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GOVERNOR OF HAWAII



'93 MAY 12 P2:36  
STATE OF HAWAII

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LAND MANAGEMENT  
STATE HISTORIC PRESERVATION  
STATE PARKS  
WATER AND LAND DEVELOPMENT

In reply, please refer to:  
REF: DOFAW

May 10, 1993

Mr. Brian J.J. Choy, Director  
Office of Environmental Quality Control  
220 South King Street, 4th Floor  
Honolulu, HI 96813

Dear Mr. Choy:

Subject: Negative Declaration for Pu'u Kukui Watershed Management Area/Natural Area Partnership Program, District of Lahaina, County of Maui, Hawaii; TMK's: 4-1-1-17, 4-2-1-1 (portion), 4-1-4-23(portion), 4-1-5-10, 4-1-5-13, 4-1-5-16, 4-1-5-17, 4-3-1-1, (portion), 4-3-1-17 (portion).

The Department of Land and Natural Resources, Division of Forestry and Wildlife has reviewed and responded to the comments during the 30-day public comment period which began on February 8, 1993. The agency has determined that this project will not have significant environmental effect and has issued a negative declaration. Please publish this notice in the May 23, 1993 OEQC Bulletin.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the final EA.

Please contact Peter Schuyler at 587-0054 if you have any questions.

Sincerely,

  
MICHAEL G. BUCK, Administrator  
Division of Forestry and Wildlife

Enclosures

cc: Keith W. Ahue, DLNR Chairperson  
W. Wong/ B. Evanson, Maui District  
Peter Schuyler, NARS Program Manager

1993-05-23-MA-FA-Pu'u Kukui Watershed Management Area /  
Natural Area Partnership

MAY 23 1993

30 p.  
document

Final  
Environmental Assessment  
For the  
**Pu'u Kukui Watershed Management Area /  
Natural Area Partnership Program**

This Environmental document prepared pursuant to Chapter 343, HRS

PREPARED FOR

MAUI LAND & PINEAPPLE COMPANY, INC.  
P.O. BOX 187  
KAHALUI, HI 96732-0187

PREPARED BY

DIVISION OF FORESTRY & WILDLIFE  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII

TABLE OF CONTENTS

I.	<b>SUMMARY</b> .....	1
	<i>Project Name</i> .....	1
	<i>Approving Agency</i> .....	1
	<i>Project Location:</i> .....	1
	<i>Agencies Consulted during EA preparation:</i> .....	2
II.	<b>PROJECT DESCRIPTION</b> .....	3
	<i>Summary description of the Affected Environment</i> .....	3
	<i>Location</i> .....	3
	<i>Flora</i> .....	3
	<i>Fauna</i> .....	4
	<i>Historical/Archeological and Cultural Sites</i> .....	4
	<i>Adjacent Natural Resources</i> .....	8
	<i>Sensitive Habitats</i> .....	8
	<i>General description of the action's technical, socio-economic and</i> <i>environmental characteristics</i> .....	9
	<i>Technical</i> .....	9
	Management Considerations .....	9
	Management Units .....	10
	Management Goals .....	14
	Non-native Species Control Program .....	15
	Ungulate Control .....	15
	Weed Control .....	17
	Invertebrate and Small Mammal Control .....	20
	Monitoring and Research .....	21
	Rare Species Protection .....	23
	Personnel, Equipment, and Facilities .....	24
	<i>Socio-economic</i> .....	25
	<i>Environmental</i> .....	25
III.	<b>SUMMARY OF MAJOR IMPACTS</b> .....	26
	<i>Major Impacts - Positive</i> .....	26
	<i>Major Impacts - Negative</i> .....	26
IV.	<b>ALTERNATIVES CONSIDERED</b> .....	26
V.	<b>PROPOSED MITIGATION MEASURES</b> .....	26
VI.	<b>DETERMINATION</b> .....	27
VII.	<b>FINDINGS, AND REASONS SUPPORTING DETERMINATION</b> .....	27
VIII.	<b>LIST OF PREPARERS</b> .....	27

<b>IX.</b>	<b>APPENDICES</b> .....	<b>A1</b>
	<i>Appendix 1. Native Natural Communities of Pu'u Kukui Watershed</i> .....	<b>A1</b>
	<i>Appendix 2. Rare Native Plants of Pu'u Kukui Watershed</i> .....	<b>A2</b>
	<i>Appendix 3. Rare Land Snails of Pu'u Kukui Watershed</i> .....	<b>A3</b>
	<i>Appendix 4. Pu'u Kukui Watershed Area - Key to Figure 3</i> .....	<b>A4</b>
	<i>Appendix 5. Summary - Natural Area Monitoring Protocols</i> .....	<b>A10</b>
	<i>Appendix 6. Comments</i> .....	<b>A20</b>

**I. SUMMARY**

**CHAPTER 343, HAWAII REVISED STATUTES (HRS)  
ENVIRONMENTAL ASSESSMENT**

**Project Name:** Pu'u Kukui Watershed Management Area (WMA) /  
Natural Area Partnership

**Proposing Agency / Applicant:**  
Division of Forestry and Wildlife  
Department of Land and Natural Resources  
State of Hawaii  
  
Maui Land & Pineapple Company, Inc.  
P.O. Box 187  
Kahalui, HI 96732-0187

**Approving Agency:**  
Division of Forestry and Wildlife  
Department of Land and Natural Resources  
State of Hawaii

**Project Location:**  
Pu'u Kukui WMA, 8,661 acres in the District of Lahaina, County of Maui,  
State of Hawaii

Tax Map Key	Acres
4-1-1-17	5,780.00
4-2-1-1 (portion)	2,450.38
4-1-4-23 (portion)	0.40
4-1-5-10	1.75
4-1-5-13	2.48
4-1-5-16	<0.01
4-1-5-17	<0.01
4-3-1-1 (portion)	92.00
4-3-1-17 (portion)	334.00

***Agencies Consulted during EA preparation:***

**Federal:**

US Department of Agriculture/ Soil Conservation Service - Maui District  
US Fish & Wildlife Service

**State:**

DLNR/ Division of Forestry & Wildlife - Maui District  
DLNR/ Division of Land Management - Maui District  
DLNR/ State Historic Preservation Division  
Natural Area Reserve System Commission

**County:**

Planning Department - Maui County

**Private:**

National Audubon Society  
Natural Resources Defense Council  
Sierra Club Legal Defense Fund  
Sierra Club/ Maui Group  
The Nature Conservancy

## II. PROJECT DESCRIPTION

The primary goals and objectives of this project are to maintain native ecosystems and to protect the habitat of rare plants and animals in the designated area. Although one of the outcomes of this management will be to maintain and enhance the supply of water that comes from the Pu'u Kukui WMA, it is not the intention of this project to determine the allocation and utilization of that water once it leaves the watershed management area. If the recharge and storage areas are not protected, planning for water use and allocation in the lower valley has the potential to become a moot point. The issues raised by this comment are important ones but need to be addressed in a different forum. Maintaining and increasing the water quality and output from the upper watershed areas as envisioned by this project can only help ensure that a meaningful dialogue with a greater number of options will be possible when that forum does occur.

