

State of Hawai'i
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawaii 96813

May 26, 2017

Chairperson and Members
Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Land Board Members:

SUBJECT: AUTHORIZATION OF FUNDING FOR MAUI LAND & PINEAPPLE COMPANY, INC. FOR \$1,280,165 DURING FY18-24 FOR PUU KUKUI WATERSHED PRESERVE CONTINUED ENROLLMENT IN THE NATURAL AREA PARTNERSHIP PROGRAM AND ACCEPTANCE AND APPROVAL OF THE PUU KUKUI WATERSHED PRESERVE LONG RANGE MANAGEMENT PLAN, TMK 4-1-1-17, 4-2-1-1:por, 4-1-4-12:por, 4-1-5-10, 4-1-5-13, 4-1-5-16, 4-1-5-17, 4-3-1-1:por, 4-3-1-17:por, MAUI

BACKGROUND:

This submittal requests the Board to authorize matching funding for the management of the 8,660-acre Puu Kukui Watershed Preserve as part of the Natural Area Partnership Program (NAPP). Although Natural Area Partnership agreements are made in perpetuity, funding is authorized on a six-year basis to allow for periodic State and public review. The current contract is scheduled to terminate at the end of this Fiscal Year, and Maui Land & Pineapple Company, Inc. (MLP) has prepared a new six-year management plan for Fiscal Years 2018-2024. The Division of Forestry and Wildlife (DOFAW) recommends the authorization of matching funding, in the amount of \$1,280,165, to continue conservation management of the Preserve for the next six fiscal years. The Natural Area Reserves System Commission approved this Long Range Management Plan on March 31, 2017.

Chapter 195-6.5, HRS established the NAPP in 1991 and authorized the Department of Land and Natural Resources (DLNR) to provide state funds on a two-for-one basis with private funds for the management of private lands that are dedicated to conservation. The program seeks to protect, restore, or enhance significant native resources of the state. Puu Kukui Watershed Preserve was the first participant in the NAPP and is one of the largest privately-owned nature preserves in the State, protecting significant watershed, endangered species, and native ecosystem resources. The Long Range Management Plan (LRMP) (Attachment) provides a more detailed description of proposed activities and maps. MLP will be responsible for the actual implementation of the management plan.

The total budget for Fiscal Years 2018-2024 is \$1,920,246. Continuing as a Preserve under the NAPP, the State would provide 2:1 matching funding for the natural area protection efforts outlined in the FY18-24 LRMP. Total State funding requested for Fiscal Years 2018-2024 is \$1,280,165; MLP will provide the match of \$640,081.

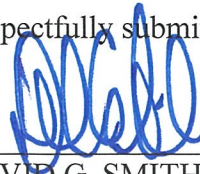
The plan's environmental assessment received a Finding of No Significant Impact in 2011. Conservation District Use Permit MA-2111 permits ongoing watershed and vegetation protection and Site Plan Approval MA-09-07 permits the Axis Deer Fencing Project within the Preserve.

RECOMMENDATION

That the Board:

1. Continue approval of the activities identified in the Puu Kukui Watershed Preserve FY 2018-2024 Long Range Management Plan;
2. Authorize the continued funding for the Puu Kukui Watershed Preserve as part of the Natural Area Partnership Program for Fiscal Years 2018-2024 in the amount requested (\$1,280,165);
3. Authorize the Chairperson to negotiate and enter into a contract encumbering funds for a Puu Kukui Watershed Preserve Natural Area Partnership Agreement with Maui Land and Pineapple Company, Inc. for Fiscal Years 2018-2024 with the following conditions:
 - a. The long range management plan is accepted for a six-year period.
 - b. Funding is authorized for the full six-year period as described in the agreement, subject to annual availability of funding and annual budget procedures and approvals, and approval as to form by the attorney general's office.

Respectfully submitted,



DAVID G. SMITH, Administrator
Division of Forestry and Wildlife

APPROVED FOR SUBMITTAL:



SUZANNE D. CASE, Chairperson

Attachment: Puu Kukui Watershed Preserve Long Range Management Plan

**Fiscal Years 2018-2024
Long Range Management Plan
Natural Area Partnership Program**



*Pu'u Kukui Watershed Preserve Boardwalk thru the bog
Photo: courtesy of Herb Coyle (PKW photographer)*

**PREPARED FOR
DIVISION OF FORESTRY & WILDLIFE
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE OF HAWAI'I**

**PREPARED BY:
MAUI LAND & PINEAPPLE COMPANY, INC.
200 Village Road
Lahaina, Hawai'i 96761
February 2017**

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Contents

| | |
|--|-----------|
| I. SUMMARY | 4 |
| Project Name: Pu'u Kukui Watershed Preserve (PKW) Natural Area Partnership | 4 |
| Proposing Agency / Applicant | 4 |
| Approving Agency | 4 |
| Project Location | 4 |
| PROJECT DESCRIPTION | 5 |
| Background | 5 |
| Location | 7 |
| Flora and Fauna | 8 |
| Historical/Archeological and Cultural Sites | 9 |
| Adjacent Natural Resources | 9 |
| Sensitive Habitats | 10 |
| Management Considerations | 11 |
| Management Unit Descriptions | 12 |
| Management Goals & Programs | 19 |
| Feral Ungulate Control | 20 |
| Weed Control | 26 |
| Monitoring and Research | 30 |
| Rare Species Protection | 34 |
| Community Outreach and Educational Opportunities | 37 |
| Watershed Partnerships | 40 |
| Facilities and Operating Expenses | 41 |
| CONCLUSION | 43 |
| List of Preparers | 45 |
| BUDGET SUMMARY | 46 |
| APPENDIX 1 | 47 |
| Natural Plant Communities of the Pu'u Kukui Watershed Preserve | 47 |
| APPENDIX 2 | 49 |

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

| | |
|---|----|
| Rare Plants of the Pu`u Kukui Watershed Preserve | 49 |
| APPENDIX 3 | 53 |
| Rare Animals of the Pu`u Kukui Watershed Preserve | 53 |
| APPENDIX 4 | 54 |
| Prevalent Habitat-Modifying Weed Species of the PKW Preserve & Adjacent Areas | 54 |
| APPENDIX 5 | 56 |
| Prevention of Alien Species Introduction | 56 |

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

I. SUMMARY

Project Name: Pu`u Kukui Watershed Preserve (PKW) Natural Area Partnership

Proposing Agency / Applicant

Division of Forestry and Wildlife
Department of Land and Natural Resources
State of Hawai‘i

Maui Land & Pineapple Company, Inc.
200 Village Road
Lahaina, Hawai‘i 96761

Approving Agency

Division of Forestry and Wildlife
Department of Land and Natural Resources
State of Hawai‘i

Project Location

Pu`u Kukui Watershed Preserve, 8,661 acres in the District of Lahaina, County of Maui, State of Hawai‘i

Tax Map Key/Acreage

| | |
|--------------------|----------|
| 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 |

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

PROJECT DESCRIPTION

Background

The Pu`u Kukui Watershed Preserve (PKW or Pu`u Kukui Preserve) was established in 1988 to protect watershed forests and associated native plants and animals (Figure 1). At over 8,600 acres, the Pu`u Kukui Preserve is one of the largest privately-owned nature preserves in the state. Maui Pineapple Company, Ltd. (MPC), a subsidiary of Maui Land & Pineapple, Inc. (ML&P), began management programs in August 1988 under a management agreement with The Nature Conservancy of Hawai'i (TNCH). The Nature Conservancy assisted MPC's PKW Preserve manager to implement management programs, and has continued to act as a consultant to the project on an ad hoc basis. In July of 1992, ML&P entered into a six-year contract with the State of Hawai'i as the first private landowner participant in the Department of Land & Natural Resources' (DLNR) Natural Area Partnership (NAP) program; and renewed this contract for FY2012-2018. At this time, the current Pu`u Kukui Preserve contract (FY 2012-2018) is scheduled to be renewed in 2017 for State Fiscal Years 2018-2024; ML&P has prepared a new 6-year management plan as required by the Natural Area Partnership program and State of Hawai'i law.

This Long Range Management Plan consists of a brief description of the Pu`u Kukui Preserve, overview of the native resources that are protected, and how those resources complement the Natural Area Reserve System (NARS). In the next section, management considerations that have shaped the management programs are documented. A description of each management program follows, and includes a goal statement, an explanation of the management method chosen, and a detailed timeline. Although Natural Area Partnership agreements are made in perpetuity, funding is authorized on a six-year basis to allow for periodic State and public review which requires approval of a 6-year management plan by the Board of Land and Natural Resources. Timelines for the management programs described in this long range management plan are subject to change and may extend past the FY 18-24 timeframe as proposed management actions and their maintenance will be ongoing.

Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program

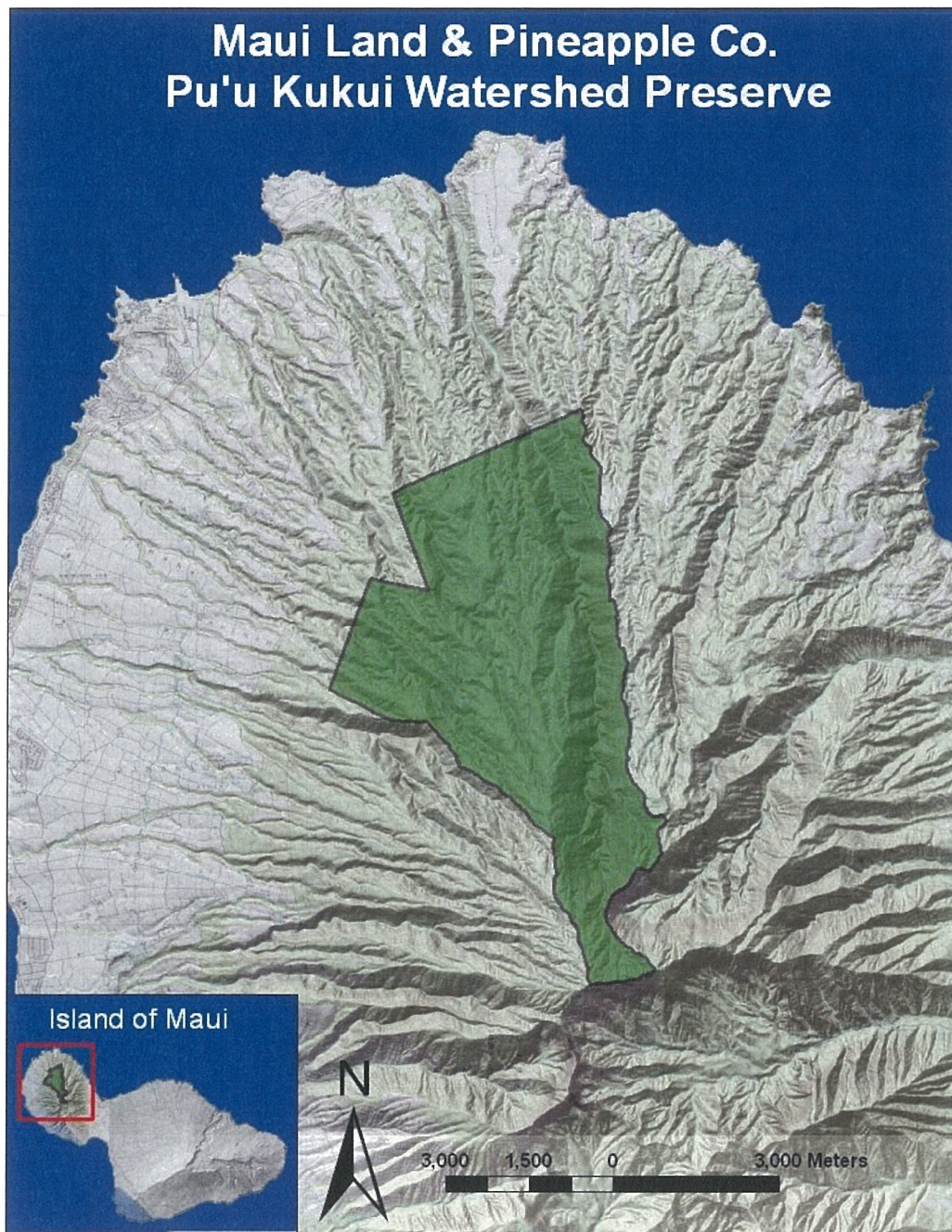


Figure 1. Maui Land & Pineapple Company Inc.'s Pu'u Kukui Watershed Preserve

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Location

The Pu'u Kukui Preserve stretches from about 480 feet elevation at Honokohau Stream to the Pu'u Kukui summit - the highest point on Mauna Kahalawai (West Maui) at 5,788 feet elevation. The rain forests, shrub lands, and bogs of the Pu'u Kukui Preserve serve as a significant water source for West Maui residents and industries. ML&P and the West Maui community depends on the watershed to provide aquifer recharge and ensure adequate supply of water is available for agricultural, irrigation and domestic uses in West Maui. 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; subsequently, ML&P's conservation efforts in the Pu'u Kukui Preserve also benefits the shoreline resources of the Honolua - Mokule'ia Marine Life Conservation District. Unique bog and stream ecosystems and native-dominated forests and shrub lands make up the majority of the watershed.

