insulating bark, that allow them to resist damage during the burning event.

Pili grass (*Heteropogon contortus* (L.) Beauv. Ex Roem. Et Schult.) was a dominant species on many of the major Hawaiian Islands until the introduction of livestock grazing and aggressive exotic grass species. *Heteropogon* benefited from occasional fires because the competing woody species were destroyed leaving the area free of an overstory (Shaw 1957). Grasses in general tend to be adapted to fire and this is likely true for many of the Hawaiian grasses such as *Eragrostis* spp. However, the invasion of the islands by exotic pyrophytic grasses that are much better adapted to fire has made this an inconsequential point, as competition with the exotics after fire, not recovery from fire alone, is currently controlling the fate of the native species.

Two of the dominant species at PTA are *Dodonaea viscosa* Jacq. and *Myoporum sandwicense* A. Gray (naio), both shrubs that are common in large portions of western part of the installation and within the Kipuka Kalawamauna. Even in the presence of invasive exotics, *D. viscosa* fares well after fire because it resprouts vigorously and regenerates extensively from seed (Shaw et al. 1995, Hughes and Vitousek 1993), both common adaptations of fire tolerant plants elsewhere in the world. *M. sandwicense*, however, responds more slowly to fire. It is more easily killed than *D. viscosa* and its recovery after fire appears to be much slower (Shaw et al. 1995).

The native Hawaiian species in Table 3 are known to be fire tolerant in the absence of invasive exotic species. Table 4 lists native species known to respond negatively to fire.

Table 3 – Fire Tolerant Native Species

Scientific Name	**Common Name**	**Response to Fire**
Acacia Koa	Koa	Regenerates from seed[1] and/or root suckers[2]
Chamaesyce degeneri	‘Akoko	Resprouts[3]
Deschampsia nubigena	N/A	Resprouts[4]
Dodonaea viscosa	‘A‘ali‘i	Resprouts and regenerates extensively from seed[5]
Eragrostis grandis	‘Emoloa Grass	Resprouts[6]
Eragrostis atrapioides	Hawaiian Lovegrass	Resprouts[14]
Gossypium tomentosum	Hawaiian Cotton	Resprouts[7]
Haplostachys haplostachya	Honohono	Resprouts and regenerates from seed after low intensity fire, Regenerates from seed after moderate intensity fire[8]
Hetropogon contortus	Pili Grass	Resprouts vigorously after low intensity fire[9]
Metrosideros polymorpha	‘Ōhi‘a	Resprouts from root crown[3], killed by high intensity fire[5]
Myoporum sandwicense	Naio	Resprouts but slow growth[3]
Sadleria cyatheoides	‘Ama‘u	Quickly reproduces killed fronds[3]
Santalum spp.	Sandalwood	Resprouts and regenerates from seed[2]
Sida fallax	‘Ilima	Resprouts[10]
Silene hawaiiensis	HI Catchfly	Resprouts immediately[8]
Silene lanceolata	Lanceleaf Catchfly	Resprouts unless completely consumed by fire[8]
Sophora chrysophylla	Māmane	Resprouts but cover reduced[11], seed viability diminished[12]
Stenogyne angustifolia	Creeping Mint	Resprouts and regenerates from seed if precipitation occurs[8]
Tetramolopium arenarium	Mauna Kea Pamakani	Regenerates slowly from seed[8]
Vaccinium spp.	‘Ōhelo	Resprouts but slow growth[4]

*Note: These species possess adaptations that allow them to recover from fire, however, fire adapted exotic species will outcompete natives after fire almost without exception.

Table 4 – Non-Fire Tolerant Native Species

Scientific Name	Common Name	Response to Fire
Chenopodium oahuense	‘Āheahea	Very little recovery after fire[8]
Dicranopteris linearis	Uluhe	Recovers very slowly[3]
Diospyros sandwicensis	Lama	Easily killed[3]
Metrosideros polymorpha	‘Ōhi‘a	Killed by high intensity fire[5], resprouts otherwise[3].
Osteomeles anthyllidifolia	‘Ūlei	Easily killed[3]
Styphelia tameiameiae	Pūkiawe	Killed by fire[6] and will not reestablish from seed[5]
Wikstroemia sandwicensis	‘Ākia	Easily killed at low elevations but resprouts if within the coastal strand ecosystem[3]
Wikstroemia phillyreifolia	N/A	Easily killed[13]
Zanthoxylum hawaiiense	N/A	Does not resprout or regenerate from seed following fire[8]

*Note: This is a short list of native plants that have been documented to have a negative response to fire. Because of the lack of fire in the evolutionary background of most Hawaiian species it can be assumed that many of them are not fire adapted.

1 Scowcroft and Wood 1976
2 Smith, C.W. Unpublished
3 Smith and Tunison 1992
4 Loope, L.L. and Smith C.W. Unpublished
5 Hughes 1989
6 Smith et al. 1980
7 Vogl, R.J. and Kartawinata, K. Unpublished
8 Shaw et al. 1995
9 Tunison, J.T. Unpublished
10 Stephens 1963, 1964
11 Mueller-Dombois 1981
12 Warshauer 1974
13 Hughes and Vitousek 1993
14 Personal Communication with J.M. Castillo

The presence of a few fire adapted species does not insinuate that fire is a beneficial or even benign part of the Hawaiian ecosystem. Hawaiian Cotton or ma‘o (*Gossypium tomentosum* Nutt.) and ‘ilima (*Sida fallax* Walp.) have both been observed to resprout after fire (Stephens 1963, 1964; Vogl and Kartawinata unpublished). *Dubautia* and *Dodenaea* produce flammable oils and resins (Smith and Tunison 1989). These adaptations, usually associated with fire adapted species, do not necessarily mean that fire is beneficial to these ecosystems as a whole (Smith and Tunison 1989; Mueller-Dombois 1981, Shaw et al. 1995). For example, other Hawaiian species, such as lama (*Diospyros sandwicensis* (A. DC) Fosb.) and wiliwili (*Erythrina sandwicensis* Degener) do not resprout even though they would be expected to because they occur in dry, fire prone areas (Smith and Tunison 1989). This further implies that fire is not a common or beneficial disturbance in Hawaiian ecosystems because these common species would be expected to benefit from fire in some respect

Fire History of Pohakuloa Training Area

1.1 Summary

Historically, fire in the area of PTA was most likely rare and of little significance, limited to volcanically started fires and occasional lightning ignitions. Military use for live fire exercises and target practice has increased ignition frequency dramatically and resulted in numerous small fires, though it appears that much of the threat to endangered species populations is a result of off post ignitions.

1.2 Fire History Methods

The historical fire regime of the Hawaiian Islands is documented in Analysis of Fire Management Concerns at Makua Military Reservation (Beavers et al. 1999). Recent fire history at PTA was inferred as best as possible from existing fire records and documentation provided by USARHAW, the Federal Fire Department at PTA, the USFWS, and the State of Hawaii Department of Land and Natural Resources (DLNR). Trend analyses were performed on the relation of fire frequency to year, month, time of day, and location. We also attempted to relate fire frequency with use of the installation. However, utilization records are archived for only two years, and because of the variability in the location of training throughout the installation this analysis was not possible.

1.3 Fire History Results

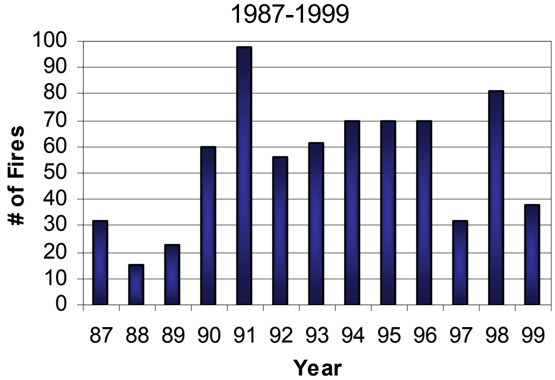
All available records were compiled into the fire history in Appendix 1. These records were supplied by the PTA Federal Fire Department, PTA Range Control, the USFWS, and the State of Hawaii DLNR. Fire records were numerous for PTA but most were incomplete. Many records included a date, time, and location for the fire but very little information was available about the size of fires or the weather conditions during the fires. The amount of information included in reports seemed to be related to the year, probably as a result of changes in management. For this reason, many of the analyses utilized only years in which data was available for the parameter of interest.

Many fires were not recorded at all. The most notable omission is fires that occurred in the impact area, where only 16 fires were recorded over the 13 years of records reviewed. There were, by all accounts, tens to hundreds of fires in the impact area during this time period. However, because these fires tend to be small, they have little chance of escaping the boundary of the impact area, generally are not suppressed, and often were not recorded. These omissions surely affected the results of the analysis to some degree, but the extent to which this is true cannot be known.

The limitations mentioned above prohibited a complete analysis of fire trends. However, we did conduct analyses on the year, month, and time of fires, the acreage, and the relation to weather conditions. Analyses were also conducted on the ignition source and location for years in which that information was available.

Figure 3

Number of Fires per Year at PTA 1987-1999



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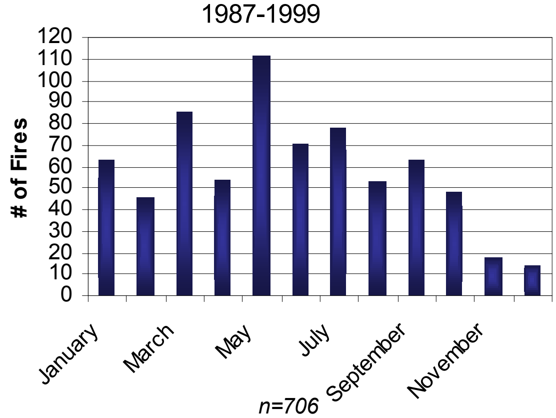
No trend was evident in the number of fires per year (Figure 3) over the last decade. There was some interesting variation in the data, particularly a marked decrease in the number of fires in 1997 and 1999 and an increase in 1991.

There is little information to suggest that there was an actual decrease in the number of fires during 1997 and 1999. Most fire indicators, such as the ongoing drought that began in early 1997, suggest that an increase should have been observed. These decreases may simply represent poor record keeping or lost records, but there is no way to definitively assess the cause. The infrequent fires from 1987-1990 is almost certainly a result of lost records. Attaining information about this period was difficult due to the lack of available personnel who were at PTA at the time and who may have known what happened to any records that may have existed, and the government's policy on record keeping which is to dispose of all non-vital documents after several years.

Nineteen Ninety was the wettest of the past 17 years with an annual total rainfall nearly twice the average. It was followed by one of the driest years, 1991 (Bern 1995) which also showed a notable spike in fire frequency. This may have been caused by increased vegetation production as a result of the wet year of 1990 and a corresponding increase in fuel loading in

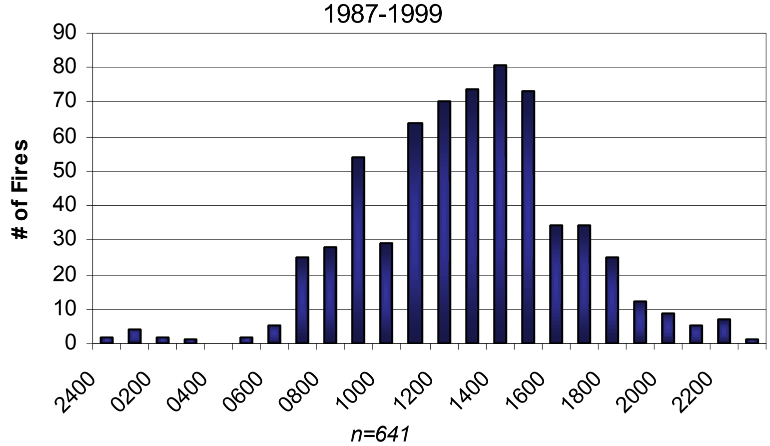
1991 when precipitation decreased. These climatic factors may have resulted in larger than normal fuel loads and an increase in fire frequency that year.

Figure 4
Number of Fires per Month at PTA
1987-1999

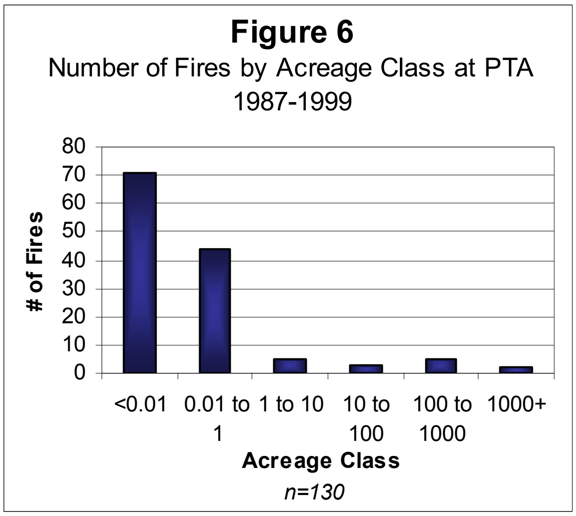


The climate fluctuations that caused this spike are notable for their impact on vegetation as well as their influence on fire frequency. During a Land Condition Trend Analysis (LCTA) survey in 1993, vegetation cover, density, and biomass production were lower than all previous surveys (Bern 1995), suggesting that the large precipitation decrease observed in 1991-1992 did affect vegetation recovery. This is important because of its implications for post fire recovery and fuel management. Low precipitation or other deleterious climate variations could increase the impact of fires by prolonging the time necessary for native vegetation recovery and thereby increase the opportunity for alien species invasion. Alien species tend to be generalists and are better adapted to a wider range of environmental conditions. Therefore, they are more tolerant of drought and other climatic variations that produce negative impacts on the natives. Thus, during periods of stress for the native populations, the exotics have an increased competitive advantage.

Figure 5
Number of Fires by Time of Ignition at PTA
1987-1999

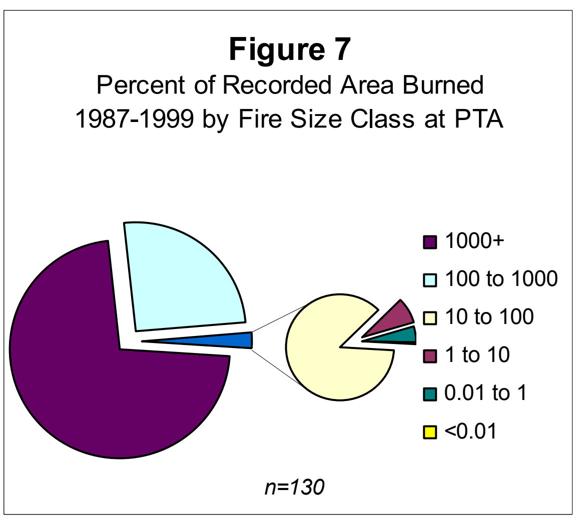


The number of fires per month exhibits a rough curve peaking in the months of March to July (Figure 4). One might expect this because these are the driest months of the year (Bern 1995). However, PTA is dry throughout the year and the amount of precipitation received during the winter is probably not enough to change the probability of fire by any significant amount. For this reason we would not expect to see any noticeable annual cycle in fire frequency. The main cause of monthly variation in the data is probably the frequency and intensity of use by the military. Increases in ignition sources as a result of increases in training will lead to increases in the number of fires. The months of highest use by the military vary from year to year, possibly explaining some of the variation in fire frequency per month. We attempted to link fire frequency per month with military usage of the installation. However, the results were ambiguous because only two years of utilization records were available and there was substantial variability in both the utilization of the installation and the number of fires per month.



Fire frequency by time of day (Figure 5) illustrates that fires occur most frequently during the early afternoon and least frequently at night. Eighty percent of all recorded fires started between 0900 and 1700, the hours when levels of training and fire danger indices tend to be at their highest. No explanation is immediately apparent for the low number of fires occurring between 1000 and 1100 hours. It appears to be simply an anomaly of the data.

The acreage per fire (Figure 6) was only available for approximately 20% of the fire records, but we can conclude from the available evidence that the huge majority of fires are very small (<1 acre). When fire size is taken into account (Figure 7), it becomes clear that a small number of large fires are responsible for most of the acreage burned. Over 97% of the recorded acres damaged by fire from 1987-1999 were burned by eight individual fires of 100 acres or more. The two Kipuka Kalawamauna fires, which started off post, account for 72% of all acres burned within PTA's boundaries. This is significant because it demonstrates that, though military training does pose a danger, the real threat to endangered species at PTA is from civilian



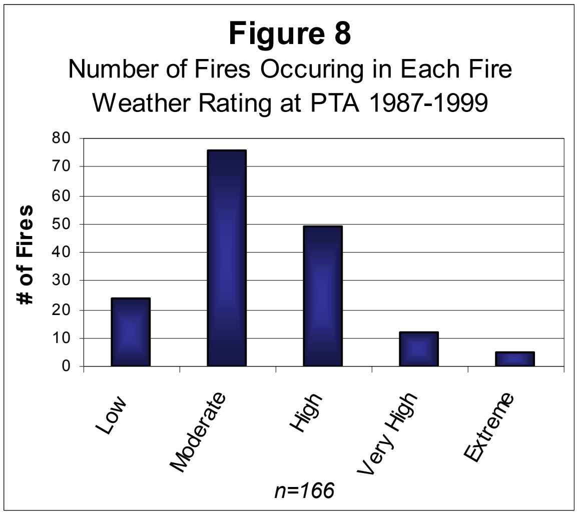


Figure 8
Number of Fires Occuring in Each Fire Weather Rating at PTA 1987-1999

ignition sources. This topic is discussed in further detail in the Pre-Suppression and Fuel Management Options section.