In general, the proposed management activities will reduce decrease erosion with its subsequent siltation of streams, improve water quality by lowering potential for incidence of bacterial coliform and leptospirosis in the water, and promote a more stable water regime in areas in the project area by reducing the potential for rapid runoff from disturbed or degraded areas within the Pu'u Kukui WMA. The effects of all these activities will be to improve the habitat of the native riparian and aquatic flora and fauna by reducing long term disturbance from feral ungulate activity

### *Summary description of the Affected Environment*

#### *Location*

Pu'u Kukui WMA is located in the West Maui mountains and stretches from the Pu'u Kukui summit (the highest point in the area at 5,788 feet) to about 600 feet elevation at Honokohau Stream. The Pu'u Kukui WMA includes three major streams: Honokohau, Honolua and Honokahua (Figure 1). The project area does not encompass the entire physiographic watershed but instead deals only with the upper recharge and storage portions.

#### *Flora*

Pu'u Kukui WMA contains two aquatic and 12 terrestrial native natural communities (Figure 2; also see Appendix 1). These natural communities vary from lowland shrublands to montane forests and bogs. Two of the communities are considered rare, as they occur in fewer than 20 sites worldwide. They are the 'Ohi'a (*Metrosideros*) Mixed Montane Bog and Hawaiian Continuous Perennial Stream.

Although modified by water diversion in the lower reaches, Honokohau stream still contains all the pre-requisite species to be classified as an occurrence of a Hawaiian Continuous Perennial Stream. Although it fits this classification better than any other, it should be noted that this occurrence should not be considered as a pristine example of this

community type and the potential to restore this stream to a better representation of this community type exists. Among the key components that are found in the stream are diandromous fish species which spend a part of their life in fresh water and part in salt water. The presence of such species is a good indicator that adequate water flow is present from the upper reaches to the ocean. In addition, few non-native species were present, also indicating a good native community.

Pu'u Kukui WMA contains at least 29 species of rare plants, including the Eke Silversword (*Argyroxiphium caliginis*) and four other rare plants endemic to West Maui (Figure 3; also see Appendix 2 & 4). The following five species of rare plants found in the Pu'u Kukui WMA are proposed for federal listing as endangered: *Acaena exigua*, *Alectryon macrococcus* var. *macrococcus*, *Clermontia oblongifolia* var. *mauiensis*, *Cyanea lobata* and *Huperzia mannii*.

A complete list of aquatic and riparian plants has not been completed. Most plant species are ones that are found in a number of communities and are not restricted to either riparian or aquatic areas. One of the few species that is normally found only on or near stream banks is *Hedyotis formosa*. Proposed management activities that reduce soil erosion on stream banks and promote a more stable water regime will favor the maintenance of this species.

#### *Fauna*

Two native forest birds are found in Pu'u Kukui's forests: the 'apapane (*Himatione sanguinea sanguinea*) and 'amakihi (*Hemignathus virens wilsoni*). The 'i'iwi (*Vestiaria coccinea*) has also been reported from these areas, but has not been seen in recent years. Four species of rare native Achatinellid land snails have been found in Pu'u Kukui recently (*Partulina perdix*, *P. splendida*, *P. tappaniana*, *Perdicella kuhnsi*) (Figure 3; also see Appendix 3 & 4).

A complete list of aquatic and riparian fauna has not been completed. A partial list includes the rare goby, 'o'opu alamo'o (*Lentipes concolor*), at least one other gobiid species, the mollusk, hihiwai (*Neritina granosa*) and the native shrimp, 'opae kala'ole (*Atyoida bisculata*). In addition, the abundant aquatic insect fauna includes the native dragonflies such as pinao (*Anax strenuus*) and members of the endemic damselfly genus, *Megalagrion*. No alien fish or prawn species were noted by the Hawai'i Heritage surveys in 1988.

#### *Historical/Archeological and Cultural Sites*

Although no archaeological surveys have been conducted within the boundaries of the Pu'u Kukui WMA no historic sites are known to exist in the area. The project area is generally higher than the lower valley elevations where a greater number of archeological and historic sites are known to occur. In the lower elevations of the project area, agricultural related structures such as ditches and terraces are expected to be present while in