A significant amount of fresh water used by West Maui's residents, agriculture, and other commercial businesses comes from this watershed area, and active management by all West Maui landowners is needed to prevent damage to the native forests by feral ungulates (pig, goat & deer) and invading weeds. Nine strategic fences have been built cooperatively by ML&P, the State Division of Forestry & Wildlife (DOFAW), and TNCH staff in the PKW Preserve, Kahakuloa (4 fences) and Honokowai (4 fences) sections of the West Maui NAR, and the Kapunakea (1 fence) Preserve. Additionally, new fences have or are currently being constructed in cooperation with NARS and staff of the West Maui Mountains Watershed Partnership (WMMWP); a joint, public/private partnership between majority landowners of ma uka conservation lands on West Maui whose intent is to protect and conserve the water and other native natural resources on their respective properties. These kinds of cooperative projects improve the efficiency of management efforts and benefit the entire Mauna Kahalawai and West Maui area.

Access to foot trails leading into the lower edge of the watershed area is mostly along private dirt roads through ML&P agricultural fields. Agricultural activities frequently involve the use of large trucks on unpaved (and often muddy) roads, making access dangerous. This, coupled with the fragile native ecosystems in the watershed, results in a policy of restricted public access to the Pu'u Kukui Preserve. There are only road that access the preserve directly is the road to Haela'au Cabin at 2,980 feet elevation on Kaulalewalewa. This road can only be driven by four-wheel drive vehicles.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Flora and Fauna

The Pu'u Kukui Preserve contains 15 terrestrial native natural communities (Appendix 1). These natural communities vary from lowland shrub lands to montane forests and bogs. One of these communities is considered rare, as it occurs in fewer than 20 sites worldwide: 'Ohi'a (*Metrosideros*) Mixed Montane Bog. Seven of the native natural communities found in the Pu'u Kukui Preserve, including 'Ohi'a Mixed Montane Bog, are also found in the West Maui NAR.

The Pu'u Kukui Preserve is home to at least 36 species of rare plants; three other taxa endemic to West Maui also occur here (Appendix 2). Eight species of rare plants found in the PKW Preserve are listed as Endangered (E) by the U. S. Fish & Wildlife Service (USFWS). One other taxa *Clermontia oblongifolia* subsp. *mauiensis* [oha wai] listed as Endangered potentially occurs in the Preserve, but require further study to determine their identity. Specimens have been collected and forwarded to local herbaria but the taxa are problematic taxonomically and still undetermined. Twenty-eight other rare plant species are also listed as either Candidate (C) or Species of Concern (SOC) by the USFWS.

Three native forest birds found in the PKW Preserve's forests are also found in the West Maui NAR: the 'Apapane (*Himatione sanguinea sanguinea*), 'Amakihi (*Hemignathus virens wilsoni*), and 'I'iwi (*Vestiaria coccinea*). The PKW Preserve also provides habitat for the Pueo (*Asio flammeus sandwichensis*, Hawaiian Short-eared Owl) - a USFWS Species of Concern, as well as for migratory and sea birds such as Koa'e (*Pluvialis fulva*, Pacific Golden Plover), 'Ulili (*Heteroscelus incanus*, Wandering Tattler), Koa'e Kea (*Phaethon lepturus dorotheae*, White-tailed Tropicbird), the endangered 'Ua'u (*Pterodroma phaeopygia*, Hawaiian Petrel), and the Threatened Newell's shearwater or A'o (*Puffinus newellii*). Our endangered State Bird, Nene (*Nesochen sandvicensis*) has been observed several times in recent years due to the State's rearing & release program near Hana'ula, and potentially could establish a breeding colony near ML&P's Haela'au Cabin on Kaulalewalewa (2980' asl.).

At least seven species of rare native tree snails and two freshwater species (see Appendix 3) have been observed and recorded in the PKW Preserve since management began in 1988. A snail species not seen on Maui for over a half-a-century; *Newcombia cumingi*, was rediscovered in the PKW Preserve in 1994 by Preserve staff. A new population of *N. cumingi* was discovered in 2013 in collaboration with OANRP (Oahu Army Natural Resources Program) but this species is still a high priority target for SEPP (Snail Extinction Prevention Program). PKW Preserve is the only known location where this rare snail species exist. Other rare invertebrate species include an endemic Hawaiian damselfly (*Megalagrion pacificum*); a candidate endangered species, as well as others (see Appendix 3). Hawai'i's only endemic land mammal; the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) has been observed by PKW staff at various locations throughout the Preserve.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Historical/Archeological and Cultural Sites

In the lower elevations, agricultural related structures such as ditches and terraces are likely to be present while in the higher elevations only trails and/or temporary shelters might be expected. The activities planned are covered in the Environmental Assessment and Finding of No Significant Impact published on March 17, 2011, which included consultation with the State Historic Preservation Division (SHPD). If PKW Preserve staff encounters any evidence of historic sites at a site of management activity, they will cease all management activity and immediately notify SHPD staff to obtain their input and suggestions for any mitigation measures deemed necessary. In general, fencing provides protection for historic resources by eliminating disturbance from ungulates, which damage sites such as *lo'i kalo* (taro plots) by rooting and trampling, or displacement of these rock walls. Proposed fencing projects which might be considered a source of disturbance will avoid all sensitive areas and will be constructed with minimal soil disturbance on the landscape.

Restricted access will also minimize inadvertent disturbance or intentional vandalism. The bulk of the PKW Preserve was considered *wao akua* (realm of the gods) by native Hawaiians and was deemed sacred; with little or no regular access by either the *maka'ainana* (commoners) or the *ali'i* (chiefs). What little access likely to occur was by certain *kahuna* (priests), *kia manu* (those trained to collect native bird feathers for an *ali'i's* cloak) or others with specific collection purposes. Therefore; no significant negative impact on cultural resources or historic practices by native Hawaiians is anticipated from the actions delineated in this plan. Additionally, the preservation of habitats and natural communities preserve plant and animal species integral to Hawaiian culture. Many of these species are prevalent in Hawaiian song, chant, and legend, and the protection of these species to be accomplished by this management plan will help to ensure a continuing living culture.

Adjacent Natural Resources

The PKW Preserve lies between the Kahakuloa and Honokowai sections of the state's West Maui Natural Area Reserve (Figure 1). These three areas, together with the 1,264 acre Kapunakea Preserve (managed by The Nature Conservancy of Hawai'i), form 13,000 acres of contiguous forests that are protected by the programs of state and private natural area managers. According to DOFAW records, at least seven of the native natural communities found in Pu'u Kukui Preserve, including the 'Ohi'a Mixed Montane Bog, are also found in the West Maui NAR. Of the 36 rare plants found in Pu'u Kukui, 16 are also found in the West Maui NAR. Four species of land snails listed in Appendix 3 are also found in the West Maui NAR.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Additionally, in 1998, other adjacent private & public (e.g. County of Maui Board of Water Supply, State of Hawaii Dept. of Land and Natural Resources) landowners of ma uka conservation lands on West Maui (Mauna Kahalawai) agreed to join together to form the West Maui Mountains Watershed Partnership (WMMWP) with the intent to conserve and protect the native biodiversity and natural resources of nearly 50,000 acres (including the Pu'u Kukui Preserve) of their adjoining lands for current and future generations.

Maui Land & Pineapple Co. Inc also owns over 1,000 acres of conservation land ma kai of PKW Preserve (Figure 1). Conservation lands ma kai of the Pu'u Kukui Watershed Preserve can be addressed in three general categories, each with its own unique features. Forested sections bordering the Preserve and upland from agricultural land range in elevation from around 640 to 1620 feet above sea level at the ma uka boundary; riparian areas along Honokohau and Honolua Streams serve as major drainage ways for surface water flow from developed, agricultural and forested lands; coastal areas stretching 11.5 miles provide an interface between the marine environment and forested, agricultural and developed lands. Although a majority of the vegetation in this area is currently non-native, pockets of native plants and animals exist within the ma kai conservation lands. ML&P's long term goal is to increase the existing PKW Preserve by incorporating approximately 3,000 acres of conservation lands in the coastal and riparian areas ma kai of the current project area. The expansion of the preserve will create one of Hawai'i's largest privately managed preserves that are managed from the summit of the mountain down to the sea. Coastal and marine resources are directly affected by land use practices in the upper watersheds, therefore the inclusion of ma kai conservation lands will allow management of the entire watershed area, enabling holistic decision making and better protection of natural resources, with increased community outreach opportunities to accessible lands.

Sensitive Habitats

The sensitive habitats and resources listed above and in the appendices are found both within and adjacent to the Pu'u Kukui Preserve. 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, The Nature Conservancy of Hawai'i's Kapunakea Preserve or on other private lands within the WMMWP will be coordinated with appropriate staff from these organizations to reduce any potential negative impacts.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Management Considerations

The management goal for Pu`u Kukui Preserve is to maintain the native ecosystems as intact watershed, and protect the habitat of rare Hawaiian plants and animals. This project is a long term one consisting of several different phases. Maui Land & Pineapple Company, Inc. will be responsible for the completion of the management work. This section describes specific management strategies that will be undertaken to maintain and enhance the PKW Preserve. These strategies are shaped by the following considerations.

- The Pu`u Kukui Preserve encompasses a very large area, much of which is remote and extremely rugged. Inclement weather is the norm in the upper reaches. The Management Units have been defined by biological and topographical features (Figure 1). Priorities for management have been determined for each unit according to the extent of current disturbance, the urgency of other biological threats within and near the unit, and the feasibility of management.
- Feral ungulates remain the primary threat to the watershed, and limiting pig damage and other feral ungulate ingress is the top management priority. Prior to active management efforts, moderate to heavy damage by pigs had 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 mosquitoes, which transmit bird diseases which in part, is responsible for the low numbers of native birds on West Maui. With the introduction of Axis deer to West Maui, construction of new fences and retrofit of existing fences to deter any intrusion into the Preserve is a high priority. Additionally, preventing domestic cattle from entering the watershed from adjacent pasturelands, or removal of said cattle from the watershed remains an objective as well.
- 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 (Appendix 4). Weed control activities will focus on these priority weeds throughout the watershed. Due to the widespread distribution of some weed species, populations will need to be mapped and strategies determined before removal with special attention to removing incipient "satellite" (outlying) weed locations to prevent their spread.
- Access to the entire PKW Preserve area is restricted by ML&P. This policy is intended to

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

minimize human impacts and protect public safety. Volunteers or other visitors will be accompanied by appropriate staff and restricted to designated areas and trails in the Preserve. Human traffic in pristine areas, especially the upper elevation bogs, will be kept to the minimum required for watershed protection.

- Management activities in the watershed that affect adjacent NARS will be coordinated with state Natural Area Reserves staff when necessary. Staff of The Nature Conservancy and the West Maui Mountains Watershed Partnership (WMMWP) will assist the PKW Preserve manager with planning and technical advice as requested. These partnerships will maximize the cost effectiveness of management efforts at the Pu`u Kukui Preserve and provide a larger pool of management expertise to draw from.
- The management goals for the ma kai conservation lands are to preserve and enhance native plant and animal communities, protect nearshore waters from land based pollutants, increase community stewardship of coastal lands and ahupua`a connectivity. These efforts compliment and strengthen the continuing efforts in the Pu`u Kukui Watershed Preserve to maintain the native ecosystems as intact watersheds and protect the habitat of rare Hawaiian plants and animals. PKW staff and crew will assist efforts in the ma kai conservation lands on a limited basis.

