

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawaii 96813

March 11, 2016

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

Land Board Members:

**SUBJECT: REQUEST APPROVAL OF THE AHUALOA HOMESTEADS FOREST
STEWARDSHIP MANAGEMENT PLAN AND FOREST
STEWARDSHIP AGREEMENT WITH ALAN R. EVERSON, TMK (3)
4-6-009:102, HAMAKUA DISTRICT, ISLAND OF HAWAI'I**

AND

**REQUEST APPROVAL OF DECLARATION OF EXEMPTION FROM
CHAPTER 343, HRS ENVIRONMENTAL COMPLIANCE
REQUIREMENTS FOR THE PROJECT.**

BACKGROUND:

The State of Hawaii Forest Stewardship Program (FSP) provides technical and financial assistance to private landowners and land managers committed to the stewardship, conservation and restoration of important forest resources across the state. These private properties provide a variety of public benefits for the residents of Hawaii, including but not limited to: fresh water capture and production, decreased soil erosion, wildlife habitat, forest products, recreational and educational opportunities, and local jobs. The assistance provided by FSP enables private landowners to develop and implement long-term multi-resource management plans to conserve, restore and maintain forested areas on their property.

The program was established through Chapter 195F-6, Hawaii Revised Statutes (HRS). The Department of Land and Natural Resources (DLNR) has the authority to provide financial assistance to approved Forest Stewardship projects for private landowners to manage, protect, and restore important natural forest resources on forested and formerly forested properties. The Forest Stewardship Program is implemented pursuant to Chapter 195F, HRS, and Hawaii Administrative Rules (HAR) Chapter 109. The program provides cost-share reimbursement for the development of long term forest management plans and for the implementation of approved Forest Stewardship management plans.

To participate in FSP, interested landowners and managers follow a sequence of application steps to develop a long-term Forest Stewardship management plans that are submitted to and reviewed by the Forest Stewardship Advisory Committee (FSAC). Landowners interested in FSP submit an application to the FSAC, whom recommends the development of a Forest Stewardship management plan based on program eligibility requirements and assures the proposed project is in line with the program's goals of conservation, restoration and/or forest production. Landowners create a forest management plan that is reviewed by both Division staff and the FSAC, and the committee recommends the management plan for approval by the Division and Department.

The award of cost-share support for Forest Stewardship management plan implementation follows a similar process to the development of a management plan. Upon approval of a project's Forest Stewardship management plan, the FSAC reviews the implementation schedule and budget summary to ensure that the practice costs are reasonable and follow the program's approved cost-share rates. The FSAC recommends cost-share support for project implementation based on the 10-year implementation schedule that is then submitted to the Board of Land and Natural Resources (BLNR) for consideration. Review and approval of the Forest Stewardship project and management plan as well as authorization of cost-share support for the project by the BLNR is required in order for DLNR to enter into the Forest Stewardship Agreement. The Division has previously worked with the Department of the Attorney General to developing a Forest Stewardship Agreement template (Exhibit A) for eligible projects.

The Āhualoa Homesteads Forest Stewardship project proposes to manage approximately 19.8 acres, Tax Map Key number (3) 4-5-009:102, in the Hāmākua District of Hawai'i County. The project will undertake active restoration of 18 acres with the main objective of restoring degraded pasture to a native forest appropriate to the area. The Forest Stewardship project area is designated by the State of Hawaii as Agriculture District and as Agriculture by the County of Hawai'i. Āhualoa Homesteads is located several miles southeast of Honoka'a on Hawai'i Island's Hamakua coast in the Āhualoa Homestead Subdivision. This rural area was originally settled by Portuguese and Japanese workers supporting the sugar plantation and has a history of ranching. Āhualoa was also the location for early plantings of coffee, which is still being grown there today.