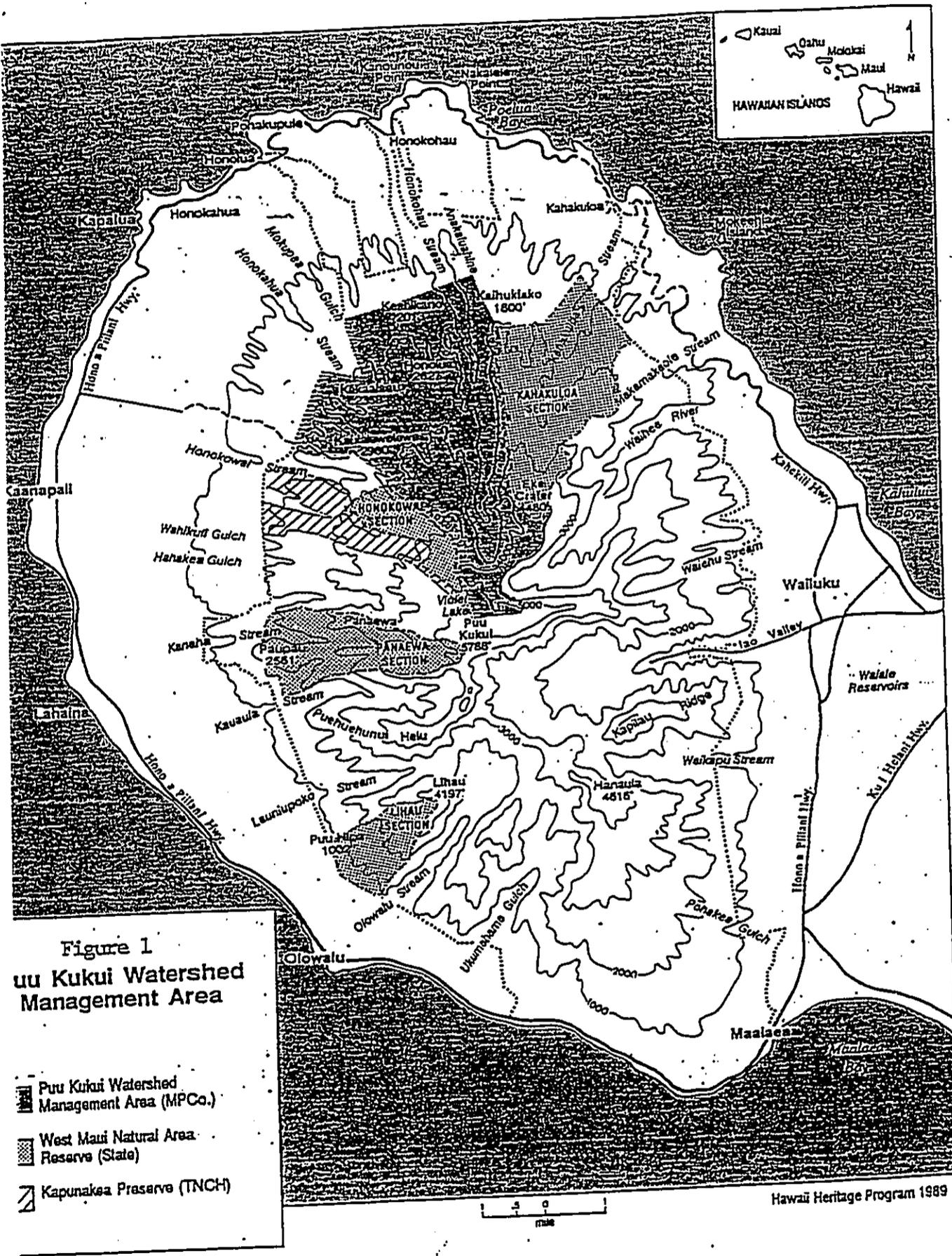
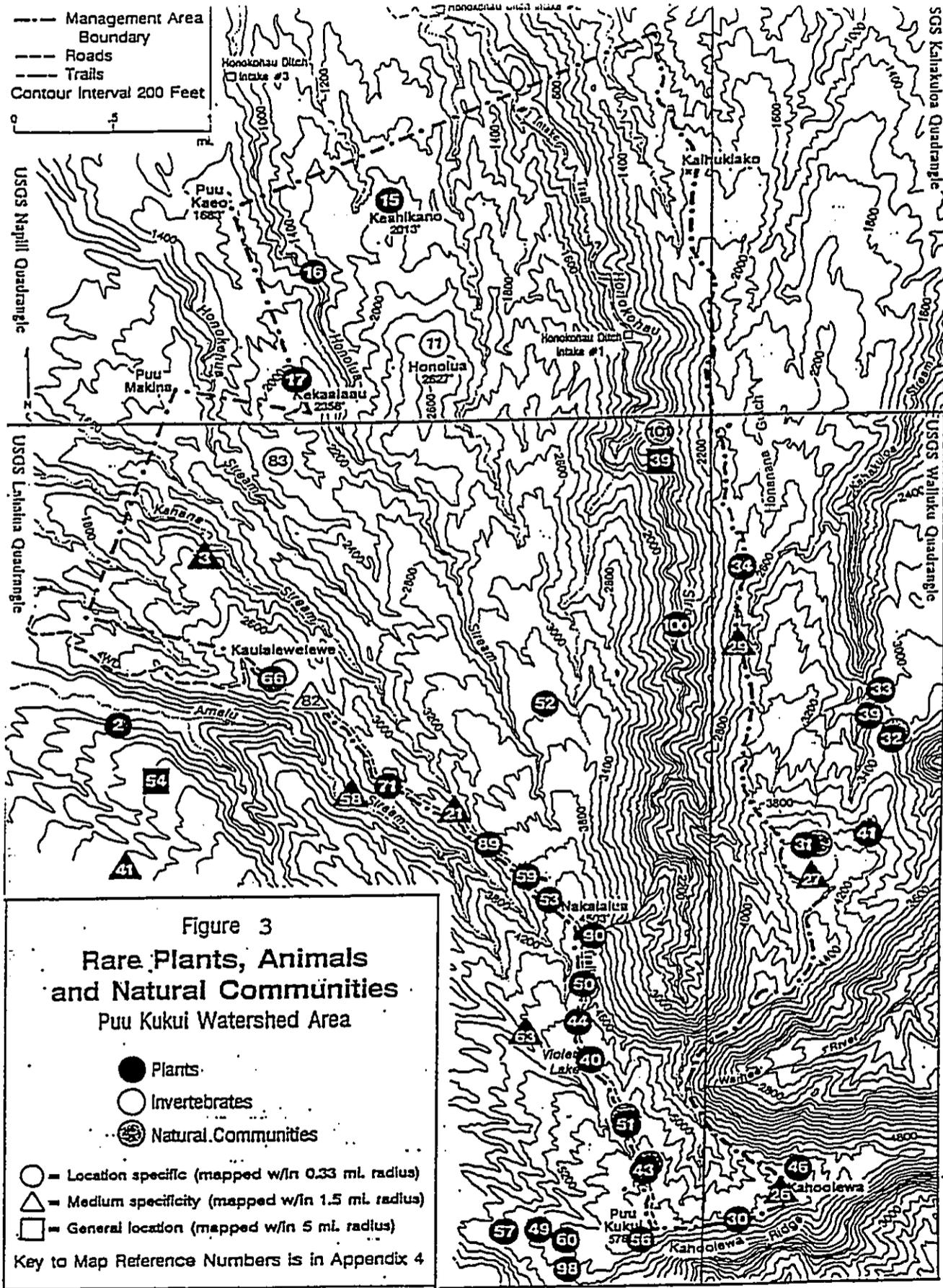


Figure 1  
 Puu Kukui Watershed  
 Management Area

-  Puu Kukui Watershed Management Area (MPCo.)
-  West Maui Natural Area Reserve (State)
-  Kapunakea Preserve (TNCH)

Hawaii Heritage Program 1989





the higher elevations only trails and/or temporary shelters might be expected. After a preliminary review of both the proposed management activities and the comments received on the draft environmental assessment, staff from the State Historic Preservation Division (SHP) agreed that the proposed project should have negligible or no impact on any possible historic sites. Division of Forestry and Wildlife staff consulted with SHP staff to ensure that the full scope of proposed activities was known to SHP staff. Proposed fencing projects which might be considered a source of disturbance will be of short length, require minimal line cutting, will generally be located on higher elevation ridges and will be constructed with metal T-stakes that will pose little risk to potential sites. SHP staff does not recommend an archeological survey at this time citing the large acreage involved, the high cost and the likelihood of minimal ground disturbance from project activities. In the event that MPCo. staff do encounter evidence of historic sites at a site of management activity, it is recommended they notify DLNR staff to obtain their input and suggestions. In the long term, the proposed activities should provide protection for historic resources by eliminating disturbance from ungulates.

#### *Adjacent Natural Resources*

The WMA lies between the Kahakuloa and Honokowai sections of the state's West Maui Natural Area Reserve (Figure 1). These three areas, and the 1,200-acre Kapunakea Preserve (managed by The Nature Conservancy), form 13,000 acres of contiguous forests that are protected by the programs of state and private natural area managers. Eight of the native natural communities found in Pu'u Kukui WMA, including 'Ohi'a Mixed Montane Bog and Hawaiian Continuous Perennial Stream (Kahakuloa stream), are also found in the West Maui NAR. Of the 29 rare plants found in Pu'u Kukui, 16 are known from the West Maui NAR. The four species of land snails listed above are also found in the West Maui NAR.

The aquatic and riparian flora and fauna include similar species to those found in Pu'u Kukui WMA. One of the particular plant species of concern is *Hedyotis formosa* which is normally found only on or near stream banks. Other plant species are ones that are found in a number of communities and are not restricted to riparian areas. A partial list of fauna includes the rare goby, 'o'opu alamo'o (*Lentipes concolor*), at least three other gobiid species, the mollusk, hihiwai (*Neritina granosa*) and the native shrimp, 'opae kala'ole (*Aryoida bisculata*). In addition, the abundant aquatic insect fauna includes the native dragonflies such as pinao (*Anax strenuus*) and members of the endemic damselfly genus, *Megalagrion*. Small numbers of the non-native prawn (*Macrobrachium* ssp. were noted).

#### *Sensitive Habitats*

The sensitive habitats and resources listed above and in the appendices are found both within and adjacent to the Pu'u Kukui WMA. The intent of all proposed management activities is to provide long term resource protection to these habitats. Negative effects such as introduction of new weeds along newly constructed fences or monitoring transects are

recognized and standardized precautions will be taken to minimize the risks. Management activities that affect adjacent sensitive habitats in state natural area reserves or Nature Conservancy preserves will be coordinated with appropriate staff from these organizations to reduce any potential negative impacts.

*General description of the action's technical, socio-economic and environmental characteristics*

*Technical*

**Management Considerations**

This project is a long term one consisting of several different phases. The primary goals and objectives of this project are to maintain native ecosystems and to protect the habitat of rare plants and animals in the designated area. Although one of the outcomes of this management will be to maintain and enhance the supply of water that comes from the Pu'u Kukui WMA, it is not the intention of this project to determine the allocation and utilization of that water once it leaves the watershed management area.