Management Unit Descriptions

The Pu`u Kukui Preserve has been divided into 19 Management Units defined by topographical and biological features (Figure 2). This increase in Management Units from 10 included in the FY2006-2011 Management Plan gives a more accurate depiction of management needs based on recorded ungulate activity levels and current fence placement. Descriptions of the units' resources, and threats to these resources, follow.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

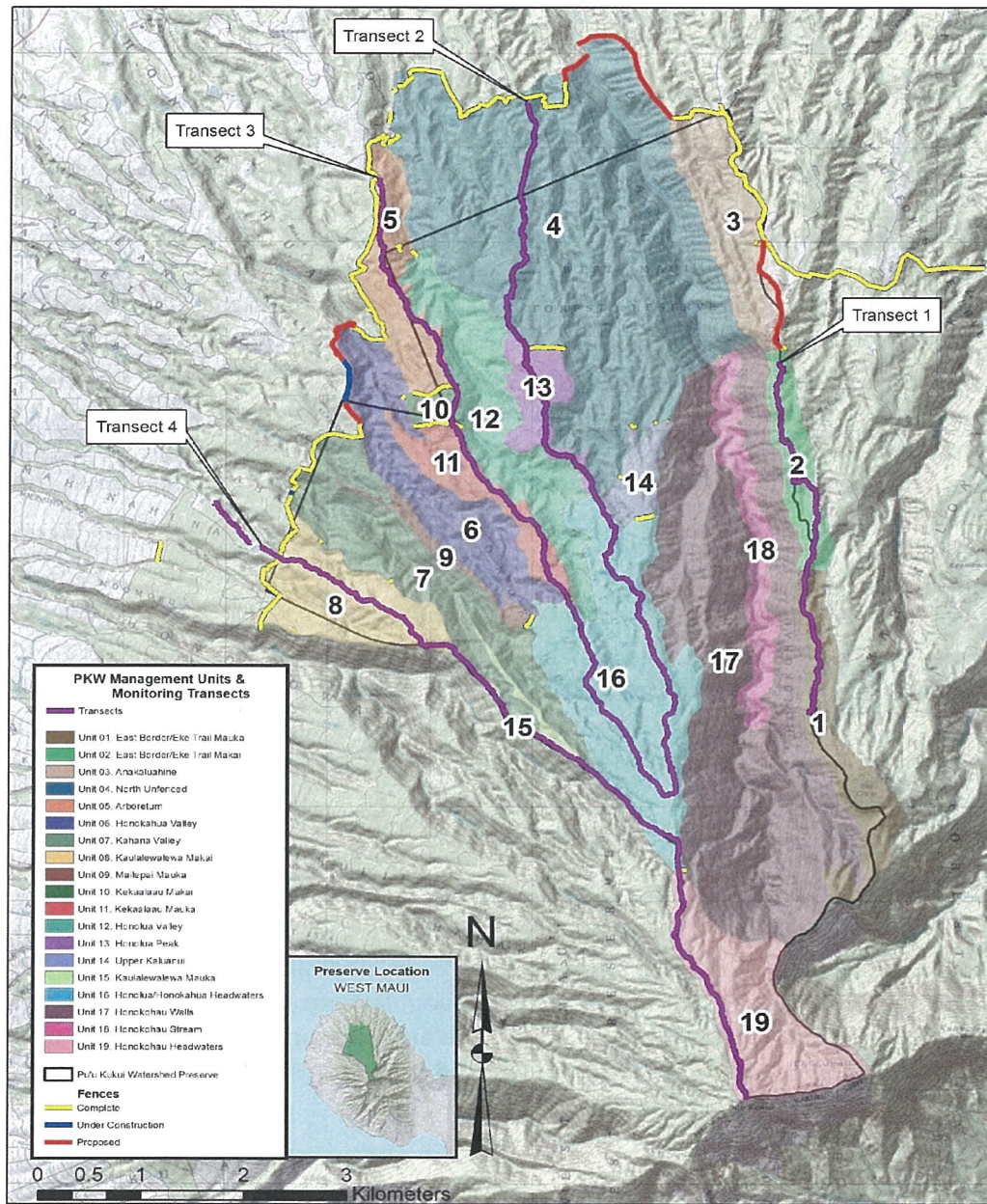


Figure 2. Pu' u Kukui Watershed Preserve Management Units

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Unit 1: East Border/Eke Trail Mauka

The East Border/Eke Trail Mauka unit is 316 acres located in the upper portion of the PKW Preserve. This unit shares most of its eastern boundary with the state's Kahakuloa section of West Maui Natural Area Reserve (NAR). The strategic fence on the lower boundary of this unit was rebuilt. The area has seen one incidence of pig activity in the past 6 years. *Myrsine vaccinioides*, a Species of Concern, is present in this unit, as well as *Gardenia remyi*. *Tibouchina herbacea* and *Clidemia hirta* (Koster's curse) are the two most invasive weed species in this unit, and are concentrated along the 'Eke Trail. *Psidium cattleianum* is present and management may be possible. Andean Pampas grass (*Cortaderia jubata*), is known from the Kahakuloa section of the West Maui NAR immediately adjacent to Units 1-3 and is considered a serious threat to native ecosystems due to its invasive reputation in California and New Zealand. PKW Preserve staff works with the Maui Invasive Species Committee (MISC) to monitor and report new locations. Native plant communities range from montane wet shrublands along the steep upper valley walls to lowland mesic forest at the lowest elevation.

Unit 2: East Border/Eke Trail Makai

East Border/Eke Trail Makai area is 180 acres in area located along the eastern boundary of the Preserve. This area continues to be weedy with *Tibouchina herbacea* and *Clidemia hirta* (Koster's curse) along the 'Eke Trail. Pig fence separating Unit 2 and 3 located at 2200 ft. elevation is in good status. One occurrence of pig activity has been seen within the past six years.

Unit 3: Anakaluahine

This unit covers 320 acres just east of the North Unfenced Unit. Although a portion of the unit is fenced, directly adjacent is the residential area of Honokohau Valley where pig activity is prevalent and ungulate ingress into this unit originates from Honokohau Valley. A boundary fence is needed in Honokohau Valley to protect the area from ungulate intrusion. PKW snaring efforts have resulted in a high number of captures. Native plant communities range from montane wet shrublands along the steep upper valley walls to lowland mesic forest at the lowest elevation.

Unit 4: North Unfenced

This unit is the largest management area at 2090 acres ranging between 1,040 and 2,920 feet elevation. ML&P's Honokohau Ditch system's #1 and #2 intakes collect surface water, respectively located in Honokohau Stream and Kaluanui Stream (the northwest drainage of Honokohau Stream).

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Over 1.7 miles of Axis Deer Fence was constructed to protect the Ma kai boundary of this large unit. Only the significantly deep Honokohau Valley has not been fenced yet. Outreach to the close-knit community of Honokohau Valley is required for the proposed fencing project to be successful long-term. Heavy pig damage has been greatly reduced through fence construction and on-going management efforts. Pig ingress is still a consistent threat. *Tibouchina herbacea* and *Clidemia hirta* are prevalent weeds of Unit 4. Natural communities include a range of wet and mesic community types; several populations of rare plants and animals occur throughout Unit 4. The *Cyanea magnicalyx* enclosure is located in the area; a few *Cyanea asplenifolia* occur along the boundary of Unit 13. PKW Preserve staff has assisted Maui Plant Extinction Prevention Program with outplantings of *Cyanea magnicalyx* in this unit. Unit four fence completion will most likely not be completed during this LRMP as it is scheduled to commence after the phase 4 & 5 sections in this LRMP due to the working from South to North continuous march approach being taken. However, if funds outside of this LRMP become available, weather is conducive and Honokohau relations have been improved then PKW would look to implement and oversee contractual construction of the unit four fencing.

Unit 5: Arboretum

The Arboretum area covers 270 acres; prominent landmarks include Pu'u Kaeo (1,683 feet elevation). Heavy pig activity occurs below the pig fence. Due to recreational use near the area, ongoing hunting is not allowed, however periodic hunts will be conducted during trail shut downs. Live pig trapping will also be implemented to reduce pressure on the fence. Future modification is planned to retrofit the current pig fence to deer fence. Natural communities contain a variety of lowland mesic and wet forests, including remnant Koa/'Ohi'a mesic forest. Unit 5 contains one designated Special Ecological Area: the *Ctenitis squamigera* (Pauoa) enclosure fence; a USFWS Endangered species. *Cinnamomum burmannii*, *Ardisia elliptica* and *Psidium cattleianum* are major weed species, with a few occurrences of *Rubus argutus* (Prickly Florida blackberry) and *Clidemia hirta*.

Unit 6: Honokahua Valley

The Honokahua Valley Unit is 420 acres in size. As part of future ungulate control, the proposed Phase 4 Axis Deer Fence from Alaeloa to Honokahua will connect into the Arboretum fence. Heavy pig pressure from below the fence is seen. As with the Arboretum Unit, recreational use prohibits hunting on a consistent basis. Natural communities contain a variety of lowland mesic and wet forests including remnant Koa forest.

Unit 7: Kahana Valley

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

The Kahana Valley unit covers 565 acres and includes the completed Phase 1 of the Axis Deer Fence project which has resulted in drastic reduction of ungulates in the area. Wet shrub land emerges at the 2,080 foot contour and grades into 'Ohi'a and 'Uluhe dominated wet forest at higher elevations along the ridge. *Santalum freycinetianum* var. *lanaiense* (Sandalwood) occurs in Kahana Valley. *Strongylodon ruber* occurs in this unit as well as a population of endangered *Cyrtandra munroi*.

Unit 8: Kaulalewalewa Ma kai

One of only two units with direct 4-wheel drive access, the Kaulalewalewa Makai unit also marks the location of ML&P's Haela'au Cabin on Kaulalewalewa peak (2,980' ASL), and the Pu'u Kukui trail head. The Kaulalewalewa Makai unit encompasses 348 acres and borders state lands and the Honokowai section of West Maui NAR on the southwest. Sporadic pig activity has occurred but has largely been successful with perpetrators captured shortly after ingress. Phase 2 of the Axis Deer Fence is nearly complete, which extends from Honokowai Valley to Kahana Stream; closing off the valleys of Mahinahina and Kahanaiki to ungulate ingress. The endangered *Cyanea lobata* ssp. *lobata* occurs in Unit 8. *Rubus argutus* (Prickly Florida blackberry), *R. discolor* (Himalayan blackberry), and *Tibouchina herbacea* are the priority weeds; with blackberry infestation the highest of any unit due to its initial introduction at Haela'au Cabin. Natural communities include a wide variety of plant community types. Unit 8 also hosts the *Newcombia cumingi* SEA; designated to protect the only known populations of a rare native tree snail species rediscovered by PKW Preserve staff.

Unit 9: Mailepai Ma uka

One of the smallest management units at 57 acres, Mailepai Ma uka is the ridge between two existing fences. The Alaeloa fence below Unit 7 protects this area.

Unit 10: Keka'ala'au Ma kai

At 42 acres, this management unit falls between strategic fences. The native plant community is comprised of lowland wet forest. Native plants such as *Acacia koa* dominate the upper canopy while the understory is comprised of non-native weed species. *Cinnamomum burmannii* is a predominant weed species. Little ungulate activity is seen in the area due to well-maintained fences.

Unit 11: Keka'ala'au Ma uka

Pu'u Keka'ala'au (2,358 feet elevation) is the prominent feature of this 187 acre unit. Also, a Special Ecological Area, rare taxa such as *Gardenia remyi* and six endemic tree snail species are present.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Unit 12: Honolua Valley

Honolua Valley unit is 481 acres. A small strategic fence located in Honolua Stream is in good condition and moderate pig activity is seen ma uka of the fence. Natural communities include a range of wet and mesic community types; several populations of rare plants and animals occur throughout Unit 3. Three strategic Axis Deer fences have been built by Preserve staff to protect the Makai boundary of this unit.