Figure 8 depicts the number of fires recorded as starting under one of the five fire weather ratings (hereafter referred to as fire danger ratings) developed by the Army. The indices were determined from a combination of the ignition component (IC), defined as a measure of "the probability of a firebrand producing a fire that will require suppression action" (Deeming et al. 1978), and the burning index (BI), which is a measure of the fire's probable intensity. Table 5 depicts the variables used to determine a day's fire danger rating.

Table 5: The fire danger rating system used by the Army at PTA until 1997.

Burning Index	*Ignition Component* 0 - 20	21 - 45	46 - 65	66 - 80	81+
0 - 5	Low	Low	Low	Moderate	Moderate
6 - 17	Low	Moderate	Moderate	Moderate	High
18 - 22	Moderate	Moderate	High	High	Very High
23 - 28	Moderate	High	Very High	Very High	Extreme
29+	High	Very High	Very High	Extreme	Extreme

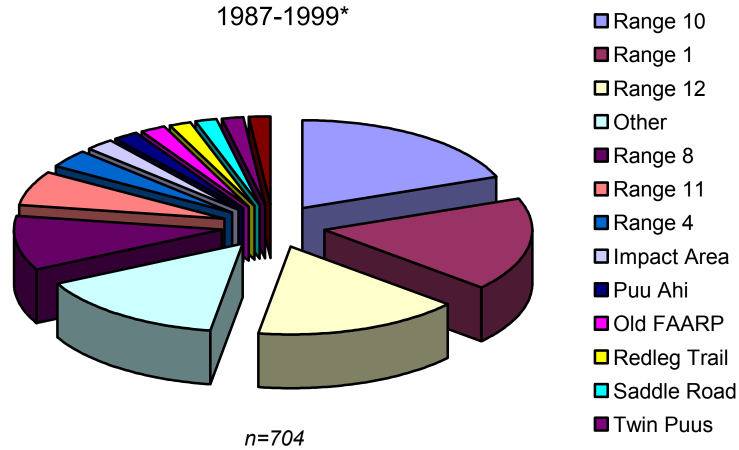
No Army employee was able to describe either the method by which the category cutoffs were determined or how the IC or BI were calculated from the limited weather data available from the Bradshaw Weather Station. There was no significant correlation between fire danger rating and the size of fires, however, only 46 (6.5%) of the 709 total records that we procured included both a fire danger and a size for the fire.

Figure 9 and Table 6 illustrate the fact that areas receiving the highest use suffer the most frequent fires. Ranges 1, 8, 10, 11, and 12 are the most heavily utilized training locations at PTA. These areas are also at the top of the list of fire frequency locations. This is not surprising because areas receiving the highest use will also have the highest number of ignition sources.

Ranges 1 and 10 are both assault courses designed for squad and platoon size units respectively. There are several possible reasons why these two ranges are the most common

Figure 9

Percent of All Fires by Location at PTA 1987-1999*



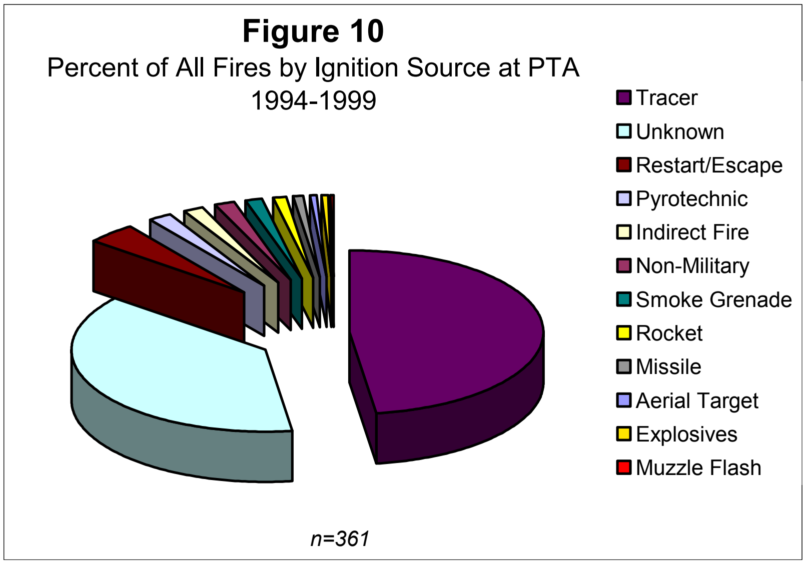
*Areas with fewer than 10 recorded fires are included in the "other" category.

locations for fires. First, these are two of the most frequently used areas at PTA. Second it is common for a large number of rounds from a wide variety of weapons systems to be expended within the course of an exercise. These weapons systems may include anything from explosives to tracers. Finally, weapons are fired at a wide variety of elevation angles and in many directions, though always within the range fan. This, in combination with the necessity of making the exercises as realistic as possible, makes control of ignition sources difficult. Vegetation at ranges 1 and 10 is not significantly different than at other ranges and, therefore, was ruled out as a reason for the higher frequency observed.

Table 6: Number of recorded ignitions per location at PTA from 1987 to 1990.

Location	*Frequency*	*Location*	*Frequency*	*Location*	*Frequency*	*Location*	*Frequency*
Range 10	134	Twin Pu'us	12	Area 4	4	BAAF	2
Range 1	122	Range 9	11	Area 8	4	MPRC	2
Range 12	113	Area 16	9	K. Kalawamauna	4	Area 10	1
Range 8	70	Range 20	9	Range 3	4	Area 17	1
Range 11	44	Area 1	8	Area 15	3	Area 21	1
Range 4	24	Range 13	8	Area 5	3	Area 3	1
Impact Area	16	Area 7	7	Area 9	3	New FAARP	1
Pu'u Ahi	14	Off Post	6	Range 5	3	POL	1
Old FAARP	13	Range 2	5	Range 10	3	Range 16	1
Redleg Trail	12	Area 18	4	Area 12	2	Range 7	1
Saddle Road	12	Area 22	4	Area 13	2		

Ranges 8 and 12 are utilized for machine gun and sniper qualification and instruction. It is likely that the large number of tracer rounds expended on these ranges is responsible for the high fire frequency here.



The remaining locations identified in Figure 9 all have one of two factors in common: either a low volume of ammunition used or weapons systems with low ignition probabilities. While some of the weapons systems fired may pose a high danger of fire (see Table 7), they are generally heavy weapons that are fired infrequently such as missiles, rockets, and demolition explosives. Some areas are restricted to low ignition probability weapons such as ball ammunition and hand grenades, or are areas in which no ammunition is fired at all, Saddle Road for example.

Of all of the fires started on or burning onto PTA, by far the most common cause is tracer ammunition (Figure 10). Tracers easily start fires and are one of the most commonly used ammunitions. The Unknown category probably includes a large number of tracer caused fires as well, if we can assume that unknown ignition sources follow the same patterns as those that are known.

It is important to note that the overwhelming majority of the acres burned at PTA have been caused by fires originating from non-military sources. Since July 1990, 8,424 acres have been recorded as burned. Of these, over 7,700 acres, or 91%, of all acres burned were by fires caused by lightning, arson, or carelessly discarded cigarettes, and the largest of these started off Army lands and later burned onto PTA.

Map 2 shows the extent of a number of significant fires that have burned in Puʻu Anahulu and map 3 shows the location and frequency of ignitions in and around PTA. These maps suggest that fires that are ignited on Army lands tend to be located in areas that have a much lower concentration of T&E species, while fires that start off Army lands and burn onto them

Table 7: Fire ignition potential of weapons/ammunition cleared for use at PTA

Weapon	*Ammunition*	*Fire Potential*
Rifle Pistol Machine Gun Shot Gun	<u>Ball</u> .50 Caliber 5.56 mm, 7.62 mm, 9 mm Buckshot	Low
	<u>Tracer</u> 5.56 mm, 7.62 mm, 9 mm 40 mm Target Practice Training (TPT), Illumination (ILLM), High Explosive (HE), High Explosive Dual Purpose (HEDP)	High
Helicopter Guns	20 mm ball	High
Mortar and Artillery	60 mm HE	Low
	60 mm ILL	High
	81 mm HE, TP	Low
	81 mm ILLM, Smoke (SMK), Red Phosphorous (RP), White Phosphorous (WP)	High
	105 mm HE	Low
	105 mm WP, HC, Smoke	High
	155 mm HE, Laser Guided (Copperhead)	Low
	155 mm WP, Smoke, ILLM	High
AT-4 Anti-Tank Weapon	84 mm HE Anti-Tank Rocket	Low
Light Anti-Tank Weapon (LAW)	66 mm HE Anti-Tank Rocket	Low
	35 mm Subcaliber Practice Rocket	High
Folding Fin Rocket	2.75 in WP, ILLM	Low
Medium Anti-Tank Weapon	Tactical Missile	High
M47 (Dragon Missile)	Inert Missile	Low
Shoulder-Launched Multipurpose Assault Weapon (SMAW)-Marines	SMAW Practice, SMAW Common Practice	Low
Tube Launched, Optically Tracked, Wire Command Link (TOW)	Inert	Low
	HE	High
Stinger	Shoulder-Fired Heat Seeking Surface-to-Air Missile	Low
Ballistic Aerial Target System (BATS)		Low
Bombs	MK-10, MK-76 (25 lbs. Practice) MK-82 (500 lbs.), MK-83 (1000 lbs.), MK-84 (2000 lbs.)	High
Grenades (Hand and Rocket Propelled)	M67 Fragmentation, Practice	Low
	WP, Smoke	High
Mines	Claymore Antipersonnel, Land Mines (Anti-Tank Mines)	Low
Demolition	TNT, C-4 Block, Detonation Cords, Bangalore Torpedo	Low
Flare	White Parachute	High

From Preliminary Draft Biological Assessment for PTA 1999 tend to occur in areas of high T&E species concentration. Two major fires have burned through Kipuka Kalawamauna in the past six years. These two fires account for 91% of all recorded acres burned within PTA in the past decade. These figures clearly indicate that the priority for fire management must focus on protecting Kipukas Kalawamauna and Alala from civilian ignited fires moving up from Mamalahoa Highway and Puʻu Anahulu.

The one exception to this generality is the Twin Puʻus area. This area has the potential for a major fire because of the high density of *Pennisetum setaceum* that provides a fire corridor to the top of Kipuka Kalawamauna and the high ignition probability weapons that are fired at the Twin Puʻus.

1.4 Conclusions and Recommendations

Fire frequency and size at PTA follow the same patterns expected of fires throughout the U.S. The highest fire frequency occurs during the hottest, driest part of the day and year. The frequency and types of training appear to have an effect on fire frequency. Areas that are heavily utilized and that are designated for high ignition probability weapons systems such as tracer ammunitions have the highest fire frequency, while areas designated for low ignition probability weapons or areas that are infrequently used have the lowest fire frequency.

In general, the fire history for PTA clearly demonstrates that civilian ignitions pose a major threat to T&E species within the military boundary. In comparison, military ignitions, while far more frequent, tend to occur in areas that are of lower protection priority and burn fewer acres. These two facts indicate that fire protection priorities need to be placed along the western PTA boundary to create a network of firebreaks and fuel management areas that will impede or stop fires approaching from Puʻu Anahulu.

The recommendations for PTA follow closely those made for Makua Military Reservation. First, fire records should be kept for every fire, regardless of extent or severity. These records should include:

- Date of ignition*
- Time of ignition*
- Ignition source*
- Date declared out
- Time declared out

- Time of escape (if appropriate)
- Burning index and fire danger category (to be determined by a future report submitted by the USDA FS) at the time of ignition and (if possible) every hour that the fire burns*
- Resources used to suppress the fire (including number and type of equipment and personnel)
- Location of the fire* (i.e. The ignition point and the burn boundary, preferably located with a GPS unit)
- The total number of acres burned*
- Whether any of the known endangered species locations were burned

Items marked with an asterisk are vital to future assessment of fire management success and should be recorded with the best possible accuracy and consistency.

Remote Automated Weather Station (RAWS) data during all fires should be retained with the fire records for future reference. The Wildland Fire Incident Report form in Appendix 1 to Annex A of the Wildland Fire Management Plan: Pohakuloa and Oahu Training Areas published March 2000, can be easily modified for use at PTA. In addition, for those fires that escape initial attack and grow beyond a threshold size (approximately 100 ac), a wildland fire situation analysis and large fire narrative should be completed. These documents summarize daily fire danger, fire behavior, resources and values at risk (including endangered species habitat), and resultant management decisions and outcomes.

Fuel Management and Pre-Suppression Options for Pohakuloa Training Area

5.1.1 Summary

With few exceptions, fire control at PTA is straightforward, though in all likelihood quite expensive because of the scale of pre-suppression actions necessary to protect the valuable resources present. Abundant barren or nearly barren lava flows provide numerous natural firebreaks for use in containing fire spread. However, areas of high resource value generally occur in dense vegetation. The most frequently utilized ranges are primarily on the east side of the installation, opposite the location of most of the endangered species and the areas with the highest potential for fire escape. Fuel management may be limited to herbicide and a number of small prescribed burn areas because there are few sites that do not contain T&E species.

5.1.2 Natural and Pre-Existing Fire Barriers

One of the most noticeable features of PTA is the large expanses of barren or nearly barren lava that cover more than half the installation. Two major flows have occurred within the last several hundred years that provide effective firebreaks. The Keamuku flow originated from Mauna Loa and spread north until it entered the saddle region, then turned to the northwest and flowed towards the western coast. This flow has very little established vegetation on it and has provided an excellent barrier to the propagation of fire in the past, though establishment of *Pennisetum setaceum* may reduce its effectiveness in the future. Because of the Keamuku flow, fires in the area of Pu‘u Ka Pele have no pathway into the Kipuka Kalawamauna and fires in the Kipuka have no way of crossing into the Ka Pele Endangered Plants Habitat, thus compartmentalizing these two areas (see Map 4).

Though the Keamuku Lava Flow has been successfully used in the past as a fire barrier, it is being overgrown with *Pennisetum setaceum*. At some point in the near future, the fuel continuity will be sufficient to sustain a fire across it. Because of this threat, plans for fire pre-suppression for the next 5-10 years should consider construction of a firebreak on top of or along the base of the Keamuku Flow. An alternative may be constructing a firebreak across the Keamuku Flow and tying it into 4WD roads on Parker Ranch and continuing into PTA in the Pu‘u Keekee/Pu‘u Ka Pele area. These 4WD roads would have to be improved to standards that would allow control of a fire burning on Parker Ranch. Because this area is heavily grazed, the roads probably would not have to be widened or herbicided, only kept clear of vegetation.

The 1859 flow also emanated from Mauna Loa but traveled in a more northwesterly direction parallel to the Keamuku flow and approximately 4.5 miles to the southwest. These two flows restrict fires starting on Mamalahoa Highway, a major ignition source, to a corridor that leads through Puʻu Anahulu to Kipuka Kalawamauna and Kipuka Alala. Controlling fire within this corridor is vital to the protection of populations of T&E species within the Kipukas.

Existing firebreaks and roads in the northwestern corner of the installation are shown in Map 4 along with recommended improvements. Most of the existing firebreaks have not been maintained since they were constructed and are completely overgrown, providing virtually no fire protection. However, pre-existing firebreaks have already been disturbed by bulldozers and can be readily improved. Because these areas have been disturbed in the past, there is a much lower probability of encountering any protected cultural or natural resources while improving the firebreak. Additionally, building firebreaks in lava is very labor intensive and areas that have already been bulldozed will require significantly less work than building in an undisturbed area.

5.4.1 Recommended Improvements

All improvements should be made only after taking full consideration of natural and cultural resource locations and sensitivity. Most of these recommendations involve creating or improving bulldozed firelines, an activity that can damage important resources. The Army should cooperate and coordinate with state and local agencies as well as neighboring private landowners to avoid unnecessary duplication of efforts. Two areas in which this is particularly important are the Puʻu Anahulu corridor to the northwest and the Palila Critical Habitat Area to the north. The state currently has plans for pre-suppression improvements in these areas that could be reinforced by Army projects.

Cost estimates for line construction varied so widely that they are not given for individual improvements. Rough costs per mile from two sources, after adjustment for inflation from the year of the quotes, varied from $10,850 to 90,000/km ($17,500 to $145,000/mile). The true cost will depend on the terrain, substrate, and accessibility. The following improvements are listed in order of priority.

West PTA Firebreak

In the past, fires in Puʻu Anahulu and Kipuka Kalawanauna have been fought from hastily constructed fire lines that generally have not been capable of stopping large fires. The top priority for fire management at PTA should be the completion of a western boundary firebreak that starts from the Keamuku lava flow on the north and continues along the installation boundary to Old Kona Highway. From here there are several options but the ultimate objective should be to tie into the 1859 lava flow thus forming a comprehensive, defensible perimeter against fires moving up the Puʻu Anahulu corridor.