This section describes specific management strategies that will be undertaken to maintain and enhance the native ecosystems and species and to promote sound watershed practices in the Pu'u Kukui WMA. In general, the proposed management activities will reduce decrease erosion with its subsequent siltation of streams, improve water quality by lowering potential for incidence of bacterial coliform and leptospirosis in the water, and promote a more stable water regime in areas in the project area by reducing the potential for rapid runoff from disturbed or degraded areas within the Pu'u Kukui WMA. Maui Pineapple Company will be responsible for the completion of the management work. These strategies are shaped by the following considerations.

1. The Pu'u Kukui watershed encompasses a very large area, much of which is remote and extremely rugged. Management units have been defined by biological and topographical features (Figure 4). Priorities for management have been determined for each unit according to the proximity of the unit to stream drainages that feed MPCo.'s water intakes, the extent of current disturbance, the urgency of other biological threats within and near the unit, and the feasibility of management.
2. Pigs are the primary threat to the watershed, and limiting pig damage is the top management priority. Moderate to heavy damage by pigs has occurred throughout most of the watershed. Pig rooting on the forest floor destroys plants, promotes erosion and weed invasion, threatens the stability of the watershed and introduces silt and disease to West Maui's water supply. Most weeds cannot establish themselves in undisturbed ground, but will readily grow in soil turned by pigs. Standing water collects in pig wallows and encourages the breeding of mosquitos, which transmit bird diseases that may be responsible for the low numbers of native birds on West Maui.

3. Many non-native plants observed in the watershed are shade intolerant and pose no major problem if pigs are removed and the native forest canopy and ground cover remain intact. There are several non-native weed species, however, which form monotypic stands and displace native vegetation over large areas. These habitat-modifying weeds are "priority weeds" for management. Weed control activities will focus on these priority weeds throughout the watershed, with special attention to removing incipient "satellite" (outlying) weed patches to prevent their spread.
4. Access to the entire watershed area is restricted by MPCo. This policy is intended to minimize trampling of fragile areas, prevent the spread of weeds by hikers, and protect public safety. Volunteers or other visitors will be accompanied by appropriate staff and restricted to designated areas and trails in the watershed. Human traffic in pristine areas, especially the upper elevation bogs, will be kept to the minimum required for watershed protection.
5. Management activities in the watershed that affect adjacent NARS will be coordinated with state Natural Area Reserves staff. Staff of The Nature Conservancy will assist the Watershed Manager with planning and technical advice as requested. These partnerships will maximize the cost effectiveness of management efforts at Pu'u Kukui, and provide a larger pool of management expertise to draw from.

#### Management Units

The Pu'u Kukui Watershed Management Area has been divided into 10 management units defined by topographical and biological features (Figure 4). Highest management priority will go to the fragile bog areas and upper reaches of units 6, 7, 8, and 9, and all of 10. Descriptions of the units' resources, and threats to these resources, follow.

#### Unit 1: HONOKOHAU

The Honokohau unit covers approximately 1,250 acres and ranges from 600 feet in the stream bed of Honokohau Valley up to the 4,400 foot rim of Eke Crater. This unit shares its east boundary with the state's Kahakuloa section of West Maui Natural Area Reserve. Two short fences have been built by NARS and watershed staff across narrow ridges to prevent pigs from moving between the areas, and up to the pristine Eke Crater. *Clidemia* and *Tibouchina* are the two most invasive weed species in this unit, and are concentrated along the Eke Trail. Native plant communities range from Mixed Fern/Shrub Montane Wet Cliffs along the steep upper valley walls to Lama/'Ohi'a Lowland Mesic Forest at the lowest elevation; the rare Hawaiian Continuous Perennial Stream community in Honokohau Stream forms the western boundary of this unit.



## Unit 2: KALUANUI

The Kaluanui unit's 1,000 acres range between 600 and 2,800 feet elevation, and collect rainfall destined for the Honokohau Ditch system's #1 and #2 intakes, respectively located in Honokohau Stream and Kaluanui Stream (the northwest drainage of Honokohau Stream). The interior of this unit is largely unknown due to its extremely rugged terrain dissected by numerous drainages. Although heavy pig damage has been reduced through pig control efforts over the past few years, continued pig control is needed to remove pigs that come up from lower elevations through the gulches. *Tibouchina* and Hilo grass are prevalent priority weeds. Natural communities include the Hawaiian Continuous Perennial Stream (bordering Honokohau unit), 'Ohi'a/Uluhe Lowland Wet Forest, and a variety of 'ohi'a-dominated montane forests.

## Unit 3: HONOLUA

Honolua unit encompasses 1,100 acres stretching from 1,000 to 2,800 feet elevation between Kaluanui (the northwest drainage of Honokohau Stream) and Honolua streams. These streams transport rainwater to the Honokohau Ditch system's #2 and #3 intakes, respectively. The two landmark peaks of Unit 3 are Keahikano (2,013 feet elevation) and the prominent ridge line of Honolua (2,627 feet elevation). Moderate to high levels of pig damage exist in this unit. *Tibouchina*, Hilo grass, and broomsedge are the principal priority weed species. A small area below the watershed boundary on the main approach trail to this unit has scattered, small patches of *Clidemia*. Natural communities range from 'Ohi'a/Uluhe Lowland Wet Forest to a mixture of 'ohi'a-dominated montane communities.

## Unit 4: KEKAALAAU

The 800-acre Kekaalaau unit ranges from 1,000 feet elevation at Honolua stream to the 3,000-foot contour between Honolua and Honokahua streams. Prominent landmarks include Pu'u Kaeo (1,683 feet elevation), and Kekaalaau (2,358 feet elevation). Pig damage in this unit has been reduced by construction of strategic fences and removal of pigs. *Tibouchina* and Hilo grass are major weed species, with a few occurrences of blackberry. Natural communities range from 'Ohi'a/Uluhe Lowland Wet Forest to 'ohi'a-dominated montane wet forests and shrublands.

## Unit 5: PU'U MAKINA

One of the smallest units of the watershed, the Pu'u Makina unit covers about 400 acres from 1,400 feet elevation to the 3,000-foot contour between Honokahua and Kahana streams. Relatively little pig damage has occurred in this narrow unit, and two short fences have been built across narrow ridges to prevent pigs from moving up into the watershed from lower elevations. A non-native pine forest around Pu'u Makina (1,970 feet elevation) displaces native shrubland, which grades into 'ohi'a and uluhe dominated communities. 'Ohi'a Mixed Montane Wet Shrubland emerges at the 2,080 foot contour and is the dominant

community along the ridge.

#### Unit 6: KAULALEWELEWE

The only unit with direct 4-wheel drive access, the Kaulalewelewe unit also marks the location of MPCo.'s Haela'au Cabin on Kaulalewelewe peak (2,980 feet elevation), and the Pu'u Kukui trail head. Ranging from 1,800 feet to 3,650 feet elevation between Kahana Stream and the Pu'u Kukui Trail, this unit encompasses 650 acres and borders state lands and the Honokowai section of West Maui NAR on the southwest. Pig damage in this unit is low, due to pig control activities over the past three years. Blackberry, *Tibouchina*, and Hilo grass are the priority weeds, with blackberry infestation the highest of any unit probably due to its original introduction at Haela'au Cabin. The range of blackberry along the trail has been reduced over the past three years of management, and this control will continue. Natural communities include the 'Ohi'a/Uluhe Lowland Wet Shrubland and 'Ohi'a/'Olapa Montane Wet Forest.