Unit 13: Honolua Peak

This 155 acre unit contains Honolua Peak at 2640 feet elevation. The lower boundary pig fence is in good condition and little pig activity is seen above the fence. The upper portion of the unit includes a small population of *Joinvillea ascendens* subsp. *ascendens*. *Cyanea asplenifolia* also occurs in the area.

Unit 14: Upper Kaluanui

102 acres of Upper Kaluanui is protected by 4 strategic fences along the ma kai boundary. No pig activity has been seen for many years. A population of *Cyanea asplenifolia* occurs in the area as well as rare *Gardenia remyi*.

Unit 15: Kaulalewalewa Ma uka

Kaulalewalewa Ma uka encompasses 51 acres and contains a large section of the newly constructed boardwalk. Both *Anoectochilus sandwicensis* and *Eurya sandwicensis*, located along the boardwalk, are listed as Species of Concern by the U.S. Fish & Wildlife Service. *Tibouchina herbacea* occurs along the boardwalk and its removal is a focus of volunteer service trips. This area has been ungulate free for many years.

Unit 16: Honolua/Honokahua Headwaters

At 847 acres, the Honolua/Honokahua Headwaters unit crosses between Kahana and Honolua streams. Unit 16 centers on an unnamed hill at 3,540 feet elevation, including the 4,503-foot twin peaks of Nakalalua; some upper sections of forest are in nearly pristine condition. Pig damage in Unit 16 has been reduced to zero for over ten years through intensive snaring and four strategic fences constructed between units 9, 11, 13, and 14. The Honokowai section of West Maui NAR neighbors Unit 16 to the southwest. The Pu'u Kukui boardwalk continues through this unit

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

and contains a rain gauge situated along the Pu'u Kukui trail at the base of the upper peak of Nakalalua. Natural communities consist of 'Ohi'a-dominated montane wet forests and shrub lands. *Joinvillea ascendens* subspecies *ascendens* and *Myrsine vaccinioides*, both listed as Species of Concern by US Fish and Wildlife Service, are present in this unit. Unit 16 also includes a rare, remnant 'Ohi'a Mixed Montane Bog community on an exposed ridge at 3,600 feet. *Tibouchina herbacea* and *Rubus argutus* are the prevalent weeds.

Unit 17: Honokohau Walls

The 1675 acre Honokohau Walls unit covers the near-vertical slopes of upper Honokohau Valley wall from the 1,000-foot elevation at Honokohau Stream to the 5,000-foot elevation of the back bowl of Honokohau Valley. Consisting mostly of montane wet forest and shrub land communities. *Tibouchina herbacea* and *Clidemia hirta* are the priority weed invasions.

Unit 18: Honokohau Stream

This 247-acre unit is comprised of Honokohau Stream's riparian corridor. Pig pressure is consistent from the lower elevation residential area and the North Unfenced Unit. One strategic fence has been built to next to ML&P's Honokohau Ditch Intake to prevent pigs from moving upslope; locked gates along the ditch hiking trail also discourage human trespass. Moderate trespassing and hunting activity is a concern in this area. Rare plants such as *Strongylodon ruber*, *Pritchardia forbesiana*, and *Cyrtandra munroi* occur in the stream corridor.

Unit 19: Honokohau Headwaters

Perhaps due to its spectacularly rugged topography, severe weather and isolation, the 471 acre Honokohau Headwaters unit has experienced the least pig damage in the watershed. However, a few pigs have historically reached the 5,788 foot Pu'u Kukui summit of Mauna Kahalawai (West Maui) and the threat of invasion into the unit along the summit approaches from adjacent properties continues to exist. Pigs that have made their way above and around Mauna 'Eke to the narrow ridge between Honokohau and Waihe'e valleys have been removed. Unit 19 ranges in elevation from 4,500 feet to the Pu'u Kukui summit and borders the Honokowai section of the NAR on the west and the Kahakuloa section of the West Maui NAR at Mauna 'Eke. It supports rare Montane Bog communities as well as a number of rare plants found only on West Maui. The 7 kilometer Pu'u Kukui boardwalk now extends through the bogs to the 5,788-ft. summit and has already been shown to protect the fragile bog habitat by reducing the impacts of PKW Preserve staff and visiting researchers traveling through the bogs. A single strategic fence has been built by PKW Preserve staff along the trail to protect Unit 19.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Management Goals & Programs

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 the Pu`u Kukui Preserve in Year 1 will be the continued reduction of pig activity that has been underway for the past 22 years, and prevention of axis deer intrusion into the Preserve. Monitoring for ungulate activity and weed distribution will be maintained via utilization of the four existing transects, as well as informal survey via air and on ground. Creation of 8 ft deer-proof fencing and retrofitting of existing 4 ft pig fencing with 4 ft mesh will be a priority, however the NAPP will not be funding fence construction, and other sources of funding will be used to accomplish this task. Weed control in Year 1 will continue to focus on satellite populations of Albizia (*Falcataria moluccana*), Australian tree fern (*Sphaeropteris cooperi*) and African Tulip (*Spathodea campanulata*). Because the wide extent of *Tibouchina herbacea* infestation in the PKW Preserve, manual & chemical control of that species will be limited to select areas; such as the Pu`u Kukui trail, to keep from further vectoring of seeds along high traffic zones. Existing priorities to map and control other priority weeds (see Appendix 4) will be reevaluated in Year 1 and mapping undertaken as necessary; control of these other weeds will begin as resources permit.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Non-Native Invasive Species Control Program

Feral Ungulate Control

GOAL: Eliminate ungulate activity in all Pu`u Kukui Preserve management units.

ML&P has established a program to prevent pig and deer ingress into pristine regions. The primary goal is to reduce pig numbers in all watershed units to zero. Progress towards this goal will be determined by the following four methods:

- Field observations of PKW Preserve staff
- Monitoring Transect data
- Permit Hunting Program Capture data
- Installation of strategic fencing to protect from ungulate ingress

Since 1988, 35 strategically located fences have been built to block or redirect ungulate movements (Figure 3), and snares set to remove pigs from the watershed. Feral goats, *Axis* deer and cattle have been reported adjacent to the area in past years, although currently no sign has been observed within PKW boundaries. If these animals are detected in the watershed, immediate efforts will be made to remove them. Eight-foot deer fences are being constructed below the preserve boundary to help prevent ingress of these destructive animals.

Approximately 2,206 snares are currently maintained within the PKW Preserve. 55 percent of the Preserve has not seen pig activity for 5 years or more. The four transects are the large-scale monitoring system that bisect the length of the Preserve and we will continue gathering information on ungulate presence throughout the core area of the watershed. All four transects will be monitored annually to determine preserve-wide levels of pig activity, and to identify areas where increased management is needed. PKW crew will perform regular snare group maintenance checks and adjust management efforts according to levels of pig activity. Additional snares will be set where pig activity is detected. Frequency of snare checks will be increased based on the degree of activity and threat priority. Snared areas showing high activity with consistent pig captures will be checked quarterly; areas showing low pig activity and captures in less than 5 years will be checked yearly at a minimum; areas having seen no pig activity in over 5 years will be checked every two years at minimum.

ML&P employees and a limited number of public hunters are given permits to hunt on company lands below the PKW Preserve boundary. Permit hunting helps reduce the pig population below the Preserve and keeps population pressures low enough to keep pigs from moving up into

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

the Preserve from the lower elevations in search of additional food sources, etc. The PKW Preserve manager will maintain contact with local hunters and remind them of the opportunities for them to hunt for feral pigs on company lands below the Preserve.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