The least expensive and quickest option is to improve existing breaks within PTA and the Puʻu Anahulu Game Management area. By improving Old Kona Highway and an existing firebreak built by State of Hawaii fire fighters during the 1999 fire, firebreaks will cut off the fire pathway from Mamalahoa Highway to PTA (see Map 4). This break would be approximately 14.5 km long (9 miles). While this will require substantial coordination and cooperation with State of Hawaii land managers, the potential benefit of establishing a firebreak across Puʻu Anahulu is considerable. Other older, overgrown breaks also may exist within Puʻu Anahulu that would be more cost effective to use.

By establishing a control line from the Keamuku flow to the 1859 flow, the corridor that allows fires to move into Kipukas Kalawamauna and Alala from Mamalahoa Highway and Puʻu Anahulu can be defended from a well established and well anchored firebreak. The location of this break protects almost all documented populations of T&E species in Puʻu Anahulu, Kipuka Kalawamauna, and Kipuka Alala. During a large fire, backfires can be lit from this firebreak allowing the establishment of an excellent barrier to wildfire. Backburns would be unlikely to destroy any T&E species that a wildfire wouldn't burn, and the benefit of backburning during a large fire, even if a few populations of T&E species are destroyed, far outweighs the costs of allowing the fire to burn to the firebreak and risking an escape.

The minimum specifications for these breaks should be a 20-foot width of bare mineral soil, and accessibility to all 4WD vehicles. The breaks should be as straight as the terrain allows to avoid bends that make a fire line difficult to defend. Herbicide should be applied to the maximum distance feasible on both sides of the firebreak with a boom applicator to widen the effective width of the firebreak to 40 to 60 feet, except in areas where T&E species exist. Hexazinone and glyphosate controlled *Pennisetum setaceum* for up to 2 years in a study by

Castillo (1997), though hexazinone is known to remain active in the soil and there is concern about leaching into groundwater. Herbicide treatment should begin as soon as possible along existing firebreaks to take advantage of the low fuel loadings that resulted from the 1999 fire. Firebreaks on State lands will probably require the Army to help with maintenance.

Option two is to continue from Old Kona Highway following the 4100 m contour line westward to the 1859 flow. This option is likely to be much more expensive than option one because of the long length of line that would need to be constructed in undisturbed lava. An Environmental Assessment or an Environmental Impact Statement may also be necessary because of the extent of the disturbance, further increasing the cost and the time to completion. The total length of this break would be approximately 8 km (5 miles), or about 6 km shorter than option one.

If funding does not allow the extension of the west PTA firebreak to the 1859 flow, it should continue from Old Kona Highway to the firebreak constructed in 1999 in the ‘ōhi‘a forest to the south. Eventually, however, a firebreak will need to be constructed that ties into the 1859 flow to allow the protection of Kipuka Alala. Although no fires have burned into Kipuka Alala in the recent past, the area will soon be at virtually the same risk as Kipuka Kalawamauna which has burned twice in the past decade. This is due to encroachment of *Pennisetum setaceum*, which will likely establish itself throughout the ‘ōhi‘a forest and elsewhere, increasing the continuity of fuels and providing the means for a fire to move from Pu‘u Anahulu into Kipuka Alala.

In order for the west PTA firebreak to be defensible, a water supply closer than the existing Kipuka Kalawamauna dip tank is needed. A number of locations have been discussed, including on top of the Keamuku flow or at the intersection of Old Kona Highway and the West PTA firebreak. The location is not of great significance except for the ease of refilling the tank, which will be a major obstacle to overcome as there are no water lines in the area.

The ideal option for protecting western PTA would be to construct and improve all of the firebreaks mentioned above to create a series of defenses allowing several chances to stop a fire before it moved into the Kipukas. However, the cost associated with the improvement or construction of firebreaks could make this impossible.

Mamalahoa Highway Firebreak

The second priority should be put on improving the Mamalahoa Highway firebreak. This firebreak runs parallel to Mamalahoa Highway for approximately 3.5 miles at the northwest end of Pu‘u Anahulu. This is an area where a large number of fires are ignited or jump the highway from the northwest and the subject of a more defensible firebreak in this area has been raised in the past. Though it is managed by the State of Hawaii Department of Forestry and Wildlife, the Army should give serious consideration to supporting firebreak improvements in this area because of the history of frequent fire starts along the highway and the tendency for fires in this area to burn into PTA. Additionally, the fires that will burn into PTA from Mamalahoa Highway will tend to be of high intensity, will not be easily stopped, and will do serious damage to large expanses of natural resources on Army lands.

The firebreak should be improved to the standards set out for the west PTA firebreak. Additionally, the Army should help to compartmentalize and prescribe burn the area between the firebreak and the highway or otherwise manage the fuels there. Currently, much of the area outside of the firebreak is in a state of very low fuel loading because it was burned by the 1999 fire, while most of the area inside the firebreak has not burned (see Map 2). Because of the unique opportunity afforded by this situation, prescription burns should be used as soon as possible to reduce fuels between the break and the highway. This can be done even before the Mamalahoa break is completed as the 1999 burned area can serve as a firebreak for a good portion of the prescription area. An additional benefit to burning now is that firefighters can gain vital experience with prescribed burning in this area at a time when potential for escape is virtually non-existent. This experience will be a valuable asset when fuels outside of the break have returned to a mature state and the risk of escape is higher.

The West PTA Firebreak should be finished prior to expenditures on the Mamalahoa firebreak because there is no guarantee that the Mamalahoa firebreak will contain all fires in the Pu‘u Anahulu area. The 1994 fire that burned most of Kipuka Kalawamauna started to the east of the Mamalahoa firebreak location. Hunters frequently use Pu‘u Anahulu and provide a potential ignition source via cigarettes and catalytic converters. Conversely, there have been no recorded fire starts in Kipuka Kalawamauna, and because PTA is a military installation, hunting is very limited, significantly reducing the likelihood of hunter started fires. This suggests that the west PTA firebreak will be in a better location to protect the resources found within the kipukas than the Mamalahoa firebreak.

Improvements to Firebreaks Within Kipuka Kalawamauna

Compartmentalization of Kipuka Kalawamauna is recommended for the purpose of giving firefighters secondary and tertiary positions from which to fight a wildfire. There is no guarantee that any single firebreak will stop a fire emanating from Puʻu Anahulu. Observations made by experienced wildland firefighters have put average flame lengths for the 1994 and 1999 fires at 20 to 40 feet. Flame lengths during the 1994 fire were estimated to be as long as 60 feet during periods of intense fire behavior. Few firebreaks can withstand a fire of this magnitude. While backfiring can help, for it to be effective during such a fire requires the backfiring operation to take place well before the fire reaches the firebreak. Fortunately, firefighters protecting PTA generally have several hours warning before a fire from Puʻu Anahulu reaches the PTA boundary. However, there may be instances in the future when the Mamalahoa Highway and West PTA firebreaks do not stop a fire's advance. When this occurs, firefighters will need a fallback position from which to continue fighting the fire. Firebreaks within Kipuka Kalamawauna can serve such a purpose. These firebreaks will allow them to contain a fire to one or several compartments and will negate the need to construct firebreaks during a fire which can sometimes be almost as damaging as the fire itself.

The 1999 firebreak that extends through the ʻōhiʻa forest on the south flank of Kipuka Kalawamauna should be improved to protect Kipuka Kalawamauna from fires that flank the southern end of the west PTA firebreak if it is not constructed across all of Puʻu Anahulu, and to provide a southern perimeter for the compartmentalization of Kipuka Kalawamauna. The firebreak needs to be widened and, if possible, straightened so that it is more defensible. This doesn't need to be finished immediately because this break will likely only have to be strong enough to stop flanking fires, not the head fires that more easily jump fire lines.

The rest of the compartmentalization can be accomplished by improving and extending the existing firebreaks that were constructed during the 1994 and 1999 fires shown in Map 4. Different firebreaks may have to be improved if any of these prove too costly to construct. Firebreaks north of Old Kona Highway should tie into the Keamuku Flow and breaks south of Old Kona Highway should tie into the 1999 firebreak.

As mentioned in the fire history, the area with the highest risk for a military caused fire escaping into endangered species habitat exists on the western edge of the impact area along the border with the Kipuka Kalawamauna. A high concentration of endangered species occurs within the Kipuka, and the border between the impact area and the Kipuka is occupied by a dense stand of *Pennisetum setaceum.* This provides a continuous and flammable fuel bed through which the fire may gain access to the Kipuka and which crosses the MPRC Access Road in several places (See Map 4). Because the Twin Puʻus are commonly used in target practice utilizing fire prone weapons, and *Pennisetum setaceum* is heavily entrenched in this area, a fire could start on or near the Twin Puʻus and move into the Kipuka. Any time that the trade winds are dominant, generally from late evening to mid morning, fires would be blown towards Kipuka Kalawamauna, threatening the T&E species there.

Fire roads in this area are generally wide enough to stop a moderate fire in *Pennisetum setaceum*, but under high wind conditions spotting could occur, allowing the fire to jump a road. The road network in this area provides multiple control lines and a defensible perimeter from which to establish control of a wildfire, however, there is no single road that can be depended upon to stop an intense fire burning towards the Kipuka.

The most significant barrier to fire spread from the impact area is the MPRC Access Road. However, this road is currently too narrow to be depended upon during a fire. The MPRC Access Road should be widened and herbicided as specified for the west PTA firebreaks. Except under the most extreme of conditions, a firebreak of such proportions will provide substantial protection against fires from the impact area. The Army should continue to restrict the use of pyrotechnics in the western portion of the impact area during periods of high winds. This is an effective means of reducing the likelihood of intense fire moving into Kipuka Kalawamauna.

<u>Protection of Palila Critical Habitat</u>

Another area of particular concern to fire managers is the Palila Critical Habitat in the northeastern section of PTA. Though ignition sources are more limited than in many other areas of the installation, the Palila Critical Habitat consists of dense shrub vegetation on the lower slopes of Mauna Kea where access for firefighters is limited. Fires that do get onto the mountain side of Mauna Kea Trail and Infantry Road will be difficult to fight from the ground, and air operations may not be effective because of the steep slopes, high winds, and the frequent lack of aircraft, which are available only when troops are training.

The easiest solution to this problem is to improve Mauna Kea Trail and Infantry Road to firebreak standards and to extend Mauna Kea Trail slightly in the area behind Pu‘u Pohakuloa (see Map 5). The improvements to Mauna Kea Trail will not need to be as substantial as those in the western section of PTA because of lower fuel loadings in the areas abutting it. However, fuel loads and the large shrub nature of the fuels around Infantry Road will require a firebreak built to the same standards as the West PTA Firebreak.

This is an area that will be affected by the future re-alignment of Saddle Road. The State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife already has plans for the protection of Mauna Kea ecosystems from potential ignitions on the new highway (Department of Land and Natural Resources 1997). The Army's improvements in this area should be coordinated to the greatest extent possible with the State to minimize any replication of efforts and to maximize the protection of the Mauna Kea ecosystems.

Central, Southern, and Eastern PTA

Central and southern PTA consists of sparse and discontinuous vegetation. UXO prohibits access to the impact area, eliminating surveys for T&E species or ground based firefighting operations. Therefore, it is not known if there are resources at risk within the impact area. Fire control problems could occur because fires will have a chance intensify before they are confronted with control measures at the boundaries of the impact area. However, backburning in conjunction with aerial bucket and retardant drops has been used in the past with much success to address this problem. With the exception of the MPRC Access Road improvements, there does not appear to be a pressing need for improvements in containing fires within the impact area.

Almost all of the eastern end of PTA is composed of large fields of lava broken by occasional pockets of vegetation. This area presents few fire management issues, as the fuels that do exist are sparse and discontinuous and resources at risk in this portion of PTA are far fewer than on the west and north ends of the installation. This area does contain all of the ranges with the highest fire frequency. However, fires on these ranges have been well controlled in the past using available control lines and suppression techniques.

5.4.2 Further Recommendations

Personnel Qualifications

A well-trained and devoted fire manager is necessary at PTA. This position could be filled within Range Control or at the Federal Fire Department. The individual chosen for this position should be experienced in wildland fire suppression, qualified through S-490 (Advanced Wildland Fire Behavior Calculations), and receive national level fire danger rating training. Responsibilities attached to this position would include ensuring that collection of data from wildland fires is complete as well as all normal firefighting duties. This position should be multi-year in duration and would preferably be filled by a civilian employee so that a competent individual can be retained for as long as possible. Experience with fire danger rating and fire fighting at PTA will result in more effective fire prevention and suppression.

Kipuka Alala

Kipuka Alala is isolated and infrequently used by the military. It is also an area containing concentrated populations of T&E species and is prone to fire because of thick vegetation. If the Army does not consider Kipuka Alala a necessary training area, it may be helpful to limit access. Fuels surrounding the Kipuka are currently sparse, though as mentioned previously, *Pennisetum setaceum* will likely begin to increase fuel continuity over the next couple of decades. Therefore, ignitions within the Kipuka presently pose a greater threat than fires burning in from elsewhere. By reducing or eliminating potential ignition sources within the Kipuka, the fire threat can be minimized.

There has been no military training within the Kipuka in recent years. However, vegetation monitoring, cultural surveys, and hunting may occur periodically. While it is necessary that these activities continue, those personnel entering the Kipuka should be notified of the threat of fire and measures that can be taken to mitigate the hazard. Vehicles should not be driven through brush or tall grass and should only be parked in areas free of vegetation to avoid fires started by catalytic converters. Smoking should not be allowed at all, but if this is not possible it should be confined to designated areas.

Conclusions

Fire frequency at PTA in the past 13 years has been high. The fire history includes two large fires that exacted a heavy toll on the T&E species within the installation. Large fires pose the greatest threat to natural resources here and must be controlled if viable populations of T&E species are to survive. While the military is responsible for most fire ignitions, it has been fires started by civilians off of Army lands that have caused the majority of the damage. Fire recording efforts need to be much improved in the future if there is to be any hope of utilizing any form of wildland fire prevention analysis.

The Army's primary fire management objective for the near future should be the completion of a large scale firebreak that extends completely across Pu‘u Anahulu between the Keamuku and the1859 lava flows. The construction of such a defensive line is vital as there is no viable way to control the frequent civilian ignitions on the state lands that lie to the northwest of PTA. Cooperation with the State will be central to successfully completing a firebreak in this area that is based on topographical features rather than political boundaries. Fire within PTA will certainly continue to be a common feature of the landscape. The nature of military training ensures this. However, the damage that it causes can be kept to a minimum by integrated planning and aggressive execution of necessary improvements.

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Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
750800	.	Puu Keekee	.	.	170	.	.	.	.	.
751100	.	Puu Keekee	.	.	56	.	.	.	.	.
771126	.	Mauna Kea For. Res.	.	.	1000	.	.	.	.	.
870123	.	Range 4	0800	1045	.	.	.	2	1 Struct Eng.	.
870130	.	Puu Menehone	1037	1058	.	.	.	2	1 Struct Eng.	.
870307	.	Range 1	1214	1303	.	.	.	4	1 Struct Eng.	.
870307	.	Range 1	1313	1457	.	.	.	8	2 Struct Eng.	.
870307	.	Range 1	1522	1815	.	.	.	4	1 Struct Eng.	.
870308	.	Range 10	1025	1330	.	.	.	8	2 Struct Eng.	.
870309	.	.	1030	1045	.	.	.	6	2 Struct Eng.	.
870309	.	Range 1	1215	1300	.	.	.	4	1 Struct Eng.	.
870310	.	Range 1	1245	2030	.	.	.	8	1 Struct Eng.	.
870311	.	Range 1	830	1115	.	.	Moderate	4	1 Struct Eng.	.
870311	.	Range 1	1215	.	.	.	.	4	1 Struct Eng.	.
870311	.	Range 1	1500	1650	.	.	.	4	1 Struct Eng.	.
870311	.	Range 1	1720	2000	.	.	.	4	1 Struct Eng.	.
870312	.	Range 1	1210	1800	.	.	Extreme	11	2 Struct Eng.	.
870323	.	Range 1	0952	1110	.	.	.	4	2 Struct Eng.	.
870325	.	Range 1	1300	1415	.	.	Very High	2	2 Struct Eng.	.
870512	.	Range 11T	1440	2000	.	.	High	9	1 Crash Eng. 1 Struct Eng.	.
870512	.	Range 4	1526	.	.	.	High	.	.	.
870516	.	Range 10	1240	1400	.	.	Low	.	1 Struct Eng.	.
870526	.	Unknown Range	0900	1020	0.01	.	Moderate	2	1 Struct Eng.	.
870613	.	Range 4	1015	1130	.	.	Moderate	2	1 Struct Eng.	.
870614	.	Range 10	1315	1555	.	.	Moderate	3	1 Struct Eng.	.
870614	.	Range 10	1705	1757	.	.	.	2	1 Struct Eng.	.
870615	.	Range 9	1025	1345	.	.	Moderate	5	1 Tanker, 1 Struct Eng.	.
870628	.	Range 10	910	1020	.	.	.	2	1 Tanker	.
870628	.	Range 10	1520	1837	.	.	.	2	1 Struct Eng.	.
870701	870702	43 mm Saddle Road	1810	1810	.	.	Moderate	All	All Available Resources	.
870718	870720	Mauna Kea Fire/Area 10	1219	1300	600 to 700	.	.	All	All Available Resources	Smoke Grenade
871013	.	Puu Ahi	1515	1755	.	.	High	.	2 Struct Eng.	.
871110	.	MPRC	1330	1700	.	.	.	.	1 Struct Eng.	.
871201	.	Puu Keekee	0120	0326	.	.	.	.	1 Struct Eng.	.
871208	.	Range 10	1130	1230	.	.	Very High	.	2 Struct Eng.	.
880120	.	Range 10	1805	1950	0.05	.	.	.	1 Struct Eng.	.
880121	.	Range 11	1720	1830	.	.	.	.	1 Struct Eng.	.
880123	.	Range 11	1345	1510	.	.	High	.	1 Struct Eng.	.
880124	.	Range 11	1530	1700	.	.	Moderate	.	1 Struct Eng.	.
880206	.	Range 10	1704	1800	<0.01	.	.	.	1 Struct Eng.	.
880604	.	Range 12	1200	1230	.	.	Extreme	.	1 Struct Eng.	.
880619	.	Range 10	1609	1828	0.02	.	High	.	1 Struct Eng.	.
880622	.	Area 13	1505	1530	.	.	High	.	.	.
880623	880708	Area 7	0155	1230	.	.	.	All	All Available Resources	.
880720	.	Puu Leilani	1820	2141	.	.	Moderate	.	1 Struct Eng.	.
880724	.	FP 436	1148	1445	.	.	Very High	.	1 Brush Eng., 1 Struct Eng.	.
880730	.	Range 9	1650	1803	.	.	.	.	1 Struct Eng.	.