#### Unit 7: PU'U 3,540'

At 400 acres, the Pu'u 3,540' unit crosses between Kahana and Honolua streams, stretching from 3,000 - 4,000 feet in elevation. The unit centers around an unnamed hill at 3,540 feet elevation; some upper sections of forest are in nearly pristine condition. Pig damage in other parts of this unit has been reduced through intensive snaring and strategic fences constructed between units 4 and 7. Fresh pig damage has been reduced significantly and the goal is to maintain these low levels of pig damage. *Tibouchina* and Hilo grass are the prevalent priority weeds, although blackberry is gaining a foothold in scattered locations throughout the unit. Natural communities include the 'ohi'a/mixed shrub and 'ohi'a/'olapa montane wet forests.

#### Unit 8: HONOLUA MAUKA

The Honolua Mauka unit consists of 500 acres of 'ohi'a/mixed shrub and 'ohi'a/'olapa montane wet forests extending from the 2,800 foot contour between Honolua Stream and the northwest tributary of Honokohau Stream up to the 4,000 foot contour. This unit also includes a rare, remnant 'Ohi'a Mixed Montane Bog community on an exposed ridge at 3,600 feet. Formerly heavy pig damage occurred through most of the unit, but pig control programs have eliminated all fresh pig sign. *Tibouchina* and Hilo grass are two of the most prevalent weeds in this unit. A few blackberry plants are scattered between 2,800 feet and 3,400 feet elevation. The unit's upper section is as pristine as the upper elevations of Unit 7.

#### Unit 9: NAKALALUA

Nakalalua unit covers about 800 near-vertical acres of upper Honokohau Valley wall from the 1,000 foot elevation at Honokohau Stream to the 4,503-foot twin peaks of

Nakalalua. Consisting mostly of Mixed Fern/Mixed Shrub Montane Wet Cliff and 'Ohi'a/'Olapa Montane Wet Forest communities, the formerly heavy pig damage has been reduced to almost none. *Tibouchina* and Hilo grass are the priority weed invasions. A short fence has been built across the Pu'u Kukui trail to prevent pigs from moving upslope. The Honokowai section of West Maui NAR neighbors this unit on the southwest.

#### Unit 10: PU'U KUKUI

Perhaps due to its rugged topography, severe weather and isolation, the 1,100-acre Pu'u Kukui unit has experienced the least pig damage in the watershed. However, a few pigs have reached the 5,788 foot summit of Pu'u Kukui and are slowly invading the summit approaches above Nakalalua. Pigs that have made their way above and around Eke Crater to the narrow ridge between Honokohau and Waihee valleys are being removed. The unit ranges in elevation from 1,800 feet at Honokohau Stream to the Pu'u Kukui summit and borders the Honokowai section of the NAR on the west. It supports rare natural communities including 'Ohi'a Mixed Montane Bog and the headwaters of the Hawaiian Continuous Perennial Stream, as well as a number of rare plants found only on West Maui. This unit will be given top management priority.

#### Management Goals

The long-range goal for each management program is listed below, followed by a brief description of the program strategies and how they will change over the six-year period covered in this plan. The goals and objectives are presented roughly in order of priority, but they fit together to form an integrated management strategy.

The management emphasis for Pu'u Kukui WMA in Year 1 will be the continued reduction of pig activity that has been underway in the past three years. Monitoring for pig activity and weed distribution will be improved by adding four additional transects. Five locations for strategic fences have been identified as needed to restrict pig movement within the WMA, and one fence will be built each year over the next five years. Weed control in Year 1 will continue to focus on the two top priority weeds, *Clidemia* and blackberry (*Rubus argutus*). Priorities to map and control other priority weeds will be set in Year 1 and mapping undertaken in Year 2; control of these other weeds will begin in Year 3. Monitoring techniques for specific resources within the WMA (other than the transects used to gauge effectiveness of ungulate and weed control programs) will be identified in Year 1 and implemented in Year 2. Programs for the protection of specific rare species will be developed and implemented in Years 2 and 3, as the threats from ungulates and weeds are reduced to maintenance levels.

## *Non-native Species Control Program*

### **Ungulate Control**

**GOAL:** Reduce ungulate activity to a level that will promote and sustain measurable recovery of native vegetation in all Pu'u Kukui management units.

MPCo. has established a program to prevent pig access to pristine regions and reduce pig numbers in all watershed units to remnant levels. Feral goats and cattle have been reported in the area in past years, but are not currently a problem. However, if these animals are detected in the watershed, immediate efforts will be made to remove them.

Since 1988, 12 strategically located fences have been built to block or redirect pig movements, and snares set to remove pigs from the watershed. The fences were built to keep pigs from entering the more pristine mauka areas. Monitoring has shown a greater number of pigs below the fences than above and at this time the most upper areas of the watershed are considered pig free. In addition, pig activity monitoring in the lower areas of Pu'u Kukui WMA has shown a decrease in pig activity above the fence as well as an increase in native plant recovery since the installation of the fences.

Snares have been used for the past 4-1/2 years. The number of snares has been reduced to less than 500, more than cutting in half the totals of previous years. Snares that have the potential to affect the valley streams are found only in Honokohau Valley. Less than 50 snares are set in this location and are generally checked once every other week. Animals found alive in these snares are shot and the meat utilized by local employees. Other snares (less than 450) are located on ridges and away from water courses. These snares are located in the mid to lower elevation regions of the project area (at this time, all snares in the remote upper portion have been removed). These snares are checked less frequently on a 3 - 6 month basis. To date, over 155 pigs have been captured by snares. The number of animals per year has also been decreasing each year with only a few pigs snared to date in 1993. Most of these animals came from the lower area. If new pig activity is detected, the need for additional snaring will be evaluated along with other proven control methods. MPCo. employees and a limited number of others are given permits to hunt in the lower part of the watershed to about 2,000 foot elevation; this hunting helps keep pigs from moving up from the lower elevations. They average 150-200 pigs / year although numbers are also decreasing in recent years. Animal control will be maintained throughout the watershed until data from monitoring programs indicate a significant decrease in pig activity for at least a year.

The current monitoring system of eight transects will be supplemented with another four transects, to be established in the next year, to gather information on ungulate damage throughout a larger area of the watershed. All transects will be checked twice a year to determine preserve-wide levels of pig activity, and identify areas where increased management is needed. The pig removal goal is to keep pig activity from affecting more

than 10% of the survey stations along the transects. An aerial ungulate population census will be conducted annually with a helicopter equipped with a Forward Looking Infra-Red (FLIR) camera. FLIR is heat sensitive, and can detect the warmth of an animal's body in low-growing or open vegetation, which can help identify areas that need management attention. Locations for five additional strategic fences have been identified, and these fences will be built at a rate of about one per year over the next five years.

### Ungulate Control Timeline

#### **Year 1**

- \* Maintain existing snares; replace approximately 10% of snares, and add or remove snares as necessary.
- \* Maintain 12 strategic fences.
- \* Add 1 strategic fence near the lower watershed boundary in management unit 3.
- \* Monitor ungulate damage along 8 existing transects twice a year; add 4 additional transects.
- \* Continue permit hunting program below WMA boundary.
- \* Conduct 1 FLIR overflight.

#### **Year 2**

- \* Maintain existing snares; replace approximately 10% of snares, and add or remove snares as necessary.
- \* Maintain 13 strategic fences.
- \* Add 1 strategic fence near new strategic fence in lower part of unit 3.
- \* Monitor ungulate damage along 12 existing transects twice a year.
- \* Continue permit hunting program below WMA boundary.
- \* Conduct 1 FLIR overflight.