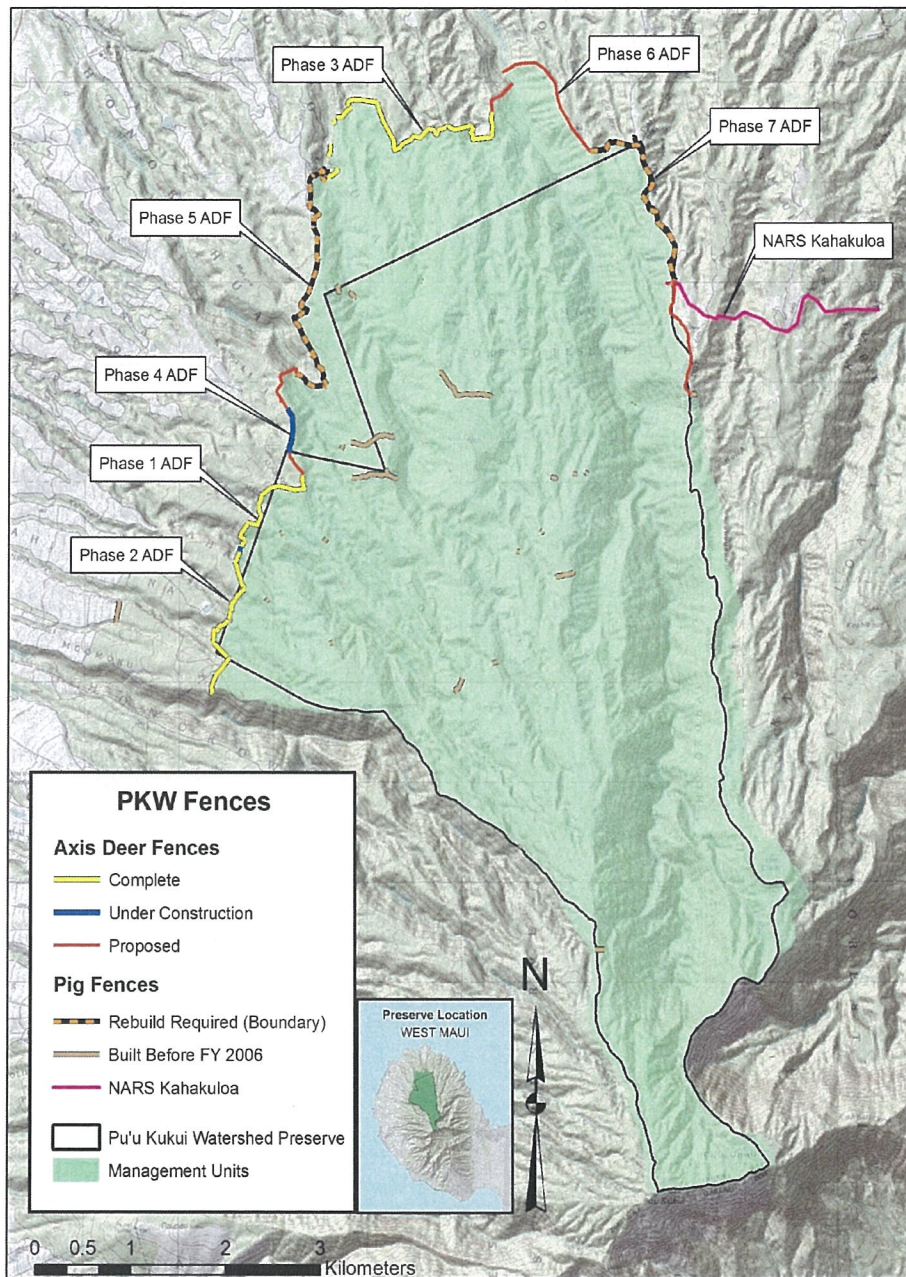


Figure 3. Pu'u Kukui Watershed Preserve Fence Locations

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

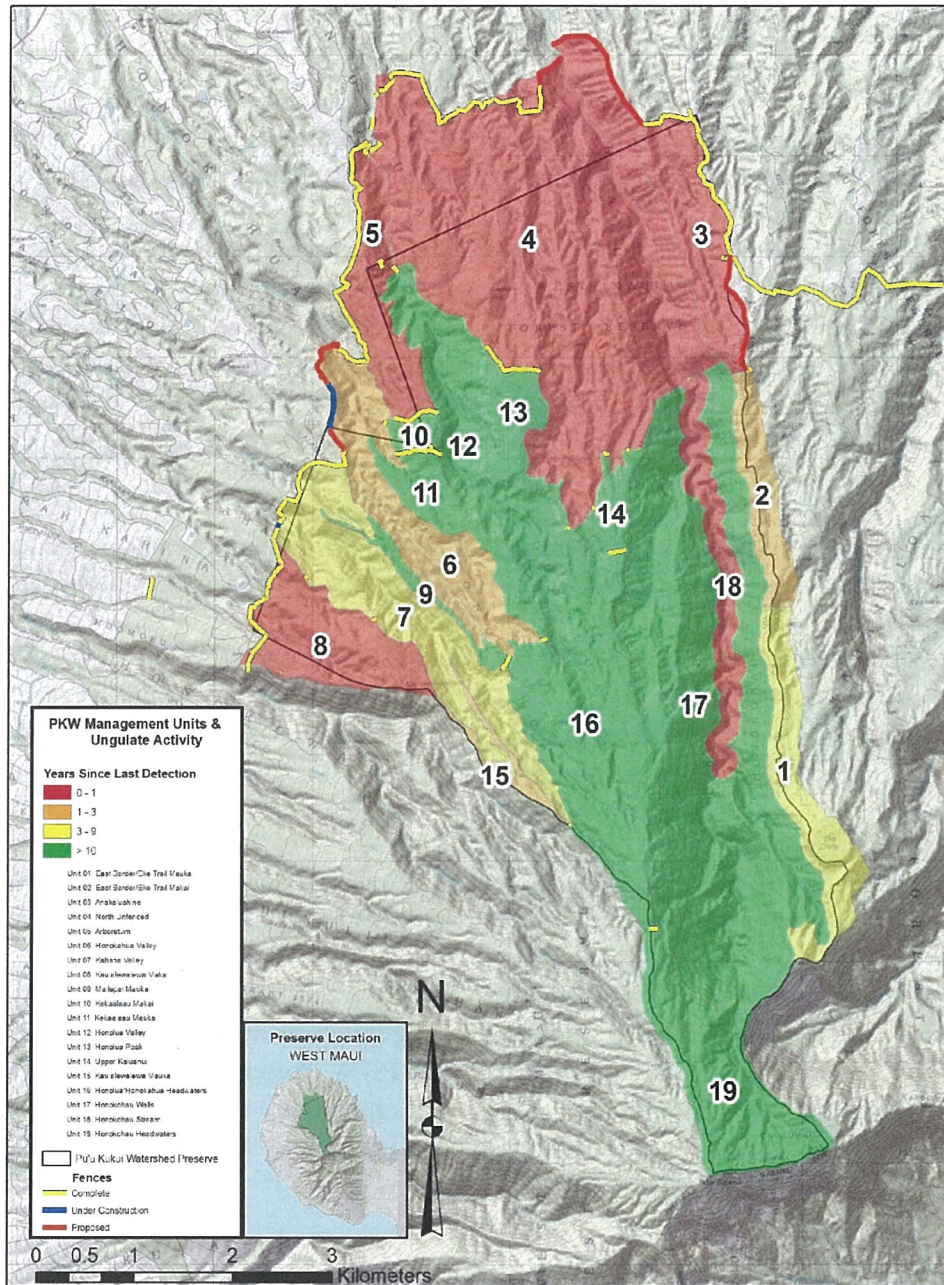


Figure 4. Pu'u Kukui Ungulate Management Units and Years Since Last Ungulate Detection

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Feral Ungulate Control Timeline

Year 1

- Maintain existing snares; replace snares as needed due to breakage, etc., and add or remove snares as necessary on a regular basis by management unit based on snaring criteria.
- Inspect and maintain 100% of PKW Preserve boundary fences annually.
- Monitor ungulate damage along 4 existing transects at least once a year.
- Continue permit hunting program below PKW Preserve boundary.
- Continue Fence Project of phase 4 as a supervisory role in collaboration with DOFAW and a fence contractor. This effort will be funded by DOH grant which has recently been approved.

Year 2

- Maintain existing snares; replace snares as needed due to breakage, etc., and add or remove snares as necessary on a regular basis by management unit based on snaring criteria.
- Inspect and maintain 100% of 35 strategic fences annually.
- Monitor ungulate damage along 4 existing transects at least once a year.
- Continue permit hunting program below PKW Preserve boundary.
- Complete Fence Project phase 4.

Year 3

- Maintain existing snares; replace snares as needed due to breakage, etc., and add or remove snares as necessary on a regular basis by management unit based on snaring criteria.
- Inspect and maintain 100% of PKW Preserve boundary fences annually.
- Monitor ungulate damage along 4 existing transects at least once a year.
- Continue permit hunting program below PKW Preserve boundary.
- Begin Fence Project Phase 5 retrofit as a supervisory role in collaboration with DOFAW and a fence contractor. This effort will be funded by DOH grant which has recently been approved.

Year 4

- Maintain existing snares; replace snares as needed due to breakage, etc., and add or remove snares as necessary on a regular basis by management unit based on snaring

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

criteria.

- Inspect and maintain 100% of PKW Preserve boundary fences annually.
- Monitor ungulate damage along 4 existing transects at least once a year.
- Continue permit hunting program below PKW Preserve boundary.
- Continue Fence Project 5 retrofit.

Years 5/6

- Maintain existing snares; replace snares as needed due to breakage, etc., and add or remove snares as necessary on a regular basis by management unit based on snaring criteria.
- Inspect and maintain 100% of PKW Preserve boundary fences annually.
- Monitor ungulate damage along 4 existing transects at least once a year.
- Continue permit hunting program below PKW Preserve boundary.
- Monitor erosion pins above and below the phase 4 & 5 fence constructed.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Weed Control

GOAL: Reduce the range of habitat-modifying weeds and prevent introduction of non-native plants.

Progress towards this goal will be met by concentrating weed control efforts in the following areas:

- Monitoring and mapping of priority weed species
- Management of satellite populations of priority weed species.
- Treatment of incipient populations of new invasive species.
- Monitoring of invasive species populations adjacent to PKW Preserve.
- Determining immediate threats to rare taxa or Special Ecological Areas (SEAs).
- Data entry of all control efforts.
- Identification and inventory of all vascular plant species in all PKW Preserve and Exterior Units.

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 Preserve will concentrate on controlling satellite populations of priority weeds and preventing further expansion of weeds into pristine areas. The top-down approach; maintaining high elevation pristine habitat and suppressing weed incursion from lower elevations has continued to be a cost-effective strategy. Incipient weed populations will be targeted for eradication before they become established at a landscape level. Manual control of large, well established weed populations is generally not practical or cost-efficient, biological control agents are a much more efficient method for these weed species. Weed control efforts for each species is based on current range and possible expansion; management will require an integrated program of applying known control methods, monitoring effectiveness, and refining control methods.

The 4 monitoring transects are also utilized to record all weed species using a simple Presence/Absence method. GIS data is also used to record and track the location of known populations and to determine if weed ranges are expanding. Weed control and transect data is entered in the PKW Preserve database (MS Access) for further analysis. Mapping of priority weed species will be updated on an annual basis. PKW weed control efforts are aligned with West Maui Mountains Watershed Partnership Weed Management Plan.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

The use of herbicides is a common control method and only herbicides approved for use in watersheds will be used. Weed control is labor-intensive and costly, new methods are always being tested to improve cost effective management. Updated information and technical support from the University of Hawai'i Cooperative Extension Service, the National Park Service, researchers and other agencies are highly valuable material for evolving weed control strategies.

The development of biological control methods for priority weeds by programs underway in the U.S. Forest Service, National Park Service and at the HDOA will be encouraged by making study sites available as requested. Deployment of these control agents will be made whenever they are available. PKW Preserve staff will continue to be an active partner with TNCH & WMMWP to discuss and map weed species, locations, and control methods.

Gear decontamination protocol to prevent the introduction and spread of new and/or established weeds in the PKW Preserve is a standard operating procedure (SOP). All who enter the watershed area are required to clean their clothing, boots, equipment and camping gear of soil and plant material to prevent weed introduction. Helicopter flights into the watershed will originate from established landing zones, 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 are inspected for new weed species each trip.

The boardwalk on the Pu'u Kukui Trail was built to reduce the impact of soil disturbance in the pristine bog areas, much of the trail at high elevation meanders through this rare habitat. This rare bog habitat is very susceptible to damage from human foot traffic because the acidic soil is heavily saturated by rainwater and the slow-growing open-canopy vegetation of the bog does not recover quickly. The boardwalk on the Pu'u Kukui Trail is a major section of monitoring transect 4.

Weed Control Timeline

Year 1

- Continue participation with MISC and other eradication strategies for other priority invasive species in the PKW Preserve.
- Continue implementing biological control agents as available targeting any aggressive invasive species.
- Continue satellite population control of priority weed species as opportunities present themselves. Nevertheless, outlier, satellite populations of priority weeds as identified in the West Maui weed management plan will be addressed immediately and remain a high priority.
- Continue control of weeds threatening rare taxa or SEAs. Treat as opportunities

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

present themselves.

- Continue eradication of incipient populations of invasive weeds in and immediately adjacent to the Preserve on ML&P lands and/or with approval from adjacent landowners.
- Continue control of priority weed species along Pu'u Kukui trail corridor. Treat 25% of trail corridor annually.
- Continue monitoring weed presence along 4 existing transects (see ungulate control section, complete 1 transect per quarter).
- Update 100% of lists & range maps of prevalent and priority weeds annually.
- Update control efforts in the PKW Preserve Database on a weekly basis.

Year 2

- Continue participation with MISC for containment, suppression and elimination of invasive species in the PKW Preserve in conjunction with other conservation partners while utilizing updated effective approaches.
- Continue implementing biological control agents as available targeting any aggressive invasive species.
- Continue satellite population control of priority weed species as opportunities present themselves.
- Continue control of weeds threatening rare taxa or SEAs. Treat as opportunities present themselves.
- Continue eradication of incipient populations of invasive weeds in and immediately adjacent to the Preserve on ML&P lands and/or with approval from adjacent landowners as identified in the West Maui weed management plan.
- Continue control of priority weed species along Pu'u Kukui trail corridor. Treat 25% of trail corridor annually.
- Continue monitoring weed presence along 4 existing transects (see ungulate control section, complete 1 transect per quarter).
- Update 100% of lists & range maps of prevalent and priority weeds annually.
- Update control efforts in the PKW Preserve Database on a weekly basis.

Years 3 / 4

- Continue participation with MISC and other eradication strategies for other priority invasive species in the PKW Preserve.
- Continue implementing biological control agents as available targeting any aggressive invasive species.
- Continue satellite population control of priority weed species as opportunities

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

present themselves.

- Continue control of weeds threatening rare taxa or SEAs. Treat as opportunities present themselves.
- Continue eradication of incipient populations of invasive weeds in and immediately adjacent to the PKW Preserve on ML&P lands and/or with approval from adjacent landowners.
- Continue control of priority weed species along Pu`u Kukui trail corridor. Treat 25% of trail corridor annually. Continue monitoring weed presence along 4 existing transects (see ungulate control section, complete 1 transect per quarter).
- Update 100% of lists & range maps of prevalent and priority weeds annually.
- Update control efforts in the PKW Preserve Database on a weekly basis.

Years 5/ 6

- Continue participation with MISC and other eradication strategies for other priority invasive species in the PKW Preserve.
- Continue implementing biological control agents as available targeting any aggressive invasive species.
- Continue satellite population control of priority weed species as opportunities present themselves.
- Continue control of weeds threatening rare taxa or SEAs. Treat as opportunities present themselves.
- Continue eradication of incipient populations of invasive weeds in and immediately adjacent to PKW Preserve on ML&P lands and/or with approval from adjacent landowners.
- Continue control of priority weed species along Pu`u Kukui trail corridor. Treat 25% of trail corridor annually.
- Continue monitoring weed presence along 4 existing transects (see ungulate control section, complete 1 transect per quarter).
- Update lists & range maps of prevalent and priority weeds annually.
- Update control efforts in the PKW Preserve Database on a weekly basis.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

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 research is needed to gain more insight of the watershed ecosystem. Monitoring provides a baseline to measure the effectiveness of management programs and the condition of natural resources within the watershed. Additional monitoring is needed to track threats to these resources within the watershed and counter measures may be implemented. The PKW Preserve staff will participate in joint USFWS/DOFAW forest bird census training exercises as well as actual monitoring of forest bird resources on Mauna Kahalawai (West Maui). PKW Preserve staff will also continue data collection and maintenance of its database and biological inventory. USGS maintains an automated weather station at the summit of Pu'u Kukui. PKW staff maintains and monitors two rain gauges at Nakalalua and Haela'au Cabin on a monthly basis.