Appendix 1

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
880823	880824	Range 10	1110	0914	.	.	.	.	1 Struct Eng.	.
880922	880927	Twin Puus	1230	0938	.	.	Very High	All	All Available Resources	.
881004	.	FP 440	0910	1430	.	.	.	.	2 GG, 1 Struct Eng.	.
890119	.	Puu Ahi	1529	1615	.	.	Moderate	.	1 Pumper, 1 Tanker, 2 GG	.
890120	890121	Bob Cat Trail	1108	1045	.	.	.	.	1 GG, 1 Struct Eng.	.
890121	.	Range 10	1317	1633	.	.	.	.	2 GG	.
890123	.	Puu Ahi	1624	2000	.	.	.	.	1 Pumper, 1 GG	.
890309	.	Kipuka Kalawamauna	1835	1916	.	.	.	.	1 GG	.
890314	.	Range 8	1155	1755	.	.	.	.	1 GG, 1 Struct Eng.	.
890325	890326	.	1251	1705	0.02	.	.	.	1 Tanker, 2 GG	.
890507	.	Range 8	1341	1545	.	.	.	4	.	.
890524	.	Range 10	0917	1145	<0.01	.	.	2	.	.
890711	.	Range 10	1909	.	<0.01	.	.	.	1 Struct Eng.	.
890718	.	Area 7	1451	1715	.	.	.	.	1 Pumper	.
890725	.	Area 7	1145	1335	.	.	.	.	1 Pumper	.
890803	.	Range 9	1535	2130	0.03	.	.	.	1 Pumper, 1 GG	.
890810	.	Range 10	1550	2233	.	.	Moderate	.	1 Pumper	.
890812	.	Range 10	1303	1345	.	.	.	.	1 Pumper	.
890813	.	Range 3	1325	1515	.	.	.	2	.	.
890816	.	Range 10	1130	1415	.	.	.	.	1 Struct Eng.	.
890909	.	Range 11	1525	1635	0.12	.	.	.	1 Pumper	.
890919	.	Range 4	1955	2140	.	.	.	.	1 Pumper	.
890921	890922	Range 4	2235	0840	<0.01	.	.	.	1 Pumper	.
890929	.	Range 9	1345	1415	.	.	.	3	1 Pumper	.
890929	.	Range 4	1415	1520	.	.	.	3	1 Pumper	.
891115	.	MPRC	1230	1235	.	.	.	.	1 Pumper	.
900109	.	Range 10	1515	1630	.	.	High	.	1 Pumper	.
900110	.	Range 8	1255	1505	.	.	Very High	3	1 Struct Eng.	.
900110	.	Range 12	1255	1505	.	.	Very High	3	1 Struct Eng.	.
900111	.	Range 4	1114	1510	.	.	.	.	1 Pumper	.
900111	.	Range 11	1640	1715	<0.01	.	.	.	1 Pumper	.
900118	.	POL	1214	1237	.	.	.	.	1 Tanker, 1 Struct Eng.	.
900129	.	Range 4	2053	2300	.	.	.	.	1 Pumper	.
900328	.	Range 1	1352	1740	.	.	.	.	1 Tanker, 1 GG	.
900330	.	Range 10	1647	1738	.	.	.	.	1 Struct Eng.	.
900604	.	Range 8	1330	1530	.	.	.	.	1 Pumper	.
900604	.	Range 10	1838	2021	.	.	.	.	1 Pumper	.
900605	.	Range 10	0833	1020	.	.	.	3	1 Tanker	.
900608	.	Range 1	1255	1827	.	.	.	5	2 Pumper, 1 Tanker	.
900609	.	Range 2	1450	1800	.	.	.	.	2 Pumper, 1 Tanker	.
900610	900611	Area 1	1350	2230	.	.	.	3	1 Tanker, 1 Struct Eng.	.
900613	900614	Range 10	1230	0630	1.2	.	.	3	1 Tanker, 1 Brush Eng.	.
900617	900618	Range 1	2255	0040	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900618	.	Range 1	0707	0845	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900618	.	Range 1	1202	2310	.	.	.	5	1 Tanker, 1 Pumper, 2 Brush Eng.	.
900619	.	Range 1	1220	2215	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900621	.	Range 1	0905	1040	.	.	.	3	1 Tanker, 1 Brush Eng.	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
900625	.	Range 10	1431	1856	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900626	.	Range 10	1433	1600	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900626	.	Range 1	1649	2040	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900627	900628	Old FAARP	0800	1935	.	.	.	5	1 Pumper, 1 Tanker, 1 Struct Eng.	.
900629	900630	Old FAARP	0800	0450	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900630	.	Old FAARP	1500	1930	.	.	.	1	.	.
900703	.	Range 10	1308	1458	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900705	.	Range 1	0948	1106	<0.01	.	.	5	1Pumper	.
900707	.	Range 1	1022	2223	.	.	.	5	1 Pumper	.
900708	.	Range 1	1020	1700	.	.	.	5	1 Tanker	.
900709	.	Range 1	1205	1500	.	.	.	5	1 Tanker, 1 Pumper, 2 Brush Eng.	.
900713	.	Range 1	0820	1620	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900714	.	Area 1	1135	1456	0.01	.	.	3	1 Tanker, 1 Brush Eng.	.
900726	.	Range 10	1205	1655	.	.	.	5	1 Tanker, 1 Pumper, 2 Brush Eng.	.
900804	.	Range 8	1612	1720	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900805	.	Impact Area	1105	2141	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900806	.	Range 1	1247	2107		.	.	6	1 Pumper, 1 Tanker	.
900807	.	Range 1	0737	1303	.	.	.	5	1 Pumper	.
900807	.	FP 402	1435	2000	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900808	.	Range 1	1645	1922	.	.	.	5	1 Tanker	.
900810	.	Puu Ahi	1239	1340	.	.	.	3	1 Tanker, 1 Brush Eng.	.
900811	900812	41 mm Saddle Road	1144	1558	.	.	.	5	1 Pumper, 1 Tanker, 1 Struct Eng.	.
900813	.	Puu Ahi	1443	1930	.	.	.	3	1 Tanker, 1 Brush Eng.	
900823	.	Range 10	1448	1747	.	.	High	3	1 GG, 1 Pumper	.
900903	.	Area 4	0830	1030	.	.	.	3	1 GG, 1 Pumper	.
900912	.	35 mm Saddle Road	1215	1259	.	.	.	3	1 Struct. Eng.	.
900913	.	Range 10	1357	1500	.	.	.	3	1 GG, 1 Pumper	.
900915	.	Range 10	1000	1130	.	.	.	3	1 GG	.
900921	.	Range 12	1623	1700	.	.	.	3	1 GG, 1 Pumper	.
900921	.	Range 20	1933	2040	.	.	.	4	1 GG, 1 Pumper	.
900922	.	FP 418	1337	1735	.	.	.	4	1 GG, 1 Pumper	.
900923	.	Range 12	1427	2040	.	.	.	2	1 GG	.
900923	.	Range 20	1940	2040	.	.	.	2	1 GG	.
900925	.	Range 1	1310	1410	.	.	.	2	1 GG	.
900930	.	Range 12	0750	0850	.	.	.	1	1 GG	.
901002	.	Range 12	0830	0930	.	.	.	1	1 GG	.
901002	.	Range 8 & 12	1245	1400	.	.	.	2	1 GG	.
901012	.	Range 9	1315	1400	.	.	.	3	1 GG, 1 Tanker	.
901210	.	Puu Ahi	1603	1948	.	.	.	4	1 Tanker, 1 Pumper	.
910106	.	Range 5	1447	1615	.	.	.	2	1 GG	.
910117	.	Puu Ahi	1030	1330	.	.	.	3	1 GG	.
910122	.	Old FAARP	1535	1635	.	.	.	2	1 GG	.
910202	.	Range 9	1240	1330	.	.	.	1	1 GG	.
910226	.	Range 12	1412	1550	.	.	Extreme	2	1 GG	.
910227	.	Range 12	1545	1632	.	.	.	4	1 GG, 1 Pumper	.
910228	.	Range 12	1433	1533	.	.	.	2	1 Pumper	.
910311	.	Range 7	1142	1242	.	.	.	2	1 GG	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
910408	.	Range 12	1449	1549	.	.	.	2	1 Pumper	.
910410	.	Puu Ahi	1924	2024	.	.	.	2	1 Pumper	.
910411	.	Puu Ahi	1749	1849	.	.	.	2	1 Pumper	.
910412	.	Redleg	1310	1410	.	.	.	2	1 GG	.
910424	.	Range 12	1150	1550	.	.	.	2	1 GG, 1 Pumper	.
910425	.	Range 12	1402	1455	.	.	.	2	1 Pumper	.
910425	.	Range 3	1545	1645	.	.	.	2	1 Pumper	.
910426	.	Range 3	1107	1555	.	.	High	2	1 Pumper	.
910426	.	Range 3	1236	1636	.	.	.	4	2 Pumper	.
910427	.	Range 12	1515	1615	.	.	Very High	2	1 Pumper	.
910428	.	Range 2	1326	1710	.	.	.	2	1 Pumper	.
910428	.	Range 1	1545	1645	.	.	.	2	1 Pumper	.
910430	.	Range 8A	0827	1058	.	.	.	6	1 GG, 1 Pumper	.
910430	.	Range 12	0827	1058	.	.	.	4	1 GG, 1 Pumper	.
910430	.	Old FAARP	1215	1615	.	.	.	2	1 GG	.
910430	.	Range 1	1525	1627	.	.	.	2	1 Pumper	.
910430	.	Old FARRP	1812	2012	.	.	.	2	1 GG	.
910430	.	Range 10	0130	0230	.	.	.	2	1 GG	.
910501	.	Range 1	0748	0925	.	.	.	2	1 Pumper	.
910501	.	Range 1	1315	1815	.	.	.	1	1 GG	.
910502	.	Range 10	0643	0752	.	.	.	2	1 GG	.
910502	.	Old FAARP	1500	1550	.	.	.	1	1 GG	.
910502	.	Range 1	1515	1615	.	.	.	3	1 GG, 1 Pumper	.
910502	.	Old FAARP	1820	1920	.	.	.	2	1 GG	.
910504	.	Puu Keekee	1303	1403	.	.	.	2	1 GG	.
910505	.	Range 1	1522	1622	.	.	.	1	1 GG	.
910506	.	Range 2	1030	1130	.	.	.	2	1 GG	.
910507	.	Range 10	1103	1206	.	.	.	2	1 GG	.
910507	.	Range 2	1300	1400	.	.	.	2	1 Pumper	.
910515	.	Range 10	1220	1630	.	.	.	2	1 GG	.
910516	.	Range 2	1215	1254	.	.	.	2	1 GG	.
910612	.	Area 1	1330	1430	.	.	.	2	1 GG	.
910616	.	Range 12	1745	1826	.	.	.	2	1 GG	.
910619	.	Range 12	1530	1630	.	.	.	2	1 Pumper	.
910620	.	BAAF	1115	1215	.	.	.	4	1 GG, 1 Crash	.
910620	.	BAAF	1545	1615	.	.	.	4	1 GG, 1 Crash	Drone Booster Pod
910620	.	Range 12	1725	1825	.	.	.	2	1 GG	.
910626	.	Range 12	1553	1808	.	.	.	2	1 GG, 1 Pumper	.
910702	.	Range 12	1323	1500	.	.	.	2	1 GG	.
910702	.	Range 4	2010	2127	.	.	.	2	1 Pumper	.
910703	.	Range 1	0830	1030	.	.	.	2	1 GG	.
910703	.	Range10	1111	1211	.	.	.	2	1 GG	.
910703	.	Range 1	1253	1400	.	.	.	2	1 GG	.
910707	.	Range10	0930	1030	.	.	.	2	1 GG	.
910707	.	Area 1	1155	1255	.	.	.	3	1 GG, 1 Pumper	.
910707	.	Range10	1535	1735	.	.	.	2	1 Pumper	.
910710	.	Twin Puus	0915	1045	.	.	.	3	1 GG	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
910710	.	Twin Puus	1515	1615	.	.	.	2	1 GG	.
910712	.	Range 12	1443	1525	.	.	.	2	1 GG	.
910723	.	Range 12	1336	1436	.	.	.	2	1 Pumper	.
910724	.	Range 12	1434	1643	.	.	.	2	1 GG	.
910724	.	Range 12	1743	1850	.	.	.	3	1 GG, 1 Tanker	.
910725	.	Puu Keekee	.	.	50	.	.	.	.	.
910727	.	Range 13	1000	1100	.	.	.	2	1 Pumper	.
910728	.	Area 4	0700	0935	.	.	.	2	1 GG	.
910728	.	Area 4	1110	1312	.	.	.	2	1 GG	.
910728	.	Area 4	1440	1655	.	.	.	2	1 GG	.
910731	.	Range 12	1330	1430	.	.	.	2	1 GG	.
910809	.	Range 12	1845	1913	.	.	.	2	1 GG	.
910810	.	43 mm Saddle Rd	1531	1731	.	.	.	6	1 Struct. Eng, 1 Tanker, 1 GG	.
910815	.	Range 12	1344	1502	.	.	.	3	1 GG, 1 Tanker	.
910816	.	Range 12	1515	1800	.	.	.	4	1 GG, 1 Pumper, 1 Tanker	.
910817	.	Range 4	0645	0745	.	.	.	2	1 GG	.
910817	.	Range 12	1440	1540	.	.	.	2	1 GG	.
910818	.	Range 12	0715	0915	.	.	.	2	1 GG	.
910818	.	Range 10	1852	1935	.	.	.	2	1 GG	.
910821	.	Range 12	1443	1643	.	.	.	2	1 GG	.
910821	.	Range 4	1940	2128	.	.	.	2	1 Tanker	.
910822	.	Old FAARP	0710	0940	.	.	.	3	1 Pumper	.
910822	.	Old FAARP	1530	1630	.	.	.	2	.	.
910823	.	Old FAARP	0945	1045	.	.	.	2	1 Tanker	.
910824	.	Area 7	1131	1331	.	.	.	2	1 Brush Eng.	.
910825	.	Area 7	1335	1435	.	.	.	2	1 Brush Eng.	.
910901	.	37 mm Saddle Rd	1112	1217	.	.	.	6	1 Tanker, 1 Struct. Eng.	Cigarette
910902	.	Range 4	1430	1820	.	.	.	2	1 Tanker	.
910902	.	Area 3	1720	1820	.	.	.	2	1 Tanker	.
910903	.	Range 12	1455	1600	.	.	.	2	1 Tanker	.
910906	.	Range 12	1324	1458	.	.	.	2	1 Tanker	.
910907	.	Range 12	1237	1405	.	.	.	2	1 GG	.
910927	.	Twin Puus	1242	1342	.	.	.	2	1 GG	.
911001	.	Range 10	1730	1830	.	.	.	2	1 Tanker	.
911013	.	Range 1	0705	0900	.	.	.	2	1 Tanker	.
911013	.	Range 10	1426	1757	.	.	.	2	1 Tanker, 1 Brush Eng.	.
911014	.	Range 10	1111	1217	.	.	.	3	1 Brush Eng.	.
911019	.	Range 9	2053	2153	.	.	.	2	1 Brush Eng.	.
911029	.	Area 1	1420	1520	.	.	.	4	1 GG, 1 Pumper, 1 Tanker	.
911107	.	30 mm Saddle Rd	1006	1106	.	.	.	1	.	.
911108	.	Range 12	1657	1818	.	.	.	2	1 Brush Eng., 1 GG	.
911112	.	Range 12	1040	1120	.	.	.	2	1 GG	.
911118	.	Range 12	1653	1853	.	.	.	2	1 Brush Eng.	.
920205	.	MPRC Road	1205	1900	1.2	.	.	All	All Available Resources	.
920208	.	Puu Ahi	1623	1827	1.2	.	.	3	1 Tanker, 1 Brush Eng.	.
920209	920211	Impact Area	1522	1830	.	.	.	.	1 Pumper, 1 Brush Eng.	.
920215	.	Range 4	1145	2110	.	.	.	.	1 Brush Eng.	.