#### **Years 3 & 4**

- \* Add snares or other proven control method in any unit with fresh pig sign at more than 10% of monitoring stations. Remove snares in areas that showed no pig sign in the past 18 months. Replace other snares in remaining snare groups as needed.
- \* Maintain 14 strategic fences.
- \* Add 1 strategic fence each year (near Kaulalewelewe in lower part of unit 6).
- \* Monitor ungulate damage along 12 existing transects twice a year.
- \* Continue permit hunting program below WMA boundary. Evaluate hunting program and evaluate need for contract hunting. Implement contract hunting if needed.
- \* Conduct 1 FLIR overflight.

#### **Years 5 & 6**

- \* Add or remove snares as needed.

- \* Maintain 16 strategic fences.
- \* Add 1 strategic fence in Year 5 to prevent ingress from Kahakuloa near Pu'u Kukui summit.
- \* Monitor ungulate damage along 12 existing transects twice a year.
- \* Continue hunting program as developed in Years 3 & 4.
- \* Conduct 1 FLIR overflight.

### Weed Control

**GOAL:** Reduce the range of habitat-modifying weeds and prevent introduction of new problem weeds.

Reducing disturbances to intact native vegetation will be one of the most effective methods to prevent weeds from becoming established. However, there are weeds established in the preserve that require control. The weed control strategy for the Pu'u Kukui Watershed will concentrate on controlling "satellite" populations of priority weeds and preventing further expansion of weeds into pristine areas. Treatment of large, well-established weed populations is generally not practical or cost-efficient, and these weeds are controlled only enough to prevent their further spread. Weed control efforts will require an integrated program of applying known control methods, monitoring effectiveness, and refining control methods.

The 8 monitoring transects used to measure ungulate damage are also used to note weed presence. The addition of four transects to the monitoring system (as noted in the ungulate control section) will improve information on the range and types of weeds in the watershed. Maps showing ranges of priority weeds can be used to track the location of known populations, and to determine if the weeds are expanding their range. Over the next two years, range maps will be completed for *Clidemia* (*Clidemia hirta*), blackberry (*Rubus argutus*), and *Tibouchina* and a schedule for mapping other priority weeds will be set and instigated.

Pu'u Kukui staff and volunteers have already treated approximately two acres of blackberry along the Pu'u Kukui Trail using a 1 - 2% foliar spray solution of Roundup. Several thousand *Clidemia* plants have been pulled in units 1 and 3. *Clidemia* will be considered the number one priority weed. All known colonies of *Clidemia* will be re-treated annually, until these colonies no longer re-occur. Blackberry is the second priority weed, and all blackberry along the Pu'u Kukui trail will be treated annually, until the blackberry no longer resprouts. All newly discovered incipient populations of blackberry will be removed as soon as possible. Larger populations of blackberry will be treated to reduce the known population range by 10% per year. Time-tables for treatment of other weeds will be established after evaluating the success of *Clidemia* and blackberry control programs.

The use of chemical control methods will be minimized and only herbicides approved for use in watersheds will be used. To date, only Roundup has been used on blackberry patches. Roundup has a short half life (< 60 days) and degrades to non toxic compounds. Garlon 3A applied according to label specifications is the only other herbicide currently under consideration for use in Pu'u Kukui WMA. All staff will undergo required pesticide application training. Weed control is labor-intensive and benefits from technologically sophisticated techniques, and will require technical support from the University of Hawaii Agricultural Extension Service, the National Park Service, and other researchers. The development of biological control methods for priority weeds by programs underway in the U.S. Forest Service and National Park Service will be encouraged by making study sites available as requested.

The Watershed Supervisor participates in the Tri-Isle Resource, Conservation and Development Council's Melastome Action Committee. This committee's goal is to identify solutions to reduce the invasions and extent of Melastomes in forested and watershed areas throughout the state through long-term biological control, and short-term manual and chemical control and on less widespread Melastomes. *Tibouchina* has invaded more of the Pu'u Kukui WMA than any other weed, rendering manual and chemical controls ineffective due to this weed's extent.

Those who enter the watershed area will be required to clean their clothing, boots, equipment and camping gear of soil and plant material to prevent the introduction of new weeds. Wherever possible, helicopter flights into the watershed will originate from weed-free areas such as wooden platforms or pavement, and all materials hauled into the watershed will be inspected and cleaned to remove soil, plant material, and insects. Helicopter landing sites and areas frequented by staff will be inspected for weeds each trip.

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**TABLE 1**  
**PRIORITY WEED SPECIES OF PU'U KUKUI WATERSHED**

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1. <i>Clidemia</i> (Koster's curse)	<i>Clidemia hirta</i>
2. Blackberry	<i>Rubus argutus</i>
3. <i>Tibouchina</i>	<i>Tibouchina herbacea</i>
4. Hilo grass	<i>Paspalum conjugatum</i>
5. Strawberry guava	<i>Psidium cattleianum</i>
6. Guava	<i>Psidium guajava</i>
7. Meadow rice grass	<i>Ehrharta stipoides</i>
8. Glenwood grass	<i>Sacciolepis indica</i>
9. Molasses grass	<i>Melinis minutiflora</i>
10. Broomsedge	<i>Andropogon virginicus</i>
11. Ginger	<i>Hedychium</i> spp.

## OTHER IMPORTANT WEED SPECIES

1. Christmas berry	<i>Schinus terebinthifolius</i>
2. Silk oak	<i>Grevillea robusta</i>
3. Pamakani	<i>Ageratina adenophora</i>
4. <i>Lantana</i>	<i>Lantana camara</i>
5. Formosan koa	<i>Acacia confusa</i>
6. Butterfly bush	<i>Buddleia asiatica</i>
7. Bog rush	<i>Juncus effusus</i>
8. Thimbleberry	<i>Rubus rosifolius</i>

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A half-mile boardwalk has been built over severely damaged sections of the Pu'u Kukui trail to reduce the spread of weeds to unit 10. Much of the higher elevation trail crosses boggy areas with very fragile ground cover. In some areas hikers have created 10-foot wide paths to avoid sinking in the deep mud. Delicate native ground-cover is being destroyed and weeds are spreading in these disturbed trail sides. The boardwalk will be extended as necessary to prevent further damage in the area from Nakalalua to the Pu'u Kukui summit.

### Weed Control Timeline

#### **Year 1**

- \* Map all known populations of blackberry and *Clidemia*.
- \* Retreat blackberry along Pu'u Kukui Trail; reduce large populations of blackberry by 10% of range.
- \* Retreat all known *Clidemia* populations.
- \* Determine order of priority for mapping other priority weeds.
- \* Monitor weed presence along 8 existing transects twice a year; add 4 additional transects (see ungulate control section).
- \* Continue participation in RC&D Melastome Action Committee to promote biological control solution to widespread *Tibouchina herbacea* in watershed.

#### **Year 2**

- \* Retreat blackberry along Pu'u Kukui Trail; reduce large populations of blackberry by 10% of range.
- \* Retreat all known *Clidemia* populations.
- \* Implement mapping of other priority weeds as determined in Year 1.
- \* Monitor weed presence along 12 existing transects twice a year (see ungulate control section).
- \* Continue participation in RC&D Melastome Action Committee to promote biological control solution to widespread *Tibouchina herbacea* in watershed.

#### **Years 3 & 4**

- \* Retreat blackberry along Pu'u Kukui Trail; reduce large populations of blackberry by 10% of range.
- \* Retreat all known *Clidemia* populations.
- \* Continue mapping of other priority weed ranges as determined in Year 1.
- \* Develop strategies and schedule for control of other priority weeds based on results of weed range maps, and begin implementation of control.
- \* Monitor weed presence along 12 existing transects twice a year.
- \* Continue participation in RC&D Melastome Action Committee to promote biological control solution to widespread *Tibouchina* in watershed.