Scientific research is utilized to increase effectiveness of management efforts to protect the rich biodiversity found here. However, unfettered research access could have negative impacts on Preserve resources. Therefore; all scientific research will be allowed on a permit basis only. The PKW Preserve manager & staff 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 scientific importance and priority will be allowed. However, PKW will always take into consideration, assess and support as much as possible within reason Native Hawaiian cultural practices including those acknowledged by the state and it's 'aha moku system to be allowed. Only researchers from accredited and valid organizations and agencies will be permitted access to the Preserve and its natural resources after submitting state access and collection permits to PKW staff for evaluation. Those that request to perform cultural practices in and adjacent to the preserve will also be addressed on an individual basis to ensure safe and sound practices that will not be detrimental to both the practitioner as well as the preserve habitat, biodiversity and habitats.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**



Nohoanu- *Geranium hillibrandi*
Photo: courtesy of Herb Coyle PKW photographer)



USGS weather station @ Pu`ukukui, Mauna Kahalawai, Maui, Hawai'i
Photo: G. Hansen/ML&P ©2004

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Monitoring and Research Timeline

Year 1

- Continue providing logistical support, on a noninterference basis, for approved research projects in the watershed.
- Continue updating photo-monitoring point stations as schedule allows.
- Conduct at least one remote survey trip annually to identify & inventory native resources and threats to same.
- Monitor rain gauges at Nakalalua and Kaulalewalewa on a monthly basis.
- Continue to gather GPS coordinates for all infrastructure, rare element occurrences, priority weeds, etc. for inclusion in the PKW GIS.
- Participate in USFWS/DOFAW forest bird census on Maui.

Year 2

- Continue providing logistical support, on a noninterference basis, for approved research projects in the watershed.
- Continue updating photo-monitoring point stations as schedule allows.
- Conduct at least one remote survey trip annually to identify & inventory native resources and threats to same.
- Monitor rain gauges at Nakalalua and Kaulalewalewa on a monthly basis.
- Continue to gather GPS coordinates for all infrastructure, rare element occurrences, priority weeds, etc. for inclusion in the PKW GIS.
- Participate in USFWS/DOFAW forest bird census on Maui.

Years 3/4

- Continue providing logistical support, on a noninterference basis, for approved research projects in the watershed.
- Continue updating photo-monitoring point stations as schedule allows.
- Conduct at least one remote survey trip annually to identify & inventory native resources and threats to same.
- Monitor rain gauges at Nakalalua and Kaulalewalewa on a monthly basis.
- Continue to gather GPS coordinates for all infrastructure, rare element occurrences, priority weeds, etc. for inclusion in the PKW GIS.
- Participate in USFWS/DOFAW forest bird census on Maui.

Years 5/6

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

- Continue providing logistical support, on a noninterference basis, for approved research projects in the watershed.
- Continue updating photo-monitoring point stations as schedule allows.
- Conduct at least one remote survey trip annually to identify & inventory native resources and threats to same.
- Monitor rain gauges at Nakalalua and Kaulalewalewa on a monthly basis.
- Continue to gather GPS coordinates for all infrastructure, rare element occurrences, priority weeds, etc. for inclusion in the PKW GIS.
- Participate in USFWS/DOFAW forest bird census on Maui.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Rare Species Protection

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

Protection of the rare native species found within the preserve is essential to maintain the ecosystem as a whole. In addition, more rare species may be discovered in new areas of the watershed with further exploration. However, particularly rare plants and animals may need more immediate attention and direct management than current habitat protection measures provide.

The goal of this program is to identify the rarest species and implement management to prevent their loss. Surveys of flora and fauna will be conducted in-house by PKW Preserve staff and visiting biologists at substantial savings over contracted consultants, however; the PKW Preserve manager will not hesitate to hire appropriate expert consultants as needed to assist the Preserve staff in protecting rare taxa from the threat of extinction. Programs such as *in situ* enclosure fences, *ex situ* propagation and restoration of rare taxa will be implemented as determined necessary or as opportunities arise to enhance the viability of rare species. PKW staff will work with the Maui PEPP, SEPP when fieldwork and workshop opportunities are coordinated. Access for PEPP/SEPP management will continue as requested. PKW efforts will also focus on protection of aquatic flora and fauna such as *Lentipes concolor* (Hawaiian Red-Tailed Goby), a US Fish & Wildlife Listed Species of Concern. Opportunities will be explored for riparian improvements or modifications to current in stream structures to facilitate and improve passage for native fish and invertebrates.

New and established threats to native flora and fauna are constantly being assessed. Non-native species continue to have severe impacts on rare species. PKW will aim to support the state's and the USFWS action plans and goals for species protection and recovery within the limitations of the current funding of this long-range management plan. Any new proposed action is dependent on new allocations of funding or leveraged resources outside of this funding. Nevertheless, as more species become threatened it is highly likely that during the time period of this long-range management plan, that PKW will be approached to consider a conservation action within or adjacent to the preserve due to the location, lighting, current protection efforts in place and the overall health and biodiversity of the preserve. At that time, PKW staff will approach the state to discuss the situation if a pro-active measure would benefit an endangered species recovery and/or enhance the biodiversity of the preserve.

PKW is forming a new management initiative in rare species protection regarding native mollusks. PKW preserve staff is planning the construction of a predator-proof snail enclosure for

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Newcombia cumingi, a critically endangered tree snail. PKW has partnered with USFW, OANRP (Oahu Army Natural Resources Program), University of Hawaii, Bishop Museum and the newly formed SEPP (Snail Extinction Prevention Program) in PKW's snail management initiative. Due to this inter-agency collaboration, great advances in Hawaiian land snail biology have been made. Another result of this partnership and collaboration is the discovery of a new population of the *Newcombia cumingi* within the preserve. PKW's snail management initiative will require significant resources to be successful long-term, it is a very labor intensive process to sustain this type of management efforts.



Endangered *Ctenitis squamigera* (Pauoa fern)
Photo: H. Oppenheimer/ML&P ©2004

Rare Species Protection Timeline

Year 1

- Collection & delivery of appropriate taxa propagules to appropriate facilities (e.g. University of Hawaii's Lyon Arboretum, National Tropical Botanical Garden [NTBG]).
- Maintain information exchanges with leading conservation organizations regarding biological resources and threats on Maui.
- Continue to survey for new plant & animal populations with in-house staff.
- Perform biological monitoring of Honolua and Honokohau stream systems and assess feasibility of riparian and stream improvements or modifications to improve native fish and invertebrate passage.
- Note presence of non-native insects, mollusks and small mammals and control

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

satellite populations when possible.

- Continue to map rare species and include in PKW GIS. 100% of known rare species mapped annually.
- Maintain PKW Preserve Database of rare species on a biweekly basis.
- Continue maintenance of *Ctenitis squamigera* SEA on a biannual basis.

Year 2

- Continue collection & delivery of appropriate taxa propagules to appropriate facilities (e.g. University of Hawaii's Lyon Arboretum, NTBG).
- Maintain information exchanges with leading conservation organizations regarding biological resources and threats on Maui.
- Continue to survey for new plant & animal populations with in-house staff.
- Obtain permits and funding to support riparian and stream improvements or modifications to improve native fish and invertebrate passage.
- Continue to map rare species and include in PKW GIS. 100% of known rare species mapped annually.
- Note presence of non-native insects, mollusks and small mammals and control satellite populations when possible.
- Maintain PKW Preserve database of rare species on a biweekly basis.
- Continue maintenance of *Ctenitis squamigera* SEA on a biannual basis.

Years 3/4

- Continue collection & delivery of appropriate taxa propagules to appropriate facilities (e.g. University of Hawaii's Lyon Arboretum, NTBG).
- Maintain information exchanges with leading conservation organizations regarding biological resources and threats on Maui.
- Continue to survey for new plant & animal populations with in-house staff.
- Installation of riparian and stream improvements or modifications to improve native fish and invertebrate passage.
- Continue to map rare species and include in PKW GIS. 100% of rare species mapped annually.
- Note presence of non-native insects, mollusks and small mammals and control satellite populations when possible.
- Maintain PKW Preserve Database of rare species on a biweekly basis.
- Continue maintenance of *Ctenitis squamigera* SEA on a biannual basis.

Years 5/6

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

- Continue collection & delivery of appropriate taxa propagules to appropriate facilities (e.g. University of Hawaii's Lyon Arboretum, NTBG).
- Maintain information exchanges with leading conservation organizations regarding biological resources and threats on Maui.
- Continue to survey for new plant & animal populations with in-house staff.
- Conduct biological monitoring of Honolua and Honokohau stream systems to determine impacts of riparian and stream improvements or modifications to improve native fish and invertebrate passage.
- Continue to map rare species and include in PKW GIS. 100% of known rare species mapped annually.
- Note presence of non-native insects, mollusks and small mammals and control satellite populations when possible.
- Maintain PKW Preserve Database of rare species on a biweekly basis.
- Continue maintenance of *Ctenitis squamigera* SEA on a biannual basis.
- Continue maintenance of *Newcombia cumingi* SEA on a biannual basis.

Community Outreach and Educational Opportunities

Goal: To expose the community to projects focusing on preserving and enhance native plant and animal communities.

Community exposure to Pu`u Kukui Watershed Preserve is restricted to service trips and scheduled hikes, limited opportunities exist to engage the community in hands on activities. Establishing and enhancing native plant and animal communities in the ma kai conservation areas has multiple benefits to the PKW Preserve. As mentioned previously, the long term goal is to expand the PKW Preserve to include these ma kai conservation areas to create a complete summit-to-sea system enabling management decisions based on the entire watershed area. Engaging the community as stewards for reestablishment of native habitat through restoration projects and the control of invasive plant and animal species benefits overall watershed health. The ma kai conservation projects are grant based and rely on coordinated events with community groups for restoration work. Projects located in the ma kai conservation lands allow for greater exposure of conservation efforts to a wider audience. We plan to offer educational and volunteer opportunities through these reforestation efforts as a chance to increase both community stewardship and awareness of conservation efforts throughout ML&P lands.

One example of restoration projects is a Forestry Stewardship Project in the Honolua

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

ahupua'a; which focuses on restoring 30 acres of a former pineapple field to native dryland forest. By establishing native vegetation, we hope to improve watershed functions by minimizing erosion and providing habitat for native wildlife.) One measure of success is the recorded the presence of Hawaiian yellow-faced bees (*Hylaeus sp.*) in the reforestation site of Honolua by entomologist Karl Magnacca (OANRP). An additional benefit is to create a site where community volunteers can readily gather native seeds increasing the seed bank. **PKW Seed Banking Initiative**, is still in the early phases of being developed into a facility that is up to par with industry standards.

The wedge-tailed shearwater or 'ua'u kani (*Puffinus pacificus*) colony at Hawea Point is another successful project that is very visible to the public. It is the largest colony on Maui island, due to the collaboration with community stewards, DLNR/DOFAW and Maui Nui Seabird Recovery Project. Consistent management efforts during the nesting season to control predators is the primary reason the colony has grown exponentially every year. Restoration and habitat improvements during the migratory season supports the expansion of the seabird colony. To maintain the success of the nesting colony, ML&P will continue to participate in community outreach events, predator control, invasive species removal and native planting projects as well as assisting DLNR with biannual 'ua'u kani banding efforts and colony monitoring.

Community Outreach and Educational Opportunities Timeline

Year 1

- Lead monthly volunteer service trip for community volunteers
- Protection of 'ua'u kani colony at Hawea Point through support of reforestation projects, predator control and assisting DLNR with ongoing monitoring.
- Assist quarterly with native reforestation projects in makai conservation lands.

Year 2

- Lead monthly volunteer service trip for community volunteers
- Protection of 'ua'u kani colony at Hawea Point through support of reforestation projects, predator control and assisting DLNR with ongoing monitoring.
- Assist quarterly with native reforestation projects in makai conservation lands.