Appendix 1

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
920215	920216	Range 20	2146	0001	.	.	.	.	1 Brush Eng.	.
920216	920223	Range 11 & 20	1033	1245	.	.	.	All	All Available Resources	.
920225	.	Range 1	1330	1625	.	.	.	3	1 Tanker, 1 Brush Eng.	.
920225	.	Range 12	2000	2120	.	.	.	.	1 GG	.
920227	.	Range 1	0741	0850	.	.	.	.	1 GG	.
920229	.	Range 12	0936	1538	.	.	Extreme	.	1 Tanker, 1 GG	.
920302	.	Range 20	1500	1545	.	.	Moderate	3	1 Tanker, 1 Brush Eng.	.
920304	920305	FP 303	1505	0055	.	.	.	3	1 Tanker, 1 Brush Eng.	.
920305	920306	FP 303	0805	2220	.	.	.	All	All Available Resources	.
920307	.	Range 20	1010	1100	.	.	.	3	1 Tanker, 1 Brush Eng.	.
920309	.	Range 12	1234	1448	.	.	.	3	1 Tanker, 2 Brush Eng.	.
920312	.	Range 20	1105	1140	.	.	.	.	1 Tanker	.
920317	.	Range 20	1419	1550	<0.01	.	.	.	1 Tanker	.
920319	.	Range 20	1115	1520	.	.	.	.	1 Tanker, 1 Brush Eng.	.
920323	.	Range 20	1020	1155	.	.	.	.	1 Brush Eng.	.
920428	.	Range 12	1152	1519	.	.	High	.	1 Brush Eng.	.
920430	920501	Range 10	1440	0215	.	.	.	.	1 Tanker, 2 Brush Eng.	.
920501	.	Range 10	0730	0920	.	.	.	.	.	.
920501	.	Range 10	1434	1525	.	.	.	.	1 Tanker	.
920508	.	Range 10	0933	1340	.	.	High	.	1 Tanker	.
920509	920510	Range 10	2250	0200	.	.	.	.	1 Tanker	.
920510	.	Range 10	0715	0900	.	.	.	.	.	.
920510	.	Range 10	2021	2125	.	.	.	.	.	.
920511	.	Range 10	0712	1000	.	.	.	.	.	.
920513	.	Puu Kapele	1445	1530	.	.	.	.	1 Tanker	.
920515	.	Range 10	1518	1616	.	.	Moderate	.	.	.
920517	.	FP 801	0930	1806	.	.	Moderate	.	2 Pumper	.
920518	920519	FP 312	1150	0455	.	.	.	All	All Available Resources	Drone
920519	920520	FP 312	0730	0620	.	.	.	All	All Available Resources	Drone
920520	.	Range 12	1240	1312	.	.	.	1	.	.
920520	.	Range 8	1506	1542	.	.	.	.	1 Tanker	.
920520	.	Range 10	1530	1558	.	.	.	.	.	.
920521	920522	Range 10	1425	1925	.	.	Very High	.	2 Pumper, 1 Struct Eng.	.
920522	.	Range 12	1928	2046	.	.	.	.	1 Tanker	.
920523	.	Range 12	1041	1150	.	.	Very High	.	1 Pumper, 1 Brush Eng.	.
920523	.	Range 10	1515	1745	.	.	Very High	.	1 Tanker, 1 Pumper	.
920524	.	Range 10	1402	1512	.	.	High	.	.	.
920526	.	Area 1	1710	1750	.	.	.	.	1 Tanker, 1 Pumper, 1 Brush Eng	.
920527	.	Range 10	1600	1805	.	.	.	.	1 Pumper	.
920529	.	Range 10	1255	1550	.	.	.	.	1 Pumper	.
920602	.	Range 10	1532	1656	.	.	.	.	1 Pumper	.
920603	920604	Puu Ahi	1802	0048	.	.	.	.	1 Tanker, 2 Pumper	.
920604	920608	FP 427	1020	1400	.	.	.	All	All Available Resources	.
920616	.	Range 13	1045	1435	<0.01	.	.	.	1 Tanker	.
920802	.	Range 1	1815	2135	.	.	.	.	1 Brush Eng	.
920807	.	Range 10	1450	1610	.	.	.	.	1 Brush Eng	.
920810	.	Range 1	1505	1620	.	.	Low	.	1 Brush Eng	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
921006	.	Range 10	0901	0957	.	.	High	.	1 Tanker, 1 Brush Eng.	.
921009	.	Range 8	1120	1335	.	.	Moderate	.	1 Pumper	.
921015	.	Range 8	1223	1320	.	.	High	.	1 Pumper	.
921020	.	Range 11	0913	1055	.	.	.	.	1 Pumper	.
921022	.	Range 11	1726	1815	.	.	.	.	1 Tanker	.
930115	.	Range 1	.	.	.	.	.	.	.	.
930120	.	Range 4	.	.	.	.	.	.	.	.
930121	.	Range 4	.	.	.	.	.	.	.	.
930121	.	Range 12	.	.	.	.	.	.	.	.
930126	.	Range 4	.	.	.	.	.	.	.	.
930127	.	Range 12	.	.	.	.	.	.	.	.
930128	.	Range 12	.	.	0.01	.	.	.	.	.
930206	.	Range 10	.	.	.	.	.	.	.	.
930224	.	Range 12	.	.	.	.	.	.	.	.
930225	.	Range 10	.	.	.	.	.	.	.	.
930226	.	Range 16	.	.	.	.	.	.	.	.
930307	.	Old FAARP	.	.	.	.	.	.	.	.
930308	.	Twin Puu's	.	.	.	.	.	.	.	.
930308	.	Range 1	.	.	.	.	.	.	.	.
930309	.	Range 8	.	.	.	.	.	.	.	.
930310	.	Range 8	.	.	.	.	.	.	.	.
930316	.	Range 13	.	.	.	.	.	.	.	.
930318	.	Range 12	.	.	.	.	.	.	.	.
930321	.	Range 12	.	.	.	.	.	.	.	.
930322	.	Range 12	.	.	.	.	.	.	.	.
930326	.	Twin Puu's	.	.	.	.	.	.	.	.
930328	.	East of Main Gate	.	.	.	.	.	.	.	.
930420	.	Range 12	.	.	.	.	.	.	.	.
930421	.	Range 12	.	.	.	.	.	.	.	.
930422	.	Range 12	.	.	0.01	.	.	.	.	.
930425	.	Range 11	.	.	.	.	.	.	.	.
930517	.	Kaupulehu Boundary Fire	.	.	351	.	.	.	.	.
930517	.	Range 10	.	.	.	.	.	.	.	.
930519	.	Range 10	.	.	.	.	.	.	.	.
930520	.	Range 10	.	.	.	.	.	.	.	.
930604	.	Range 8A	.	.	.	.	.	.	.	.
930604	.	FP 801	.	.	.	.	.	.	.	.
930606	.	FP 801	.	.	.	.	.	.	.	.
930607	.	FP 801	.	.	.	.	.	.	.	.
930608	.	FP 312	.	.	.	.	.	.	.	.
930608	.	Twin Puu's	.	.	.	.	.	.	.	.
930610	.	FP 801	.	.	.	.	.	.	.	.
930613	.	FP 801	.	.	.	.	.	.	.	.
930812	.	Puu Menehune	.	.	.	.	.	.	.	.
930921	.	Range 1	.	.	.	.	.	.	.	.
930924	.	Range 1	.	.	.	.	.	.	.	.
931005	.	Range 8	.	.	.	.	.	.	.	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
931007	.	Range 11	.	.	.	.	.	.	.	.
931007	.	Range 8	.	.	.	.	.	.	.	.
931008	.	Twin Puu's	.	.	.	.	.	.	.	.
931011	.	Range 13	.	.	.	.	.	.	.	.
931012	.	Range 8	.	.	.	.	.	.	.	.
931013	.	Range 8	.	.	.	.	.	.	.	.
931018	.	Range 12	.	.	.	.	.	.	.	.
931113	.	Range 13	.	.	.	.	.	.	.	.
931114	.	Grid #265/835	.	.	.	.	.	.	.	.
931117	.	Twin Puu's	.	.	.	.	.	.	.	.
931205	.	Range 12	.	.	.	.	.	.	.	.
931207	.	Range 11	.	.	.	.	.	.	.	.
931208	.	Range 10	.	.	.	.	.	.	.	.
931208	.	Range 4	.	.	.	.	.	.	.	.
931209	.	Range 1	.	.	.	.	.	.	.	.
931209	.	Range 10	.	.	.	.	.	.	.	.
931210	.	Range 10	.	.	.	.	.	.	.	.
931213	.	Range 1	.	.	.	.	.	.	.	.
931213	.	Range 11	.	.	.	.	.	.	.	.
940114	.	Range 8	1044	1205		.	.	4	3 HV, 1Tanker	Tracer
940114	.	Range 8	1650	1750		.	.	2	1 HV, 1 Tanker	Tracer
940117	.	FP 312	1131	1140	0.01	68	Low	2	1 HV	Streaker
940121	.	FP 801	1235	1240	0.01	62	Mod	1	1 HV	Bats
940122	.	Old FAARP	1423	1515	.	.	.	1	1 HV	.
940228	.	Range 8	1100	1215	.	70	Low	1	1 HV	Tracer
940228	.	Range 8	1325	1344	.	59	Mod	1	1 HV	Tracer
940302	.	Range 8	1205	1315	.	47	High	3	2 HV	Tracer
940304	.	Range 8	1141	1225	.	60	Mod	1	1 HV	Tracer
940305	.	Range 8	1030	1132	0.01	39	High	1	1 HV	Tracer
940308	.	Range 1	1704	1939	0.5	77	Low	3	1 HV, 1 Tanker	Tracer
940308	.	Range 10	1755	1835	.	77	Low	1	1 HV	Tracer
940309	.	Range 1	729	1015	0.01	60	Mod	2	2 HV	Tracer
940309	.	Range 10	1325	1400	0.45	65	Mod	2	2 HV	Tracer
940320	.	Range 10	1428	1530	.	.	.	2	1 HV	Tracer
940411	.	Range 10	1820	1857	.	.	.	2	1 HV	Tracer
940417	.	Range 10	1501	1630	0.25	.	.	2	2 HV	Tracer
940417	.	Range 4	1928	2000	.	.	.	1	1 HV	Tracer
940417	.	Range 8	2012	2018	0.01	.	.	1	1 HV	Tracer
940418	.	Range 4	0658	0727	.	76	Low	1	1 HV	Tracer
940418	.	Range 8	1418	1500	.	55	Mod	2	1 HV	Tracer
940418	.	Range 1	2025	2125	0.01	65	Mod	2	1 HV	Tracer
940419	.	Range 4	0645	0748	.	.	.	1	1 HV	Tracer
940419	.	Range 1	1100	1125	.	.	.	1	1 HV	Tracer
940506	.	Range 4	0503	0639	.	.	.	1	1 HV	Tracer
940506	.	Range 4	1201	1215	0.01	48	High	1	1 HV	Tracer
940506	.	Range 4	1315	1330	0.01	48	High	1	1 HV	Tracer
940510	.	Range 11	1914	2010	.	.	.	2	1 HV, 1 Brush Eng	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
940516	.	Range 1	1435	1508	0.01	59	Mod	3	2 HV, 1 Brush Eng	Tracer
940516	.	Range 1	1722	1835	.	.	.	1	1 HV	Restart
940517	.	Range 1	1455	1530	0.01	.	.	1	1 HV	Tracer
940517	.	Range 8	1500	1535	0.01	.	.	2	1 HV, 1 Brush Eng	Tracer
940517	.	Range 8	1743	1829	.	.	.	1	1 HV	Tracer
940518	.	Range 8	1225	1320	.	55	Mod	1	1 HV	Tracer
940520	.	Range 10	1214	1353	1	55	Mod	2	1 HV, 1 Tanker	Tracer
940521	.	Range 12	1645	1736	.	.	.	1	1 HV	.
940522	.	Range 10	1245	.	0.01	.	.	1	1 HV	Tracer
940523	.	Range 10	0300	.	0.01	.	.	1	1 HV	Tracer
940526	.	Range 12	1524	1722	0.75	58	Mod	4	2 HV, 1 Brush Eng, 1 Tanker	Tracer
940710	.	Range 10	1240	1555	.	.	.	4	2 HV, 1 Brush Eng	Tracer
940711	.	Range 10	1000	1045	.	64	Mod	1	1 HV	Tracer
940711	.	Range 10	1518	1538	.	.	.	1	1 HV	Tracer
940711	.	Range 8	1715	1725	.	.	.	2	1 HV, 1 Tanker	Tracer
940711	.	Range 1	2107	2120	.	.	.	1	1 HV	Tracer
940712	.	Range 1	0747	0830	.	.	.	1	1 HV	Tracer
940712	.	Range 1	1535	1545	.	49	High	1	1 HV	Restart
940712	.	Range 1	1802	1816	.	.	.	1	1 HV	Tracer
940712	.	Range 1	2123	2132	.	.	.	1	1 HV	Tracer
940713	.	Range 10	0700	0810	.	63	Mod	2	1 HV, 1 Tanker	Restart
940713	.	Range 5	0753	0930	.	63	Mod	1	1 HV	.
940713	.	Range 1	0814	0835	.	63	Mod	2	1 HV, 1 Tanker	Tracer
940713	.	Range 5	0934	1150	.	.	.	2	1 HV, 1 Tanker	Restart
940713	.	Range 1	0946	1010	.	.	.	1	1 HV	.
940713	.	Range 10	1256	1401	.	37	High	1	1 HV	Tracer
940720	.	Range 1	0940	1130	.	53	Mod	2	1 HV, 1 Tanker	Tracer
940721	.	Range 12	1400	1430	0.01	65	Mod	1	1 HV	.
940723	.	Parker Ranch	1445	1525	.	88	Low	2	1 HV, 1 Tanker	Cigarette
940724	940916	Kipuka Kalawamauna	.	.	4100	.	.	6	4 HV, 1 Tanker, 2 Brush Eng	Camp Fire
940926	.	FP 403	1238	1357	0.25	45	High	2	1 HV, 1 Tanker	.
940928	.	Range 8	1437	1450	0.01	61	Mod	1	1 HV	Tracer
940929	.	Range 12	1147	1225	0.01	51	Mod	1	1 Brush Eng	Tracer
940930	.	Range 8	1140	1230	0.01	53	Mod	1	1 HV	Tracer
940930	.	Range 12	1412	1435	0.01	53	Mod	2	1 HV	Rocket
941002	.	Range 8	0750	0823	.	.	.	2	1 HV	Tracer
941005	.	Range 11L	1055	1220	0.01	53	Mod	1	1 HV	Tracer
941020	.	Range 11	1501	1530	.	59	Mod	1	1 HV	Tracer
941021	.	Impact Area	0930	1815	.	.	.	All	All Available Resources	Artillery
941030	.	Range 12	1327	1500	0.01	.	.	2	1 HV	Tracer
941031	.	Range 11	1115	1200	0.01	.	.	1	1 HV	.
941205	.	Mahukona, Kohala	0046	1700	.	.	.	3	1 HV, 1 Tanker	.
950122	.	FP 424	1530	1803	0.5	.	.	5	2 HV, 1 Tanker	Con. Grenade
950124	.	Range 11	0810	900	.	.	.	2	1 HV	.
950124	.	Range 10	1445	1509	.	.	.	2	1 HV, 1 Tanker	Tracer
950125	.	Range 1	0952	1102	0.01	59	Mod	2	1 HV	Tracer
950209	.	Range 12	1218	1325	0.01	40	High	3	1 HV, 1 Brush Eng	Tracer