#### Years 5 & 6

- \* Retreat blackberry along Pu'u Kukui Trail; reduce large populations of blackberry by 10% of range.
- \* Retreat all known *Clidemia* populations.
- \* Continue additional priority weed control begun in Year 4; implement additional control for other priority weeds.
- \* Monitor weed presence along existing transects twice a year.
- \* Continue participation in RC&D Melastome Action Committee to promote biological control solution to widespread *Tibouchina* in watershed.

#### Invertebrate and Small Mammal Control

**GOAL:** To reduce known threats by non-native invertebrates and small mammals.

Non-native insects, mollusks and small mammals [e.g. rats (*Rattus* spp.), mongooses (*Herpestes auropunctatus*), feral cats (*Felis catus*)] are poorly understood but potentially major threats to native species and ecosystem stability. Ants, yellow jackets and snails like *Euglandina rosea* have displaced native invertebrate fauna at lower elevations. Rats and mongooses are major predators of birds. Over the next six years at Pu'u Kukui, incidental sign of small mammals and non-native invertebrates will be noted, and traps will be set where mammal sign is seen. In Year 3, the incidental sign gathered will be evaluated and the need for a more comprehensive control program determined. Also in Year 3, Pu'u Kukui managers will follow the lead of other natural area managers to develop and implement invertebrate control in the watershed.

Small mammal control will begin in Year 1 by setting traps around camp sites for rats and mongoose during each visit. Material attractive to these pests will be securely stored or removed. Monitoring transects for ungulates and weeds will be expanded to include incidental sign of small mammals.

### Invertebrate and Small Mammal Control Timeline

#### **Year 1**

- \* Set rat and mongoose traps around camp sites and monitor for small mammal sign.
- \* Collect data on small mammal sign and non-native invertebrate presence along ungulate and weed monitoring transects; set traps in areas where sign warrants.

#### **Year 2**

- \* Maintain trapping program around camp sites and where monitoring data indicates need.

#### **Years 3 & 4**

- \* Maintain trapping program around camp sites and where monitoring data indicates need.
- \* Evaluate small mammal and invertebrate data gathered, and determine need for more comprehensive control plan.
- \* Follow lead of other Hawaii natural area managers in developing and implementing invertebrate control programs as needed.

#### **Years 5 & 6**

- \* Maintain trapping and monitoring program. Evaluate data at 3-year cycles and adjust control program to most efficiently reduce impacts on native species.
- \* Continue invertebrate program as implemented in Year 4.

### *Monitoring and Research*

**GOAL:** To track biological and physical resources in the watershed and evaluate changes in these resources over time; to identify new threats to the watershed; to provide logistical support to approved research projects that will improve management understanding of the watershed's resources.

Scientific monitoring is needed to measure the effectiveness of management programs, and the condition of natural resources within the watershed. The monitoring transects mentioned in the non-native species control sections evaluate those programs. The transects are 500 yards long. Additional monitoring is needed to track the major resources and threats to these resources within the watershed.

Monitoring methods are detailed in the 62 page document, *Long term Biological Resource and Threat Monitoring of Pu'u Makaala Natural Area Reserve*. The protocols and guidelines for this document come from the more general document, *Long term Biological Resource and Threat Monitoring of Hawaiian Natural Areas*, which was developed by the Nature Conservancy after consultation with more than 50 scientists and resource managers through out the state. An overview of the seven monitoring protocols as well as a summary

of the purpose and structure of the report is given in Appendix 5. The monitoring methods developed will form the basis for a resource and threat monitoring program to be applied to the watershed, and will be described in Year 1. This program will be implemented in Year 2, and will monitor major resources, including vegetation, birds, invertebrates, and rare species, as well as the major threats. Information gathered will measure trends in ecosystem "health", determine limits of natural variation in resources, diagnose abnormal conditions, and help suggest potential remedial treatments.

Maui Land and Pineapple Company maintains a daily water flow monitoring regime. These stations will continue to be monitored on a regular basis. The Division of Forestry and Wildlife (DOFAW) is planning to work closely with the Division of Aquatic Resources to develop cooperative aquatic flora and fauna resource monitoring schemes for several areas throughout the state. DOFAW staff will work with MLP staff to have Pu'u Kukui WMA included in this program.

Scientific research in Pu'u Kukui WMA will be allowed on a permit basis only. The Watershed Supervisor will evaluate all research proposals for potential direct and indirect impacts on the watershed and its resources. Proposed projects will also be evaluated based on the pertinence of the research. Only those projects deemed safe to the resources and of high priority will be allowed. Projects that have been identified as priorities for managers by the Hawaii Conservation Biology Initiative (HCBI), an informal research consortium of agencies actively involved with conservation research and management in Hawai'i will be given preference. HCBI topics are the consensus products from workshops attended by over 50 managers, researchers and "users" of natural resources.

#### Monitoring and Research Timeline

##### **Year 1**

- \* Develop resource and threat monitoring tasks and budget, based on results of Natural Resource Monitoring Plan.
- \* Provide logistical support, on a non-interference basis, for approved research projects in the watershed.
- \* Conduct 2 remote survey trips.
- \* Purchase Global Position System equipment and use to improve mapping and relocation abilities for all program activities.
- \* Participate in USFWS forest bird census training to improve bird identification and monitoring capacity for native and non-native birds.

##### **Year 2**

- \* Implement resource monitoring tasks as defined in Year 1.
- \* Conduct 2 remote survey trips.
- \* Identify appropriate Geographic Information System (GIS) technology to use on personal computer.

#### Years 3 & 4

- \* Continue resource monitoring tasks as defined in Year 1.
- \* Conduct 2 remote survey trips.
- \* Acquire computer equipment and software to establish GIS on personal computer; input necessary data.

#### Years 5 & 6

- \* Continue resource monitoring tasks as defined in Year 1.
- \* Conduct 2 remote survey trips.
- \* Utilize GIS for management system.
- \* Participate in USFWS Forest Bird Census as requested.

#### *Rare Species Protection*

**GOAL:** To prevent the extinction of rare species in the watershed.

The Pu'u Kukui watershed protects 29 species of rare plants found in fewer than 20 places in the world, and four species of rare land snails. Additional rare species may be discovered in new areas of the watershed with further exploration. Protection of the watershed's natural communities is essential to protecting the rare native species that depend on these ecosystems for survival. However, particularly rare plants and animals may need more immediate attention and direct management.

The goal of this program is to identify the rarest species and threats to them, and implement management to prevent their loss. Information on rare plants and animals in the Hawaii Heritage Program's database will be used to develop a rare species plan with the aid of consultants in Year 2. This plan will be implemented in Year 3, and continued as necessary to fulfill the goals of this program. Biologists will be contracted as needed to conduct surveys of snails and plants.

#### Rare Species Protection Timeline

##### Year 2

- \* Request updated data from Hawaii Heritage Program (HHP) to supplement 1990 information from HHP.
- \* Hire consultant to identify rarest species and develop plan to monitor and instigate emergency protection of threatened species.
- \* Contract malacologist to survey for new snail populations.

##### Years 3 & 4

- \* Implement rare species protection plan.
- \* Contract botanists to survey unvisited areas for rare plants.

#### Years 5 & 6

- \* Continue implementation of rare species protection plan.
- \* Revise plan as needed with new information.