Years 3/4

- Lead monthly volunteer service trip for community volunteers
- Protection of 'ua'u kani colony at Hawea Point through support of reforestation projects, predator control and assisting DLNR with ongoing monitoring.
- Assist quarterly with native reforestation projects in makai conservation lands.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Years 5/6

- Lead monthly volunteer service trip for community volunteers
- Protection of ‘ua‘u kani colony at Hawea Point through support of reforestation projects, predator control and assisting DLNR with ongoing monitoring.
- Assist quarterly with native reforestation projects in makai conservation lands.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

Watershed Partnerships

GOAL: To assist the long-term management of the native ecosystems of West Maui by the West Maui Mountains Watershed Partnership

Maui Land & Pineapple Co. Inc has been an active partner of the West Maui Mountain Watershed Partnership since its creation in 1998. The WMMWP provides protection for about 50,000 acres on West Maui administered by a coordinator and field crew; program activities such as fencing, ungulate removal, weed control and resource monitoring closely mirror PKW management. As such, PKW will continue to offer support by collaborating on projects that meet the common goals of the partnership and actively participating in partnership functions to set priorities for WMMWP. PKW in collaboration with WMMWP has constructed over 2.8 kilometers (1.7 miles) of Axis Deer Fence along the northern boundary of the preserve (Figure 3). The PKW staff will continue to exchange technical knowledge to improve capacity of the partnership as a whole. Costs associated with this management goal are covered under other management programs such as invasive species control, monitoring and outreach and education.

The PKW crew also supports efforts of watershed partnerships throughout the state and coordinate opportunities to work together, promote the exchange of ideas and resource sharing.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**



PKW crew assisting watershed partnership
Photo: courtesy of PKW photographer Herb Coyle

Facilities and Operating Expenses

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

The Pu`u Kukui Preserve manager is responsible for the implementation of this plan. The volume of work outlined in this plan requires the PKW Preserve manager to be assisted by one Field Operations Supervisor and three full-time Field Technicians. The current staffing level consists of one management position and three full-time PKW Preserve Field Technicians. In order to complete goals and objectives outlined in this plan, additional staff will need to be hired. The addition of a Field Operations Supervisor to the existing staff in Year 2 and a summer intern hired for a three month period during Year 1, Year 5 and Year 6 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. Contract labor may also be utilized to provide more than one additional person at a time, for labor-intensive trips, such as fence, boardwalk or platform/shelter construction and installations. Planning and Technical Assistance funds budgeted will cover consultant fees for technical assistance.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

PKW Preserve staff will attend regularly scheduled emergency training courses offered by ML&P, DOFAW, 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 the Pu'u Kukui Preserve 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 (additional insurance costs are not shown in the following volunteer costs). The PKW Preserve staff will cultivate and schedule volunteers to assist with appropriate watershed projects. Within the PKW Preserve, volunteer group size will be limited to minimize impact on fragile trails or habitat and volunteers will be escorted by Preserve staff in order to support the policy of keeping the watershed closed to the general public. Volunteer trips to the makai conservation lands will be utilized for larger groups and those unable to manage uneven terrain and strenuous activity, such as school children and elderly participants.

ML&P currently provides space for the Pu'u Kukui Preserve staff and equipment storage needs, and associated costs as "facilities". Other facilities in the PKW Preserve are needed to improve management efficiency. The Haela'au Cabin, located at the top of a 4-wheel drive road to the Pu'u Kukui trailhead at Kaulalewalewa, is used by PKW Preserve staff, volunteers and visiting researchers for lower elevation work. Monthly maintenance of the cabin is needed to keep the building (built 1920's) in usable condition. Seven (6 - 20'x20', 1 - 12'x12') wooden helicopter landing platforms have been established to provide safe landing zones, decrease impact on native vegetation and to prevent the establishment of new weeds. Maintenance of the platforms will be performed on an as needed basis; additional camp platforms/helicopter landing zones (LZ) may be installed as needed. Due to the age of the platforms and the elements they are exposed to, the majority of PKW's platform LZs will require substantial repairs within the next 6-year period to keep them structurally sound LZ's that are safe to use. All construction in the Conservation District will comply with current state regulations and NAP program rules.

Currently, the PKW Preserve has 4 dedicated 4-wheel drive vehicles to provide access to the watershed's lower areas and helicopter pickup sites by Preserve staff and manager. As new staffing is added to fulfill expanded Preserve operational requirements, additional 4-wheel drive vehicles dedicated to the Preserve's management may be needed to ensure regular transportation to and from work sites. Matching funds for a new 4x4 wheel drive has been previously allocated to maintain full capacity.

Road and trail maintenance is needed to keep the main ground access routes to the

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

watershed open; principally the 4-wheel drive to Haela'au Cabin, and the Pu'u Kukui Trail on the watershed's southwest boundary. Heavy rains cause erosion and washouts on the road, and regular road maintenance is required. The road to Haela'au Cabin is the only direct vehicle access to the preserve.

The 7 kilometer boardwalk of the Pu'u Kukui trail is in fair and usable condition but regular maintenance is necessary to repair damaged sections. The sections requiring repair are often less than twelve feet but are spread out over considerable distances along the boardwalk.

CONCLUSION

This project currently provides full-time employment for four ML&P employees with a projected increase to five full-time PKW Preserve staff as well as temporary interns. Additionally, the bulk of project expenditures are projected to stay in the local economy. Services, such as helicopter charter, are with locally owned & operated companies. Supplies are purchased locally whenever possible.

In addition, the watershed of Pu'u Kukui is the source of water for West Maui residents and industries. As stated previously, ML&P and the West Maui Community depend on the watershed to recharge the aquifer and ensure adequate supply of water is available for agricultural, irrigation and domestic uses in West Maui. 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 torrents to the sea. Subsequently, ML&P's conservation efforts in the Pu'u Kukui Preserve are also expected to benefit both the recreational and natural resources of the Honolua - Mokule'ia Marine Life Conservation District.

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 native species from the summit of Pu'u Kukui to the shores of Honolua Bay. When appropriate, volunteers will be utilized in various management projects with every opportunity to incorporate Hawaiian cultural protocol and traditional resource practices as well as western conservation practices thus providing educational, cultural and recreational opportunities for the general public. Additionally, the Public Hunting Program provides recreational opportunities for those that qualify to participate, and allows local families to supplement their diet with wild game.

The impacts of this LRMP will be:

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

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.

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.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

List of Preparers

Pomaika'i Kaniaupi'o-Crozier, Conservation Manager
Pu'u Kukui Watershed Preserve
Maui Land & Pineapple Company, Inc.
200 Village Road
Lahaina, Maui, Hawai'i 96761
Phone: (808)870-4225
Email: pkaniaupio-crozier@kapalua.com

Daniel Tanaka, Field Operations Supervisor
Address: same as above
Email: dtanaka@kapalua.com

Donna Borge, Operations Supervisor
Email: dborge@kapalua.com

Hookahi Alves, Field Technician
Email: halves@kapalua.com

Kekoa Range, Field Technician
Email: krange@kapalua.com

Garret Anchetta, Field Technician
Email: ganchetta@kapalua.com

Herb Coyle, Photographer
Email: hcoyle@kapalua.com

The Pu'u Kukui Watershed Preserve Long Range Management Plan was prepared by ML&P's Pu'u Kukui Watershed Preserve department staff. The plan has been submitted to the Natural Area Reserves System Commission for consideration as a Natural Area Partnership Program (NAPP) project for state fiscal years 2018 through 2024.

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

BUDGET SUMMARY

| Effort | Year1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 |
|--|------------------|------------------|------------------|------------------|------------------|------------------|
| Ungulate Control (50%) | \$144,750 | \$150,540 | \$156,561 | \$162,824 | \$169,337 | \$176,111 |
| Monitoring & Research (20%) | \$57,900 | \$60,216 | \$62,624 | \$65,130 | \$67,735 | \$70,444 |
| Weed Control (10%) | \$28,950 | \$30,108 | \$31,312 | \$32,565 | \$33,867 | \$35,222 |
| Rare Species Protection (5%) | \$14,475 | \$15,054 | \$15,657 | \$16,282 | \$16,934 | \$17,611 |
| Outreach & Protection (5%) | \$14,475 | \$15,054 | \$15,657 | \$16,282 | \$16,934 | \$17,611 |
| Facilities & Operating Expenses (10%) | \$28,950 | \$30,108 | \$31,312 | \$32,565 | \$33,867 | \$35,222 |
| TOTAL | \$289,500 | \$301,080 | \$313,123 | \$325,648 | \$338,674 | \$352,221 |

NAP Program Match

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 |
|---|------------------|------------------|------------------|------------------|------------------|
| PKW Preserve Budget \$289,500 | \$301,080 | \$313,123 | \$325,648 | \$ 338,674 | \$352,221 |
| Private Match (1/3 of total) -\$96,500 | -\$100,360 | -\$104,374 | -\$108,549 | -\$112,891 | -\$117,407 |
| TOTAL NAPP REQUEST (2/3) \$193,000 | \$200,720 | \$208,749 | \$217,099 | \$225,783 | \$234,814 |

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

APPENDIX 1

Natural Plant Communities of the Pu`u Kukui Watershed Preserve

As described by Gagne and Cuddihy in the *Manual of the Flowering Plants of Hawai'i*, the floristic composition of the islands can be classified according to environmental situation and the dominance of particular components. *Principal community types* - presented here in **boldface** -are general groupings based on elevation, moisture and physiognomy regimes. Within the principal community types are found unique plant communities, which are named according to their respective dominant components. Seventeen unique plant communities within eight principal community types are found within the lowland and montane regions of the PKW Preserve. Only native dominated communities are listed here:

Lowland Mesic Shrubland

'Ohi'a (Metrosideros) Lowland Mesic Shrubland

Pukiawe/ A'ali'i (Styphelia/ Dodonaea) Lowland Mesic Shrubland

Lowland Mesic Forest

'Ohi'a (Metrosideros) Lowland Mesic Forest

Papala/ Papala kepan (Charpentiera/ Pisonia) Riparian Forest

Lama/ 'Ohi'a (Diospyros/ Metrosideros) Lowland Mesic Forest

Lowland Wet Shrubland

Mamaki (Pipturus) Wet Shrubland

Lowland Wet Forest

'Ohi'a/ Uluhe (Metrosideros/ Dicranopteris) Fern Forest

'Ohi'a (Metrosideros) Lowland Wet Forest

'Ohi'a/ Olapa (Metrosideros/ Cheirodendron) Lowland Wet Forest

Koa/ 'Ohi'a (Acacia/ Metrosideros) Lowland Forest

Montane Wet Sedgeland

Carex Sedgeland

Montane Wet Mixed Communities

'Ohi'a (Metrosideros) Montane Wet Mixed Community

Subtype: *'Ohi'a/ Kuolobia/ Oreobolus* Mixed Bog

Montane Wet Shrubland

Mixed Fern Shrubland

'Ohi'a (Metrosideros) Montane Wet Shrubland

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Montane Wet Forest

‘Ohi’a (Metrosideros) Montane Wet Forest

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

APPENDIX 2

Rare Plants of the Pu'u Kukui Watershed Preserve

Endangered:

1. *Alectryon macrococcus* var. *macrococcus* (Mahoe)
2. *Bidens conjuncta* (Ko'oko'olau)
3. *Calamagrostis hillebrandii* (Reed grass)
4. *Ctenitis squamigera* (Pauoa)
5. *Cyanea asplenifolia* (Haha)+
6. *Cyanea kunthiana* (Haha)+
7. *Cyanea lobata* subsp. *lobata* (Haha)* PEP
8. *Cyanea magnicalyx* (Haha)* PEP
9. *Cyrtandra filipes* (Ha'iwaile) PEP
10. *Cyrtandra munroi* (Ha'iwaile)
11. *Hesperomannia arborescens*
12. *Myrsine vaccinioides* (Kolea)*
13. *Pteris lidgatei* PEP
14. *Sanicula purpurea* (Snakeroot)

Candidates

1. *Calamagrostis expansa* (Reed grass)
2. *Gardenia remyi* (Nanu)
3. *Geranium hillebrandii* (Nohoanu)*

Species of Concern:

1. *Alphitonia ponderosa* (Kauila)
2. *Anoetochilus sandwicensis* (Honohono)
3. *Argyroxiphium caliginis* ('Eke silversword)*
4. *Cyrtandra lydgatei* (Ha'iwaile)
5. *Dicantbelium koolauensis*
6. *Doodia lyonii*
7. *Eurya sandwicensis* (Anini)
8. *Exocarpos gaudichaudii* (Hulumoa)