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
950209	.	Range 12	1543	1800	.	.	.	2	1 HV	.
950214	.	Range 10	1858	1950	0.04	.	.	2	1 HV	Tracer
950305	.	FP 503	1705	1805	.	.	.	6	1 HV, 1 Brush Eng, 1 Tanker	.
950311	.	Range 11	1823	1910	0.01	.	.	1	1 HV	Rocket
950312	.	Puu Menehune	1725	1810	0.02	.	.	3	1 HV, 1 Brush Eng	.
950314	.	Range 12	1030	1135	0.11	60	Mod	2	1 HV, 1 Brush Eng	Tracer
950320	.	Range 4	1935	2030	0.01	.	.	2	1 HV	Tracer
950402	.	Area 1	1510	1805	.	.	.	4	1 HV, 1 Brush Eng, 1 Tanker	.
950408	.	Range 8	1523	1604	.	.	.	3	1 HV, 1 Brush Eng	Tracer
950410	.	Range 8	0845	0950	.	52	Mod	2	1 HV	Restart
950416	.	Range 10	1805	1822	.	.	.	2	1 HV, 1 Brush Eng	Tracer
950421	.	Range 10	1650	1810	0.17	.	.	3	1 HV, 1 Tanker	Tracer
950504	.	Range 8	1137	1210	.	.	.	5	2 HV, 1 Tanker	Tracer
950504	.	Range 8	1415	1615	0.01	95	Low	1	1 HV	Tracer
950505	.	Range 12	1745	1818	.	.	.	2	1 HV	.
950507	.	Range 11	1410	1459	.	.	.	1	1 HV	.
950507	.	Range 11	1650	1800	0.02	.	.	2	2 HV	Dragon Missile
950508	.	Range 1	1145	1312	0.02	.	.	1	1 HV	Tracer
950509	.	Range 10	0800	0830	.	68	Low	1	1 HV	Tracer
950509	.	Range 10	0850	0905	.	68	Low	2	1 HV	Tracer
950509	.	Range 1	1245	1325	.	44	High	1	1 HV	Tracer
950510	.	Range 1	1038	1046	.	.	.	2	1 HV	Tracer
950510	.	Range 1	1500	1515	.	.	.	1	1 HV	Restart
950513	.	Puu Leilani	1419	1540	.	.	.	5	2 HV, 1 Tanker	.
950515	.	Range 1	1401	1540	.	.	.	1	1 HV	Tracer
950517	.	Range 8	0804	0850	.	75	Low	2	1 HV	Tracer
950518	.	Range 10	1452	.	.	.	.	2	1 HV	Tracer
950519	.	Range 8	1253	1700	0.09	50	High	2	2 HV	Tracer
950520	.	Range 8	1145	1300	0.11	60	Mod	1	1 HV	Restart
950520	.	Range 12	1325	1450	.	.	.	3	2 HV, 1 Tanker	.
950529	.	Kilohana	1305	1835	100	.	.	6	2 HV, 1 Brush Eng, 1 Tanker	.
950716	.	Puu Keekee	0910	1030	0.01	.	.	1	1 HV	Cigarette
950724	.	Puu Ahi	1220	1557	10	40	High	6	2 HV, 2 Brush Eng, 1 Tanker	Short Round
950808	.	Range 12	1245	1307	0.01	30	High	2	1 HV	.
950812	.	Range 1	1421	1428	0.01	.	.	1	1 HV	Smoke Grenade
950813	.	Range 1	1520	1530	.	.	.	1	1 HV	Tracer
950816	.	Range 10	1335	1400	.	.	.	2	1 HV, 1 Brush Eng	Tracer
950818	.	Range 1	1505	1550	.	37	High	2	1 HV	Tracer
950819	.	Range 1	1230	1650	.	55	Mod	6	1 HV, 1 Tanker, 2 Brush Eng	Tracer
950821	.	Range 1	0840	0930	.	52	Mod	1	1 HV	Tracer
950823	.	Range 1	0825	1100	.	58	Mod	2	1 HV	Tracer
950914	.	Range 12	1410	1620	.	.	.	2	1 HV, 1 Brush Eng	.
950917	.	Range 12	1216	1345	0.13	.	.	1	1 HV	.
950921	.	Range 12	0901	1001	0.01	.	.	2	1 HV	Tracer
950921	.	Range 12	1600	1620	.	.	.	2	1 HV, 1 Brush Eng	.
950921	.	Range 8	1640	1708	0.01	.	.	1	1 HV	Tracer
950922	.	Range 12	1319	1400	.	50	High	2	1 HV, 1 Brush Eng	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
950923	.	Range 10	1830	.	0.01	.	.	1	1 HV	Tracer
950924	.	Range 1	1345	1428	0.5	.	.	1	1 HV	Tracer
950925	.	Range 1	1330	1515	.	55	Mod	2	2 HV	Tracer
950926	.	Range 8	1800	1830	0.25	.	.	2	1 HV, 1 Brush Eng	Tracer
950928	.	Range 8	1745	1900	0.01	.	.	1	1 HV	Tracer
950930	.	Range 1	1145	1545	.	.	.	1	1 HV	Tracer
951002	951003	Range 10	2234	0004	0.06	.	.	2	1 HV, 1 Brush Eng	Flares
951003	.	Range 10	0945	1535	.	.	.	5	1 HV, 1 Brush Eng	Flares
951006	951010	FP 503	1125	.	600	.	.	All	All Available Resources	.
951011	.	Range 10	0850	0910	.	56	Mod	1	1 HV	.
951104	.	Range 10	1435	1546	0.25	.	.	3	1 HV, 1 Brush Eng	Tracer
951105	.	Range 10	1715	.	0.01	70	Low	1	1 HV	Tracer
951106	.	Range 10	1350	1440	0.03	48	High	1	1 HV	Tracer
951111	.	Range 10	1240	1304	.	65	Mod	1	1 HV	Tracer
951111	.	Range 10	1505	1537	.	.	.	1	1 HV	Tracer
951112	.	Range 10	1855	1915	.	68	Low	1	1 HV	Tracer
951113	.	Range 10	1235	1320	.	.	.	1	1 HV	Tracer
951114	.	Range 10	1230	1349	.	59	Mod	3	1 HV, 1 Brush Eng	Tracer
960109	.	FP 402	1216	1345	1	.	.	4	2 HV, 1 Tanker	Smoke Grenade
960109	.	Range 10	1710	1757	.	.	.	2	2 HV	Tracer
960115	.	Range 10	2400	.	0.01	.	.	1	1 HV	Star Cluster
960116	.	Range 10	0141	0215	.	.	.	1	1 HV	Tracer
960117	.	Range 10	2122	2230	.	.	.	1	1 HV	Star Cluster
960123	.	Range 10	1805	1825	0.01	55	Mod	1	1 HV	.
960123	.	Range 10	1035	1100	.	.	.	1	1 HV	.
960124	.	Range 10	0728	0755	.	70	Low	1	1 HV	.
960216	.	Range 8	1406	1440	.	49	High	1	1 HV	Tracer
960307	960308	Range 1	2300	0015	.	.	.	1	1 HV	Tracer
960308	.	Range 1	1125	1245	.	.	.	2	1 HV, 1 Tanker	Tracer
960308	.	Range 12	1605	1620	.	.	.	1	1 HV	.
960308	.	Range 1	1920	1950	.	.	.	1	1 HV	Tracer
960309	.	Range 1	1720	.	.	95	Low	2	1 HV	.
960309	.	Range 10	2225	.	.	.	.	2	1 HV	.
960311	.	Range 10	0955	1410	.	35	High	1	1 HV	.
960311	.	Range 10	2127	2223	.	.	.	1	1 HV	.
960315	.	Seven Steps	1310	1955	.	.	.	5	2 HV, 1 Brush Engine, 1 Tanker	.
960317	.	Seven Steps	0815	1330	.	.	.	2	1 HV, 1 Tanker	.
960317	.	Seven Steps	1425	1612	.	.	.	1	1 HV	.
960318	.	Seven Steps	1345	1600	.	.	.	1	1 HV	.
960319	.	Range 1	1115	1200	.	49	High	1	1 HV	Tracer
960319	.	Range 1	1301	1400	.	.	.	1	1 HV	Tracer
960319	.	Range 1	1747	1840	.	78	Low	2	1 HV	Tracer
960320	.	Range 1	1125	1500	.	62	Mod	2	1 HV, 1 Tanker	Tracer
960321	.	Range 1	1305	1345	.	51	Mod	2	2 HV	Tracer
960322	.	Range 1	1616	1800	.	.	.	2	1 HV, 1 Tanker	Tracer
960412	.	Waikii Ranch	1635	1650	0.25	.	.	2	2 HV	Catalytic Converter
960418	.	Range 12	1717	1845	0.01	.	.	2	2 HV	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
960421	.	Range 1	1640	1648	.	51	Mod	1	1 HV	Tracer
960422	.	Range 12	1110	1225	.	.	.	2	2 HV	.
960422	.	Range 10	1501	1516	.	53	Mod	2	2 HV	Tracer
960422	.	Range 1	1531	1601	.	53	Mod	1	1 HV	Tracer
960422	.	Range 8	1610	1800	.	.	.	2	2 HV	Tracer
960430	.	Range 9	0845	0937	0.01	85	Low	1	1 HV	Demo Charge
960502	.	Range 12	1513	1547	.	.	.	1	1 HV	.
960504	.	FP 427	1430	1645	.	.	.	6	2 HV, 1 Tanker, 2 Dozer	Grenade Simulator
960522	.	Range 1	1600	1855	.	26	High	4	2 HV, 1 Tanker	Tracer
960523	.	Range 10	1410	1444	.	30	High	1	1 HV	Tracer
960524	.	Range 1	1141	1635	.	40	High	3	2 HV, 1 Tanker	Tracer
960524	.	Range 12	1825	2002	.	66	Low	2	2 HV	.
960525	.	Range 1	1035	1150	.	.	.	2	2 HV	Tracer
960526	.	Range 1	1523	1805	.	.	.	2	1 HV, 1 Tanker	Rekindle
960527	.	Range 1	0745	1932	.	.	.	1	1 HV	Rekindle
960527	.	Range 1	1248	1637	.	.	.	1	1 HV	Rekindle
960528	.	Range 1	1450	1908	.	.	.	3	2 HV, 1 Tanker	Rekindle
960531	.	Range 1	0600	1630	.	43	High	6	2 HV	Rekindle
960601	.	Range 1	1800	2005	.	.	.	1	1 HV	Rekindle
960604	.	Range 8	1622	1705	0.01	.	.	1	1 HV	Tracer
960606	.	Range 1	1500	1712	.	58	Mod	2	1 HV, 1 Tanker	Rekindle
960607	.	Range 12	1335	1430	0.01	37	High	1	1 HV	Tracer
960608	.	Range 12	1455	1630	.	.	.	3	2 HV	.
960610	.	Range 11T	1000	1034	.	.	.	1	1 HV	.
960610	.	Range 11T	1142	1240	.	.	.	1	1 HV	.
960612	.	Range 10	1915	1950	.	.	.	1	1 HV	.
960710	.	Range 11L	1102	1209	.	.	.	1	1 HV	.
960712	.	Range 8	1504	1615	0.01	.	.	1	1 HV	Tracer
960713	.	Range 8	1028	1147	0.01	32	High	1	1 HV	Tracer
960713	.	Range 8	1332	1418	.	59	Mod	1	1 HV	Tracer
960716	.	Range 8	1306	1413	0.01	.	.	1	1 HV	Tracer
960716	.	Range 8	1424	1504	0.01	.	.	1	1 HV	Tracer
960716	.	Range 8	1755	1829	.	.	.	1	1 HV	Tracer
960717	.	Range 10	1259	1313	.	56	Mod	1	1 HV	Tracer
960718	.	Range 8	0733	0900	0.04	.	.	1	1 HV	.
960728	.	Range 10	1450	1618	.	27	High	3	2 HV, 1 Tanker	Tracer
960826	.	Range 11	1252	1330	.	.	.	1	1 HV	.
960927	.	Range 10	1247	1315	.	.	.	2	2 HV	Tracer
960927	.	Range 10	1520	1545	.	.	.	1	1 HV	Tracer
960928	.	Range 1	0903	1749	.	.	.	2	1 HV	Tracer
961012	.	Range 12	1427	1510	.	.	.	1	1 HV	.
970110	.	Puu Keekee	0758	0909	0.01	49	High	1	1 HV	Flares
970116	.	Range 10	1430	1545	.	.	.	2	2 HV	Tracer
970212	.	Range 11	1420	1440	.	.	.	1	1 HV	.
970214	.	Range 1	1500	1543	.	.	.	1	1 HV	Tracer
970214	.	Range 8	1604	1625	.	.	.	1	1 HV	Tracer
970217	.	Range 12	1126	1205	.	.	.	1	1 HV	.

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
970223	.	Range 12	1740	1850	.	.	.	1	1 HV	.
970309	.	Range 10	1425	1500	.	28	High	1	1 HV	Tracer
970430	.	Range 12	1037	1127	0.5	50	High	4	2 HV, 1 Tanker	Tracer
970430	.	Range 12	1630	1703	.	.	.	2	1 HV, 1 Tanker	.
970502	.	Range 12	1102	1120	.	.	.	1	1 HV	.
970502	.	Range 12	1645	1740	.	.	.	3	2 HV, 1 Tanker	.
970513	.	Range 8	1423	1436	0.01	51	Mod	1	1 HV	Tracer
970528	.	Range 11T	1430	1455	.	68	Low	1	1 HV	.
970727	.	Range 11	1155	1301	.	50	High	1	1 HV	.
970727	.	Range 10	1603	1643	0.25	59	Mod	1	1 HV	.
970727	.	Range 10	1700	1730	0.01	70	Low	1	1 HV	.
970903	.	FAARP	1515	1545	.	57	Mod	2	1 HV	.
970910	.	Range 10	0723	0826	0.01	38	High	1	1 HV	.
970911	.	Range 1	1535	1600	.	.	.	1	1 HV	.
970915	.	Range 1	1730	1818	0.01	.	.	2	2 HV	.
970929	.	Range 10	1700	1837	0.01	81	Low	1	1 HV	.
970930	.	Range 10	1124	1226	.	40	High	2	2 HV	.
971001	.	Range 10	1326	1333	0.01	53	Mod	2	1 HV	Smoke Grenade
971001	.	Range 10	1450	1506	0.01	53	Mod	2	1 HV	Smoke Grenade
971003	.	Range 12	1528	1702	.	55	Mod	2	1 HV	.
971003	971004	Area 21	2026	1730	6	63	Mod	All	All Available Resources	Illum. Round
971006	.	Puu Ahi Burn Pit	1315	1359	0.02	40	High	5	1 HV, 1 Struct Eng	Stray Embers
971007	.	Range 12	1000	1030	0.01	72	Low	1	1 HV	Tracer
971007	.	Range 8	1225	1235	0.01	.	.	1	1 HV	Tracer
971007	.	Range 8	1325	1357	0.01	.	.	1	1 HV	Tracer
971007	.	Range 12	1330	1430	0.11	.	.	3	2 HV, 1 Tanker	Tracer
980129	.	Range 12	0850	1140	.	37	.	.	1 HV	.
980129	.	Range 12	1029	1520	.	.	.	.	2 HV	.
980130	.	Area 12	1140	.	.	.	.	.	.	.
980130	.	Impact Area	1140	.	.	.	.	.	.	.
980131	.	Range 12	0952	1055	.	.	.	.	2 HV	Tracer
980204	.	Range 12	1230	1343	.	.	.	.	2 HV	Tracer
980204	.	Range 12	2207	2244	.	.	.	.	2 HV	Tracer
980210	.	Range 11T	1438	1627	.	63	Mod	.	2 HV	.
980211	.	Range 11T	0200	0215	.	.	.	.	.	Tracer
980212	.	Range 11T	0725	0905	.	64	Mod	.	2 HV	.
980213	.	Range 12	1716	1815	.	.	.	.	1 HV	.
980224	.	Range 12	0945	1035	.	53	Mod	.	1 HV, 1 Tanker	.
980224	.	Area 22	1010	1029	.	.	.	.	.	.
980224	.	Range 12	1231	1556	.	53	Mod	.	1 HV, 1 Tanker	Tracer
980227	.	Range 8	1404	.	.	.	.	.	.	.
980227	.	Range 8	1620	1648	.	.	.	.	1 HV	.
980227	.	Range 1	1751	1805	.	.	.	.	1 HV	.
980301	.	Range 12	1522	1700	0.75	.	.	.	2 HV	Tracer
980305	.	Range 12	1259	1430	.	54	Mod	.	2 HV, 1 Tanker	.
980305	.	Range 1	1338	1422	.	85	Low	.	.	.
980307	.	Range 10	1432	1454	.	52	Mod	.	1 HV	Tracer