#### *Personnel, Equipment, and Facilities*

**GOAL:** To provide adequate manpower and equipment to meet the goals and objectives of this plan.

The Pu'u Kukui Watershed Manager is responsible for the implementation of this plan. The volume of work outlined in this plan requires the Watershed Supervisor to be assisted by one full-time field technician, or two to three part-time contract field technicians. All staff will be employees of MLP. A full-time field technician will help ensure that schedules can be met and longer trips can be made into the remote watershed areas, reducing helicopter time and creating more efficient working schedules. However, contract labor can provide more than one person at a time, for labor-intensive trips. MPCo. may decide, during the course of this plan, to hire a additional full-time field technician rather than use contract labor. Watershed staff will attend regularly scheduled emergency training courses offered by MPCo., Division of Forestry and Wildlife, National Park Service, and the American Red Cross. Staff will attend refresher emergency training courses on an annual basis or as required to maintain certifications.

Volunteers can help reduce management costs of labor-intensive tasks such as fence construction, weed control, and trail maintenance. However, working conditions in remote sections of Pu'u Kukui can be hazardous and adequate safety training and supervision for volunteers must be provided. Also, sufficient insurance coverage should be in place for all volunteers. The Pu'u Kukui Watershed Supervisor will cultivate and schedule volunteers to assist with appropriate watershed projects. Volunteer group size will be limited to minimize impact on fragile trails or habitat, and volunteers will be escorted by MPCo. staff in order to support the policy of keeping the watershed closed to the general public.

Maui Pineapple Company's Honolua baseyard provides space for the Pu'u Kukui Watershed Supervisor and equipment storage needs, and associated costs are shown as "facilities". Other "facilities" in the WMA are needed to improve management efficiency. The Haela'au Cabin, located at the top of the only 4-wheel drive road to the watershed and at the base of the Pu'u Kukui trail, is used by Watershed staff and volunteers for lower-elevation work. Annual maintenance of the cabin is needed to keep this old building in usable condition. A remote field camp will be set up in Year 1 to provide a place to get out of the rain at night on overnight and week-long trips. Wooden helicopter landing platforms are needed to provide safe landing zones, to protect fragile vegetation from helicopter landings, and to prevent the establishment of additional weeds. Impacts from these activities should affect only surface vegetation and will be temporary in duration. Landing zones and remote field camps are shown on Figure 4.

Road and trail maintenance is needed to keep the main ground access routes to the watershed open: principally the 4-wheel drive to Haela'au Cabin, and the Pu'u Kukui Trail on the watershed's southwest boundary. Heavy winter rains cause erosion and washouts on the road, and maintenance is needed to fill potholes and improve drainage to lessen erosion of this single vehicle access to the watershed. A boardwalk over the muddy parts of the upper Pu'u Kukui trail may need to be extended to prevent damage to fragile bog vegetation.

#### *Socio-economic*

No direct economic effects are expected to result from this project. However, the rain forests and bogs of Pu'u Kukui serve as a stable water source for West Maui residents and industries. Maui Land and Pineapple Company depends on the watershed for agricultural and resort use, and supplies water to the county water system and neighboring landowners. In particular, Honokohau valley residents depend on the watershed for agricultural water, instream flows, and subsistence items. Native vegetation is an essential component of this watershed system. Forest cover protects fragile mountain soils from erosion, and acts like an immense sponge that absorbs heavy rains. Water is gradually released into streams and groundwater aquifers, rather than running off the surface in torrents to the sea.

In addition to protecting native ecosystems, management activities will promote a more stable water regime in areas in the project area by reducing the potential for rapid runoff from disturbed or degraded areas within the Pu'u Kukui WMA. Although one of the outcomes of this management will be to maintain and enhance the supply of water that comes from the Pu'u Kukui WMA, it is not the intention of this project to determine the allocation and utilization of that water once it leaves the watershed management area.

Preservation of biodiversity has been recognized as a legitimate and necessary goal for society. This project provides multiple opportunities to protect and preserve examples of unique natural ecosystems and endemic species, including both terrestrial and aquatic flora and fauna taxa. When appropriate, volunteers will be utilized in various management projects thus providing educational and "recreational" opportunities for the general public.

#### *Environmental*

This project is expected to create positive impacts on the environment in the form of maintaining or enhancing native ecosystem habitats, maintaining or enhancing biological diversity and maintaining or enhancing water quality. The maintenance of a natural "viewshed" will enhance the aesthetics of the area. A short term increase in noise levels will occur when helicopters are used to transport staff and supplies to remote areas.

### III. SUMMARY OF MAJOR IMPACTS

#### *Major Impacts - Positive*

- Reduction of ungulate activity to a level that will promote and sustain measurable recovery of native vegetation in all Pu'u Kukui management units.
- Reduction of the range of habitat-modifying weeds and prevention of introduction of new problem weeds.
- Reduction of known threats by non-native invertebrates and small mammals.
- Tracking of biological and physical resources in the watershed and evaluation of changes in these resources over time to identify new threats to the watershed.
- Logistical support to approved research projects will improve management understanding of the watershed's resources.
- Prevention of the extinction of rare species in the watershed.
- Reduction in the amount of siltation and erosion potential in lower stream by decreasing erosion caused by feral animals in the upper area,
- Increase in water quality by lowering potential for incidence of bacterial coliform and leptospirosis in the water , and
- Promotion of a more stable water regime in areas below the project area by reducing the potential for rapid runoff from disturbed or degraded areas within the Pu'u Kukui WMA through removal of feral animals.

#### *Major Impacts - Negative*

One potential impact is the accidental introduction or spread of new weed species by managers or visitors on equipment, supplies or transport vehicles; however, with care, no major negative impacts are expected to result from the proposed activities.

### IV. ALTERNATIVES CONSIDERED

No alternatives were considered to the proposed activities. A no-action alternative would not provide any of the listed positive impacts and was not considered.

### V. PROPOSED MITIGATION MEASURES

To prevent the accidental introduction or spread of weed species, anyone entering the

watershed area will be required to clean their clothing, boots, equipment and camping gear of soil and plant material. Wherever possible, helicopter flights into the watershed will originate from weed-free areas such as wooden platforms or pavement, and all materials hauled into the watershed will be inspected and cleaned to remove soil, plant material, and insects. Helicopter landing sites and areas frequented by staff will be inspected for weeds each trip.

#### **VI. DETERMINATION**

No significant negative impacts to the environment are expected to result from the implementation of the proposed activities.

#### **VII. FINDINGS, AND REASONS SUPPORTING DETERMINATION**

Implementation of the proposed activities is expected to produce positive impacts on a number of rare species and native ecosystems found in the area. Control of ungulates and weed species will enhance the native ecosystems and protect the native biological diversity of the area. Through a careful and rigorous cleaning and monitoring program, the introduction or spread of new weed species is expected to be minimal. Impacts on historic resources is expected to be negligible, given the remote nature of the area with few, if any, historic resources to be expected and the nature of the proposed activities. Protection of the area will help maintain and enhance a stable water source for West Maui's agricultural, tourist and residential needs.

#### **VIII. LIST OF PREPARERS**

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The Pu'u Kukui long range management plan was prepared by The Nature Conservancy, acting as a consultant to Maui Land & Pineapple Company, Inc. The long range plan was submitted to the Natural Area Reserves System Commission for consideration as a Natural Area Partnership (NAP) project. The Commission has recommended to the Board of Land and Natural Resources that Pu'u Kukui WMA be accepted as a NAP project. This environmental assessment incorporates many sections and figures from that plan (e.g. all maps, descriptions of resources and proposed activities).