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

- 9. *Kadua formosa**
- 10. *Hibiscus kokio* subsp. *kokio* (Koki'o ula)
- 11. *Hillebrandia sandwicensis* (Pua maka nui)
- 12. *Joinvillea ascendens* subsp. *ascendens* ('Ohe)
- 13. *Keysseria maviensis* (Howaiaulu)
- 14. *Liparis hawaiiensis* (Awapuhiakanaloa)

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

15. *Phyllostegia stachyoides* PEP
16. *Pritchardia forbesiana* (Loulou)*
17. *Sicyos cucumerinis* (Panunu kuahiwi)
18. *Strongylodon ruber* (Nuku i`iwi)
19. *Wikstroemia bicornuta* (‘Akia)

* Indicates plants that are endemic to West Maui

+ Indicates plants that are endemic to Maui

PEP Indicates a target species for Plant Extinction Prevention Program

Plants with no current USFWS Status that are **Endemic** to Mauna Kahalawai (West Maui) and are found in PKW Preserve:

1. *Cyanea scabra* (Haha)
2. *Metrosideros polymorpha* var. *pseudorugosa* (‘Ohi‘a)
3. *Sphagnum wheeleri* (Wheeler’s Sphagnum moss)



**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

Acaena exigua (Liliwai) Photo: H. Oppenheimer/ML&P ©2000-04

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

APPENDIX 3

Rare Animals of the Pu`u Kukui Watershed Preserve

Endangered:

Vertebrate:

Lasiurus cinereus semotus ('Ope'ape'a / Hawaiian Hoary Bat)
Pterodroma sandwichensis ('Ua'u / Dark-Rumped Petrel)
Puffinus newelli ('A'o / Newell's Shearwater)

Invertebrate:

Megalagrion pacificum (Hawaiian Damselfly)
Newcombia cumingi (Cumming's Newcombia tree snail)

Species of Concern:

Vertebrate:

Asio flammeus sandwichensis (Pueo / Hawaiian Short-Eared Owl)
Lentipes concolor (O'opu alamo'o / Hawaiian Red-Tailed Goby)

Invertebrate:

Megalagrion nigrohamatum (Hawaiian Damselfly)
Coleotichus blackburniae (Koa bug)
Nesotocus giffardii
Plagithmysus alani
Plagithmysus cf. *laticollis*
Rhynchogonus lahaina (beetle)
Catinella baldwinii (Amber snail)
Lymnaea aulacospira
Neritina granosa (Hihiwai)
Partulina perdix (Pupu kani oe / Maui tree snail)
Partulina splendida (Pupu kani oe / Maui tree snail)
Partulina tappaniana (Pupu kani oe / Maui tree snail)
Perdicella kuhnsi (Pupu kani oe / Maui tree snail)
Philonesia spp.

Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program

APPENDIX 4

Prevalent Habitat-Modifying Weed Species of the PKW Preserve & Adjacent Areas
(PKW PRESERVE PRIORITY WEED CONTROL SPECIES in boldface)*

| | | |
|-----|----------------------------------|---|
| 1. | Formosan koa | <i>Acacia confusa</i> (Ex PKW) |
| 2. | Tasmanian black wood | <i>Acacia melanoxylon</i> (Ex PKW) |
| 3. | Maui pamakani | <i>Ageratina adenophora</i> |
| 4. | Kukui | <i>Aleurites moluccana</i> |
| 5. | Broom sedge | <i>Andropogon virginicus</i> |
| 6. | Sweet vernal grass | <i>Anthoxanthum odoratum</i> |
| 7. | Shoe button, Inkberry | <i>Ardisia elliptica</i> |
| 8. | <i>Hammock</i> fern | <i>Blechnum appendiculatum</i> |
| 9. | Butterfly bush | <i>Buddleia asiatica</i> |
| 10. | Padang cassia | <i>Cinnamomum burmannii</i> |
| 11. | Koster's curse* | <i>Clidemia hirta</i> |
| 12. | Andean Pampas grass* | <i>Cortaderia jubata</i> |
| 13. | Albizia* | <i>Falcataria moluccana</i> (Ex PKW) |
| 14. | Tropical ash | <i>Fraxinus uhdei</i> (Ex PKW) |
| 15. | Velvet grass | <i>Holcus lanatus</i> |
| 16. | Moonflower | <i>Ipomoea alba</i> |
| 17. | Japanese bog rush | <i>Juncus effusus</i> |
| 18. | Rush | <i>Juncus planifolius</i> |
| 19. | Molasses grass | <i>Melinis minutiflora</i> |
| 20. | Wax myrtle* | <i>Morella (Myrica) cerifera</i> |
| 21. | Hilo grass | <i>Paspalum conjugatum</i> |
| 22. | Vasey grass | <i>Paspalum urvillei</i> |
| 23. | Sweet Granadilla | <i>Passiflora ligularis</i> |
| 24. | Waiawi, Strawberry Guava* | <i>Psidium cattleianum</i> |
| 25. | Guava | <i>Psidium guajava</i> |
| 26. | Prickly Florida blackberry | <i>Rubus argutus</i> |
| 27. | Himalayan blackberry | <i>Rubus discolor</i> |
| 28. | Thimbleberry | <i>Rubus rosifolius</i> |
| 29. | Glenwood grass | <i>Sacciolepis indica</i> |
| 30. | Brazilian pepper | <i>Schinus terebinthifolius</i> (Ex PKW) |
| 31. | African tulip* | <i>Spathodea campanulata</i> |
| 32. | Australian Tree Fern* | <i>Sphaeropteris cooperi</i> |

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

33. Cane *Tibouchina*

Tibouchina herbacea

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

APPENDIX 5

Prevention of Alien Species Introduction

**Protocol for Entry into Maui Land & Pineapple Company's Pu`u Kukui Watershed Preserve
(PKW/Pu`u Kukui Preserve), including Haela'au Cabin, Honokohau Ditch Trail &
Honokohau Dam.**

**TO: Maui Land & Pineapple Company (ML&P)/Kapalua Land Company (KLC)
employees, Harmer Communications Co., volunteers, researchers, visitors, guests and
any and all others entering the PKW Preserve.**

It has been well documented that, along with habitat destruction, alien species of plants and animals (including insects, mammals, birds, reptiles, fish, etc.) have had severe negative impacts on Hawaii's unique native ecosystems. Maui Land & Pineapple Company (ML&P) is committed to the protection of these ecosystems (forests, scrublands, bogs, etc.) recognizing their vital role as the best possible watershed cover. Control of established alien species and ***prevention*** of introducing new ones is the top priority as set forth in the Pu`u Kukui Preserve Management Plan. Due to limited resources, we ask that all those entering the PKW Preserve spend a little time and effort to make certain that all gear, clothing, materials, vehicles, etc. are clean and clear of non-native organisms that may inadvertently be transported and introduced. Please help us to be a part of the solution and not part of the problem. As the saying goes "An ounce of prevention is worth a pound of cure".

Here's what *YOU* can do to help:

For those driving to Haela'au Cabin, wash the underside of your vehicle. All ML&P /KLC employees should use the high-pressure hose at the wash rack at Honolua Plantation baseyard. Others should ask the PKW Preserve manager/staff about its use. Tires, wheel wells, bumpers, truck beds, etc. should be hosed down to remove mud that may have seeds or spores of non- native plants. Materials and gear should be checked (including tools, lumber, firewood, etc.) and cleaned. PKW Preserve staff may inspect anything entering the Preserve and may deny access/entry if it is contaminated. A can of Raid or other insecticidal spray can be handy for ants or other insects/spiders that may have escaped detection. It also helps to sweep out the inside of the vehicle as well. Coolers, dishes, food and containers can all carry unwanted hitchhikers. If an item is heavily infested it is better to discard and/or replace it rather than clean it only partially. **Waivers**

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu'u Kukui Watershed Management Area
Natural Area Partnership Program**

must be signed; minors must have their parents or legal guardian's signature.

For those entering the PKW Preserve via helicopter, the Landing Zone (LZ) at the point of departure should be as weed free as possible. Cement or asphalt is preferable to grass or dirt. There is a cement slab LZ at the Honolua baseyard "ball-field". If gear and supplies are to be transported via sling or cargo net, these must be inspected prior to packing, not only for contaminants but also for any damages that may compromise the security of the material and the safety of the pilot and the people on the ground. It is best to assume that something is stuck in the netting and hose it down. Bucket bottoms can be hosed or cleaned with a stiff fiber or nylon brush. It is usually easier to clean gear and materials when they are dry. Camping and hiking gear is particularly prone to carrying hitchhikers. Tents can be turned inside-out; tubular framed cots and chairs should be checked for clods of dirt at open ends; mesh or netting on clothing or backpacks are good places for weed seeds to attach themselves and need to be inspected carefully. Footwear seems to be the easiest way for weeds to catch a ride into new areas. A stiff fiber brush is very effective for cleaning; a knife may be needed for stubborn areas such as treads and lugs. Be sure to inspect your shoelaces, as well the insides of boots and shoes.

PKW Preserve staff should monitor all LZs and campsites for weed presence, noting any new introductions. For those who will be moving across large areas of the Preserve, it is always best to work from higher elevations that are usually more weed free, down to lower and usually weedier elevations. The best scenario is to have gear and clothing dedicated to pristine areas (usually designated as a Special Ecological Area or SEA). Another quick and effective practice is to empty all bags and backpacks, turn them upside-down, and shake out any debris which may include weed seeds/spores and/or insects/eggs. Try to avoid eating food the day before which has tiny seeds such as tomatoes, guava, lilikoi, etc.

Pack out **all** trash-organic trash such as banana skins, orange peels, apple cores, etc. can have seeds or insects/eggs or more inconspicuous and potentially harmful bacteria, blight, pathogens, disease, etc. When "nature calls" stay away from streams and streambeds. Bury your waste. For those staying overnight in remote backcountry locations, ask Preserve staff for a portable waste disposal system. Food wastes also feed rats and other undesirable animals and should be taken out - if you brought it in you can take it out.

If you are allergic to bee stings or have any medical condition that requires medications, bring enough medication along; the group leader and Preserve staff should also be notified. Smoking is strongly discouraged; campfires and fireworks are strictly prohibited.

It is recommended that a cellular phone or two-way radio be taken in the event of emergency (injury, fire, etc.) or change in logistics such as pickup time or place. The PKW Preserve staff #'s are

**Long Range Management Plan
for Fiscal Years 2018-2024
Pu`u Kukui Watershed Management Area
Natural Area Partnership Program**

listed below. For those using two-way radios, a check time and channel should be prearranged. Please report anything unusual such as animal sightings, trespassers, fence damage, etc. as soon as possible.

Keys are the responsibility of those who have signed for them or received them from MLP/PKW Preserve staff.

Remember after leaving the Preserve that it is also your responsibility to avoid transporting potentially harmful non-native species to the next place. Many researchers and visitors are on busy schedules and go from one island to another. It must be remembered that not all alien species are on all islands or in all areas of the same island; *Miconia* is on East Maui but not West Maui; *Tibouchina* is not yet on Kauai. Natural area managers have enough problems to deal with; please help by not adding to them.

[illegible]

[illegible]

| From Date | To Date | Staff Hours | Volunteer Hours | Partner Hours | Other Hours |
|-------------------------------|---------|-------------|-----------------|---------------|-------------|
| Total Monitoring Person Hours | | | | | |

[illegible]

| | |
|-----------------------------|-----------------------------|
| Link To Pop | Link To Pop |
| Ref Code | Ref Code |
| Shapefile | Shapefile |
| Web Map | Download |

[illegible]

| From Date | 7/1/2017 | To Date | 12/31/2017 | |
|-----------------------------|-------------|-----------------|---------------|-------------|
| | Staff Hours | Volunteer Hours | Partner Hours | Other Hours |
| Total Planting Person Hours | 440 | 1095 | | |

[illegible]

| | | | | |
|----------------------------|-------------|-----------------|---------------|-------------|
| From Date | | To Date | | |
| | Staff Hours | Volunteer Hours | Partner Hours | Other Hours |
| Total Infrastructure Hours | | | | |