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
980307	.	Range 12	1505	1530	.	55	Mod	.	1 HV	Tracer
980311	.	Range 12	1334	1430	.	16	High	.	1 HV	.
980311	.	Range 10	1627	1732	.	.	.	.	1 HV, 1 Tanker	Ball
980313	.	Range 10	1316	1440	.	.	.	.	2 HV, 1 Tanker	.
980314	.	Range 11T	1335	1347	.	.	.	.	.	.
980315	.	Range 11T	1305	1440	.	.	.	.	.	.
980320	.	Range 10	1337	2243	.	.	Extreme	.	3 HV, 1 Tanker	.
980321	.	Range 10	0905	1750	.	57	Mod	.	3 HV, 1 Tanker	.
980324	.	Redleg Trail	2043	.	.	.	.	.	.	.
980401	.	Range 11T	1434	1452	.	.	.	.	.	.
980401	.	Impact Area	1434	1452	0.15	.	.	.	.	.
980419	.	FP 801	1400	1530	0.25	.	.	.	2 HV	.
980421	.	FP 801	1404	1525	.	.	.	.	2 HV	.
980504	.	Range 12	1152	.	.	.	.	.	.	Tracer
980504	.	Range 8	1047	1100	.	43	High	.	.	Tracer
980505		Range 8	0900	.	.	59	Mod	.	.	Tracer
980506	.	Range 11T	1737	1914	.	.	.	.	1 HV	.
980508	.	Range 1	0950	1630	.	.	.	.	.	.
980509	.	Impact Area	1051	.	.	.	.	.	.	Mortar
980511	.	Range 10	1450	1550	.	.	.	.	1 HV	.
980513	.	Range 10	1402	.	.	.	.	.	.	Tracer
980513	.	Range 12	1415	1445	.	.	.	.	1 HV	.
980521	.	Impact Area	1500	.	.	.	.	.	.	.
980521	.	Impact Area	1500	.	.	.	.	.	.	.
980521	.	Impact Area	1500	.	.	.	.	.	.	.
980521	.	Impact Area	1500	.	.	.	.	.	.	.
980522	.	Range 8	1149	1245	.	47	High	.	1 HV	.
980531	.	Impact Area	1330	.	.	.	.	.	.	.
980603	.	Puu Leilani	0845	0930	.	.	.	.	.	.
980603	.	Impact Area	0925	.	.	.	.	.	.	.
980616	.	Area 1	1352	1645	.	61	Mod	.	1 HV	.
980617	.	Range 1	1354	.	.	.	.	.	.	.
980618	.	.	1100	1900	.	.	.	.	1 HV	.
980622	.	Range 10	1201	1430	.	.	.	.	.	TOW Missile
980727	.	Twin Puus	0955	.	.	.	.	.	.	.
980814	.	Range 1	1050	1425	.	.	.	.	.	Tracer
980819	.	Range 1	1116	1140	.	30	Very High	.	1 HV	.
980819	.	Range 1	1205	1214	.	.	.	.	1 HV	.
980819	.	Range 1	1302	1310	.	.	.	.	1 HV	.
980819	.	Range 1	1339	1352	.	.	.	.	1 HV	.
980821		Range 8	0825	1215	.	.	.	.	.	Tracer
980822	.	Range 12	1315	1330	.	.	.	.	.	Tracer
980825		Kipuka Kalawamauna	0900	1510	.	.	.	.	.	Tracer
980919	.	Impact Area	.	.	.	.	.	.	1 HV	.
980923	.	Range 8	1545	1806	.	.	.	.	.	Tracer
980926	.	Range 8	1410	.	.	.	.	.	.	Tracer
980926	.	Range 12	1037	.	.	.	.	.	.	Tracer

Appendix 1

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
980926	.	Range 12	1106	1120	.	.	.	.	1 HV	.
980926	.	Range 1	1415	1445	.	.	.	.	1 HV	.
980926	.	Impact Area	1830	.	.	.	.	.	.	.
980928	.	Range 1	0925	1610	.	.	.	.	1 HV	.
980929	.	Range 13	1200	1640	.	.	.	.	.	Mortar
980930	.	Range 1	815	0930	.	.	.	.	1 HV	.
980930	.	Range 11T	1410	1600	.	.	.	.	2 HV	.
981004	.	Range 8	1005	1530	.	.	.	.	1 HV	Tracer
981005	.	Range 11T	1139	1406	.	.	.	.	1 HV	Rocket
981009	.	Range 11T	1523	1600	.	.	.	.	1 HV	.
981011	.	Burn Pit	1345	1530	.	.	.	.	1 HV	Escape
981124	.	Range 13	1022	1140	.	.	.	.	1 HV	.
981214	.	Range 11T	1010	1530	<0.01	.	.	.	.	Rocket
990112	.	Range 11T	1308	1545	.	.	.	.	2 HV	.
990113	.	Range 11T	1156	1730	<0.01	.	.	.	1 HV	Tracer
990116	.	Range 1	0906	1630	.	.	.	.	1 HV	Tracer
990118	.	Range 10	1109	1303	.	29	Very High	.	1 HV	Mortar
990118		Range 12	1455	1515	.	.	.	.	.	Tracer
990119	.	Range 10	.	.	0.61	.	.	.	.	Tracer
990121	.	Range 8	1255	1601	.	.	.	.	.	.
990121	.	Range 1	1310	1340	0.02	50	Mod	.	1 HV	.
990124	.	Range 8	0946	1530	.	.	.	.	.	Tracer
990126	.	Range 8	1331	.	.	.	.	.	.	Tracer
990128	.	Twin Puus	1124	.	.	.	.	.	.	.
990129	.	Range 13	1832	1850	.	.	.	.	.	.
990202	990204	Twin Puus	1320	1844	.	56	Mod	.	.	Tracer
990208	.	Mauna Kea Rd	0200	0518	.	.	.	.	.	.
990208	.	Range 8	1000	1800	.	.	.	.	1 HV	Tracer
990211	.	Range 12	1330	1420	0.61	.	.	.	2 HV	Tracer
990329	.	Range 9	0930	.	.	.	.	.	.	.
990427	.	Range 11T	1145	1230	0.1	.	.	.	.	Tracer
990430	.	Range 11T	1106	1200	.	.	.	.	.	.
990522	.	Saddle Rd.	1500	1604	<0.01	.	.	.	1 HV	.
990606	.	Range 11A	1315	.	.	.	.	.	.	.
990615	.	Range 12	1010	1302	0.61	.	.	.	.	Tracer
990616	.	Redleg Trail	1035	.	.	.	.	.	.	Mortar
990618	990619	Range 12	1845	1730	.	.	.	.	.	Tracer
990619	.	Range 12	1034	.	.	.	.	.	.	Tracer
990619	.	Range 1	2230	.	.	.	.	.	.	Tracer
990620	.	Range 1	0826	1025	0.61	.	.	.	1 HV	.
990621	.	Range 1	1430	1702	.	.	.	.	1 HV	Tracer
990626	.	Range 9	1300	1840	.	.	.	.	.	.
990627	.	Range 9	1018	.	0.61	.	.	.	.	.
990705	.	Range 12	0955	1015	.	.	.	.	1 HV	Tracer
990708	.	.	1420	.	.	.	.	.	.	.
990727	.	Impact Area	1454	.	.	.	.	.	.	.
990728	.	Range 1	1250	.	<0.01	.	.	.	.	Stinger

Note: Unavailable information indicated by "."

Fire History Records for Pohakuloa Training Area

Start Date (YYMMDD)	End Date (YYMMDD)	Location	Time of Start	Time Out	Acres Burned	Fire Weather Index	Fire Weather Rating	Ground Personnel	Equipment Used	Ignition Source
990728	.	Range 10	1610	1815	0.03	.	.	.	1 HV	Smoke Grenade
990729	.	Range 10	0702	0845	.	.	.	.	.	.
990729	990731	Range 12	0548	.	.	.	.	.	.	.
990804	990809	Kipuka Kalawamauna	1300	1147	3600	.	.	.	Bulldozers	Arson or Cigarette

Note: Unavailable information indicated by "."

Rare Plants of Pohakuloa Training Area

Scientific Name[1]	Common Name	Federal Status[2]	Heritage Global Rank[3]
Asplenium fragile var. *insulare*† [*Asplenium rhomboideum* in some reports]	fragile fern	E	G?T1
Chamaesyce olowaluana†	\`Akoko, kokomalei, Maui milk tree	SOC	G2?
Cystopteris douglasii†		SOC	G2
Eragrostis deflexa†	bent love grass	SOC	G1
Exocarpos gaudichaudii†	Heau, whisk broom sandlewood	SOC	G1
Festuca hawaiiensis†	Hawaiian fescue	SOC	G1
Haplostachys haplostachya†	Honohono, Hawaiian mint	E	G1
Hedyotis coriacea†	Kio'ele leather leaf sweet ear	E	G1
Melicope hawaiiensis†	Alani	SOC	G2
Neraudia ovata†	Ma\`aloa, ma\`oloa, spotted nettle bush	E	G1
Portulaca sclerocarpa†	\`Ihi hard-fruit purslane	E	G1
Portulaca villosa	hairy purslane	SOC	G1
Silene hawaiiensis†	Hawaiian catchfly	T	G1
Silene lanceolata†	lanceleaf catchfly	E	G1
Solanum incompletum †	Popolo ku mai	E	GH
Spermolepis hawaiiensis†	Hawaiian parsley	E	G1
Stenogyne angustifolia†	creeping mint	E	G1
Stenogyne microphylla†		None	G2
Tetramolopium arenarium†	Mauna Kea pamakani	E	G1
Tetramolopium consanguineum ssp. *leptophyllum* var. *leptophyllum*†	narrow leaf pamakani	None	G1T1
Tetramolopium sp. 1† [*Tetramolopium lepidotum* in some reports]	tooth leaf pamakani	E	G1T1
Tetramolopium humile ssp. *Humile* var. *sublaeve*†	sub-alpine pamakani	SOC	G3T1
Zanthoxylum hawaiiense †	Hea\`e, a\`e Hawaiian yellow wood	E	G1

**From Endangered Species Management Plan, Pohakuloa Training Area (1997)*

Table Notes:

† Seen in PTA since 1981

1 Scientific names of flowering plants are according to Wagner et al. (1990). Fern taxonomy follows Wagner and Wagner (1992).

2 Key to Federal Status (USFWS 1996e):
Endangered (**E**) .... Taxa formally listed as endangered.
Threatened (**T**) .... Taxa formally listed as threatened.
Species of Concern (**SOC**) .... Official listing for taxa that the USFWS remains concerned about and continues to monitor, but which receive no protection under the Endangered Species Act of 1973, as amended.

3 Key to Global Ranks as defined by Hawaii Natural Heritage Program (HINHP):

G1 .... Species critically imperiled globally (typically 1-5 current occurrences).
G2 .... Species imperiled globally (typically 6-20 current occurrences).
GH .... Species known only from historical occurrences (no observations in past 15 years).
G? .... More information is needed before this species can be accurately assessed.
T1 .... Subspecies or variety critically imperiled globally (typically 1-5 current occurrences).
TH.............. Subspecies or variety known only from historical occurrences (no observations in past 15 years).

Note:

- ***Hesperonide sandwicensis*** appears on earlier rare plant lists for PTA. This species was a Category 2 candidate but now has no federal status; it is no longer considered rare by HINHP.
- ***Cystopteris douglasii*** was observed during the 1995 cave survey conducted for the Endangered Species Management Plan Report (Stone et. al., 1995).

Rare Animals of Pohakuloa Training Area

SCIENTIFIC NAME[1]	COMMON NAME	FEDERAL STATUS[2]	HERITAGE GLOBAL RANK[3]
SNAILS			
Leptachatina lepida †	Amastrid land snail	SOC	G1
BIRDS			
Branta sandwicensis †	Nene	E	G1
Buteo solitarius †	\`Io, Hawaiian Hawk	E	G2
Corvus hawaiiensis	\`Alala, Hawaiian Crow	E	G1
Hemignathus munroi †	\`Akiapola\`au	E	G1
Loxioides bailleui †	Palila	E	G1
Pterodroma phaeopygia sandwichensis †	\`Ua\`u, Hawaiian Dark-rumped Petrel	E	G1
MAMMALS			
Lasiurus cinereus semotus †	\`Ope\`ape\`a, Hawaiian Hoary Bat	E	G5T2

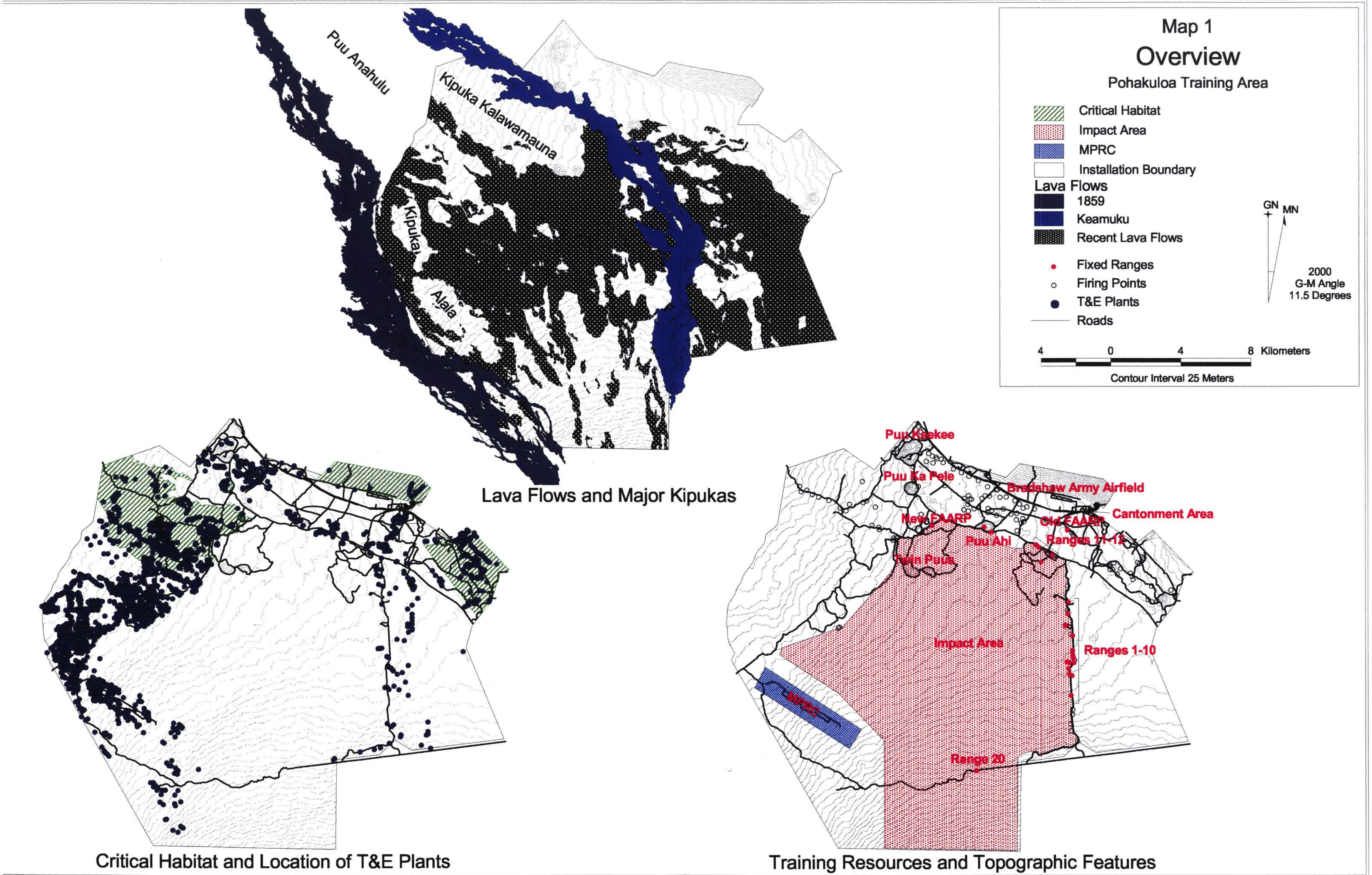
**From Endangered Species Management Plan, Pohakuloa Training Area (1997)*

Table Notes:
† = Detected in PTA since 1980.
1 The taxonomy used in this list follows the following sources:
Birds are according to Pyle (1992) and Pratt et al. (1987).
Mammals are according to Tomich (1986).

2 Key to Federal Status (USFWS 1996e):
Endangered (**E**) .... Taxa formally listed as endangered.
Species of Concern (**SOC**)…………………...Official listing for taxa that the USFWS remains concerned about and continues to monitor, but which receive no protection under the Endangered Species Act of 1973, as amended.

3 Key to Global Ranks as defined by Hawaii Natural Heritage Program:
G1 ....Species critically imperiled globally (typically 1-5 current occurrences).
G2 ....Species imperiled globally (typically 6-20 current occurrences).
G5T2...........Species globally secure but subspecies or variety imperiled globally (typically 6–20 current occurrences)

Note: The ‘Alala, (Hawaiian Crow - *Corvus hawaiiensis)* has not been recorded at PTA since 1978.



Lava Flows and Major Kipukas

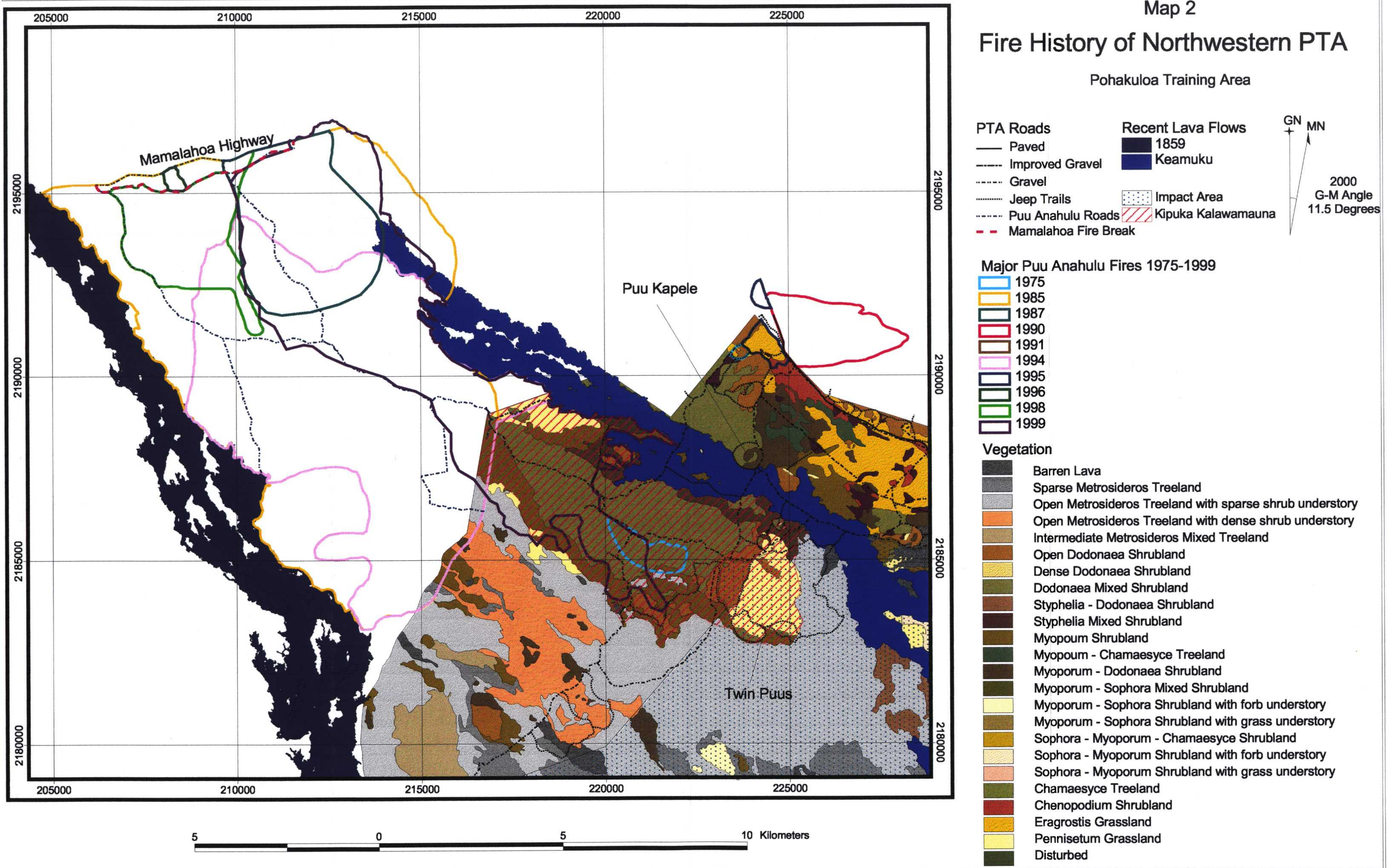
Critical Habitat and Location of T&E Plants

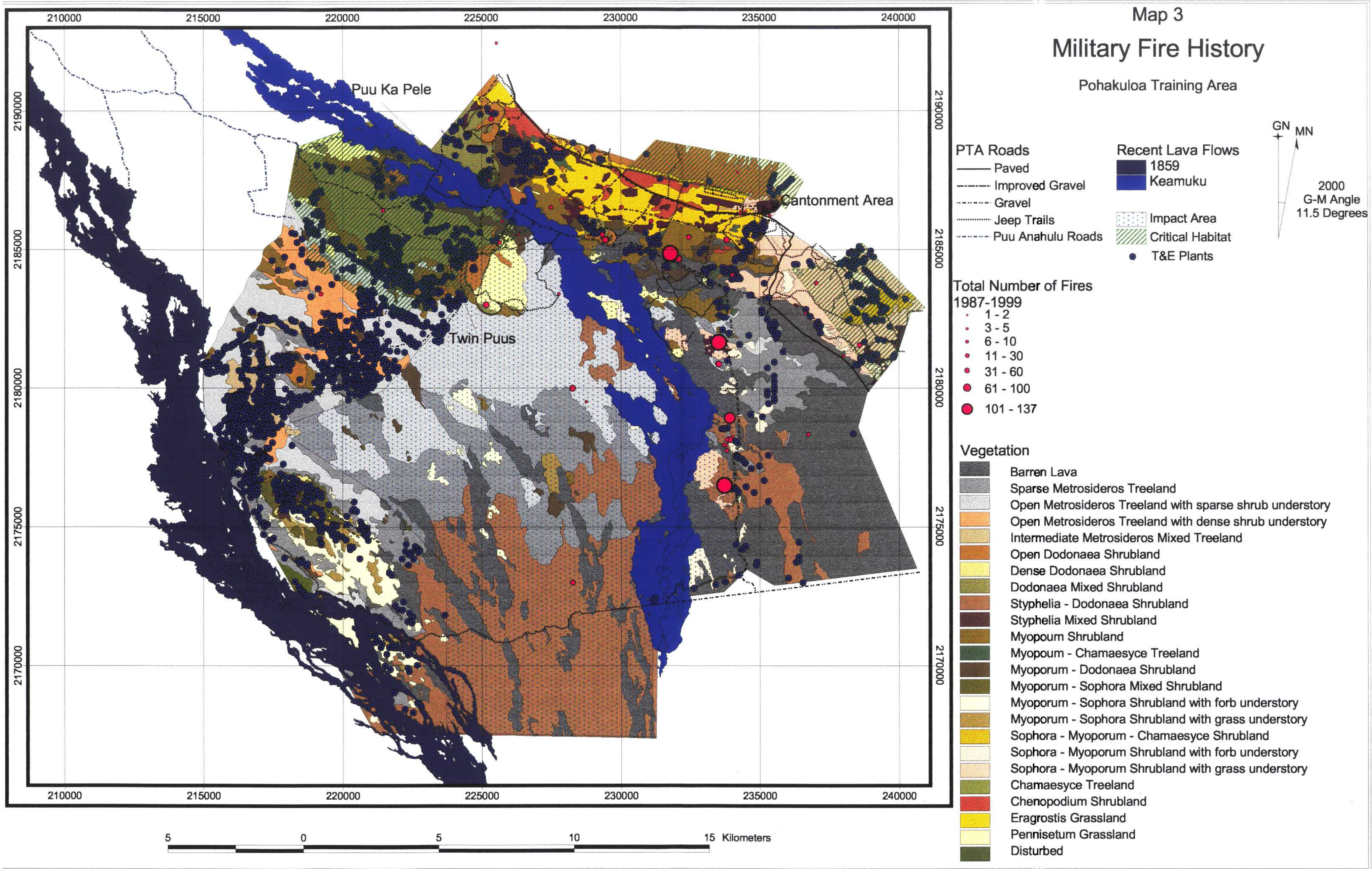
Training Resources and Topographic Features

Map 2

Fire History of Northwestern PTA

Pohakuloa Training Area

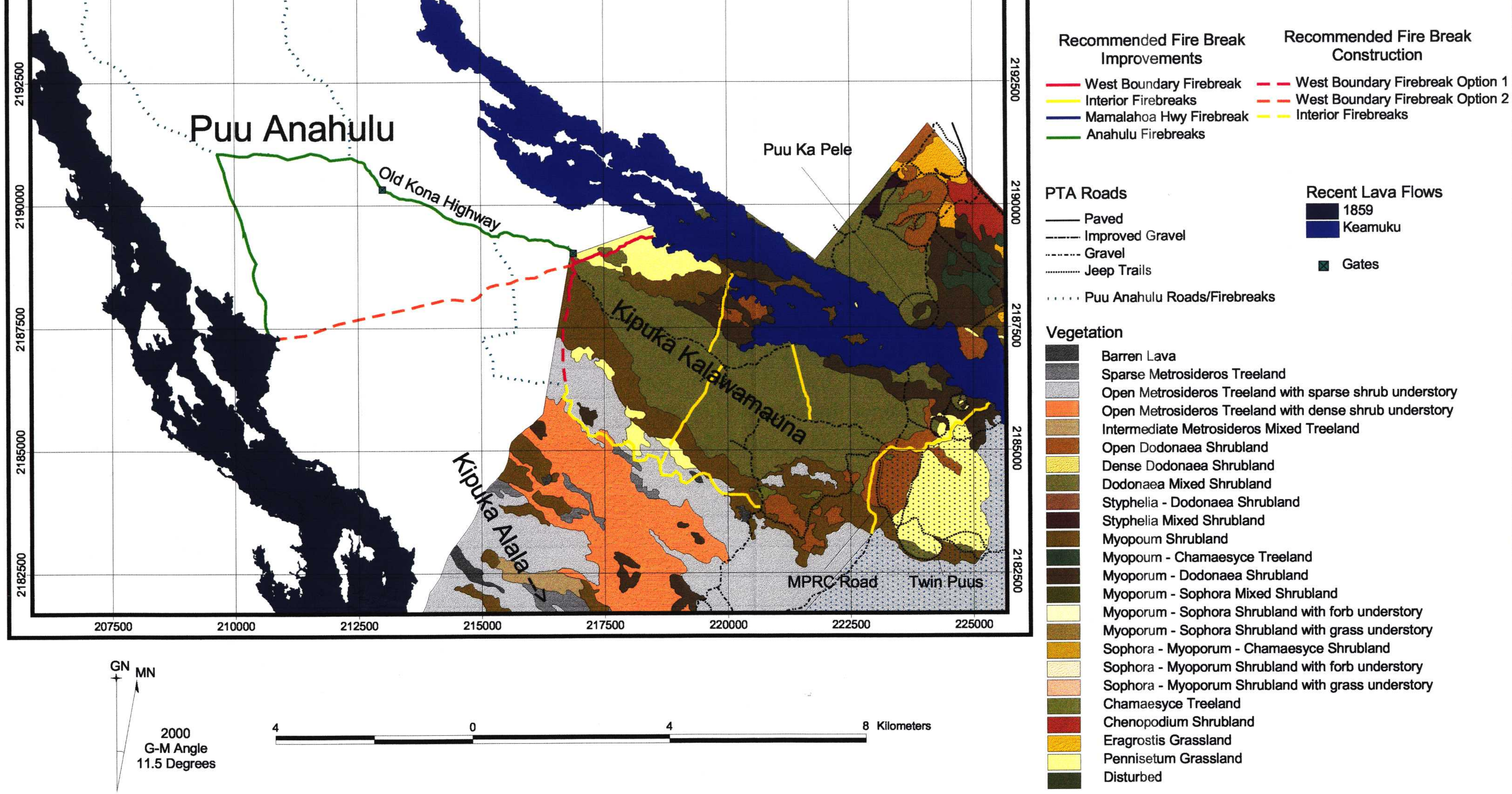



Map 3
Military Fire History
Pohakuloa Training Area
210000
215000
220000
225000
230000
235000
240000
2190000
2185000
2180000
2175000
2170000
Puu Ka Pele
Cantonment Area
Twin Puus
GN
MN
2000
G-M Angle
11.5 Degrees
PTA Roads
Paved
Improved Gravel
Gravel
Jeep Trails
Puu Anahulu Roads
Recent Lava Flows
1859
Keamuku
Impact Area
Critical Habitat
T&E Plants
Total Number of Fires
1987-1999
1 - 2
3 - 5
6 - 10
11 - 30
31 - 60
61 - 100
101 - 137
Vegetation
Barren Lava
Sparse Metrosideros Treeland
Open Metrosideros Treeland with sparse shrub understory
Open Metrosideros Treeland with dense shrub understory
Intermediate Metrosideros Mixed Treeland
Open Dodonaea Shrubland
Dense Dodonaea Shrubland
Dodonaea Mixed Shrubland
Styphelia - Dodonaea Shrubland
Styphelia Mixed Shrubland
Myopoum Shrubland
Myopoum - Chamaesyce Treeland
Myoporum - Dodonaea Shrubland
Myoporum - Sophora Mixed Shrubland
Myoporum - Sophora Shrubland with forb understory
Myoporum - Sophora Shrubland with grass understory
Sophora - Myoporum - Chamaesyce Shrubland
Sophora - Myoporum Shrubland with forb understory
Sophora - Myoporum Shrubland with grass understory
Chamaesyce Treeland
Chenopodium Shrubland
Eragrostis Grassland
Pennisetum Grassland
Disturbed
5
0
5
10
15 Kilometers

Map 4

Recommended Fire Break Improvement and Construction for Kipukas Kalawamauna and Alala

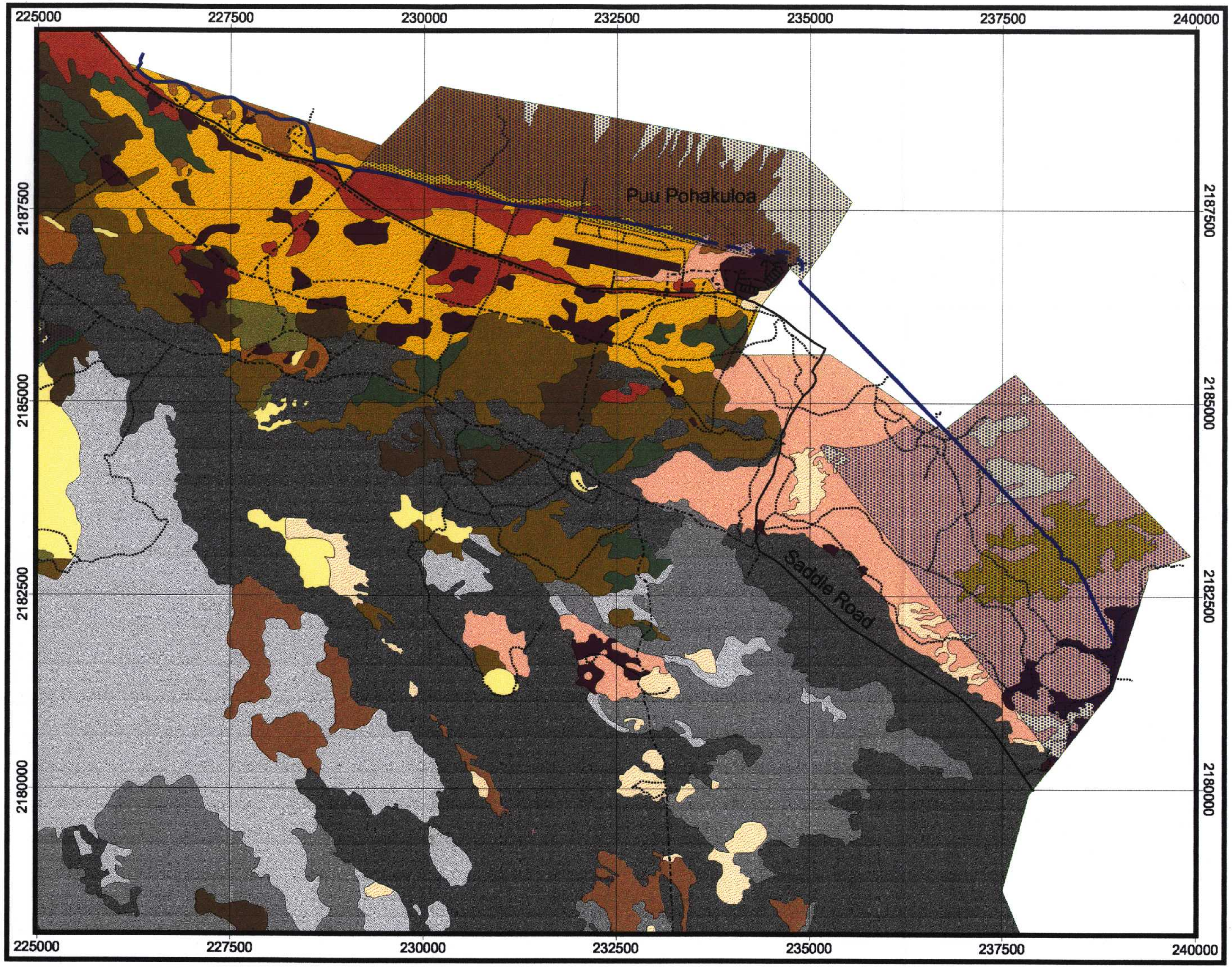
Pohakuloa Training Area



Map 5

Recommended Fire Break Construction and Improvement for the Palila Critical Habitat

Pohakuloa Training Area



GN MN

2000 G-M Angle 11.5 Degrees

2 0 2 4 Miles

Recommended Firebreak Improvements

Palila Firebreak

Recommended Firebreak Construction

Palila Firebreak

PTA Roads

- Paved
- Improved Gravel
- Gravel
- Jeep Trails

Palila Critical Habitat

Vegetation

- Barren Lava
- Sparse Metrosideros Treeland
- Open Metrosideros Treeland with sparse shrub understory
- Open Metrosideros Treeland with dense shrub understory
- Intermediate Metrosideros Mixed Treeland
- Open Dodonaea Shrubland
- Dense Dodonaea Shrubland
- Dodonaea Mixed Shrubland
- Styphelia - Dodonaea Shrubland
- Styphelia Mixed Shrubland
- Myopoum Shrubland
- Myopoum - Chamaesyce Treeland
- Myoporum - Dodonaea Shrubland
- Myoporum - Sophora Mixed Shrubland
- Myoporum - Sophora Shrubland with forb understory
- Myoporum - Sophora Shrubland with grass understory
- Sophora - Myoporum - Chamaesyce Shrubland
- Sophora - Myoporum Shrubland with forb understory
- Sophora - Myoporum Shrubland with grass understory
- Chamaesyce Treeland
- Chenopodium Shrubland
- Eragrostis Grassland
- Pennisetum Grassland
- Disturbed