The natural vegetation of this part of Hāmākua was most likely sub-montane rain forest dominated by 'ōhi'a (*Metrosideros polymorpha*) and koa (*Acacia koa*). These original communities, however, have been destroyed or heavily degraded by sugar cane cultivation, cattle grazing, and clearing for small farms and residences. The vegetation type found in Āhualoa and Honoka'a is now either managed vegetation (i.e., farms, pasture or landscaped grounds) or adventive "communities" of various alien weeds, with only small areas of remnant forest, mainly present in the upper areas of the Hāmākua coast.

The FSAC approved the Āhualoa Homesteads Forest Stewardship management plan at their meeting on January 24, 2014 and the State Forester/Division Administrator approved the Forest Stewardship Management Plan on August 18, 2014 (Exhibit B).

DISCUSSION:

The Division is requesting approval of a Forest Stewardship Agreement with Alan R. Everson for the implementation of the Āhualoa Homesteads Forest Stewardship management plan and project. Over the course of the 10-year management plan Alan R. Everson intends to promote the recovery of native Hawaiian plant and animal communities across his property beginning with the restoration of ten forest management units, labeled by sections 1-5 and either A or B (Exhibit B). The current overstory trees are mainly non-native with a few native trees of 'ōhi'a and hāpu'u, though most of the project site is degraded pasture. Management approaches will focus on promoting growth and regeneration of target tree and understory species in areas protected by new proposed fence areas. The objective is to replace the current cover with a site-appropriate native species to prevent erosion.

For the project, fencing will be the first management activity to occur to ensure that ungulates (principally feral hogs) are excluded. Site Preparation will take place next, removing the dominant invasive black wattle as well as any incipient weeds of wild olive, silk oak, and guava. Faster growing natives will be utilized as windbreaks around fenced areas with koa, ohia, and other native species planted throughout the project site. After establishment of native canopy species, a second planting of native shrubs and understory vegetation will be outplanted. Ongoing maintenance of the established areas (weed control, thinning, and invasive species removal) will also be undertaken on a regular basis after the initial planting and throughout the 10 years of the contract.

Alan R. Everson is seeking cost-share support for the implementation of his management plan from FSP and through partner programs with U.S. Department of Agriculture. One of the objectives of the Hawaii Joint Forestry Memorandum of Understanding (MOU) between the DLNR, Hawaii Association of Conservation Districts (HACD), Natural Resource Conservation Service (NRCS) and U.S. Forest Service (USFS), is to improve communication between agencies and strengthen cooperation for the delivery of forestry-related conservation assistance to private landowners and land managers. As a part of this MOU the partners agreed to use the Forest Stewardship management plans as a way to increase the cooperation and planning for forestry landowners interested in the various assistance programs including FSP and Hawaii Conservation Reserve Enhancement Program (CREP).

The template for the Forest Stewardship management plans has been modified to incorporate resource concerns, threats and needs that are common among forestry assistance programs with the ultimate goal being utilization of Forest Stewardship management plans for various cost-share assistance programs offered by the partners. The Āhualoa Homesteads Forest Stewardship project is seeking support for implementation of the approved Forest Stewardship management plan from FSP and Hawaii CREP. The FSP portion will include those practices and activities under the management plan that will encompass the entirety of the project or practices not funded through Hawaii CREP. The Hawaii CREP portion will target smaller scale restoration sites that can be completed within one to three years per those program requirements.

A total of **\$22,740** in State Forest Stewardship funding is requested to provide cost-share support for the Āhualoa Homesteads Forest Stewardship management plan and the Alan R. Everson Forest

Stewardship Agreement. Alan R. Everson will be contributing an equal amount of **\$73,378** toward the Forest Stewardship Program, plus an estimated additional **\$50,638** toward completion of the project from partner programs over the ten year period of the management plan. The costs associated with the proposed practices are consistent with the intensity of management required for this type of project. Cost-share funds are provided as reimbursement payments for implementation of approved management practices through the State fiscal year 2027. In addition Alan R. Everson has agreed to continue maintenance of the installed Forest Stewardship practices for an additional five years following the completion of the State cost-share contributions, or through State fiscal year 2031.

CHAPTER 343 – ENVIRONMENTAL ASSESSMENT

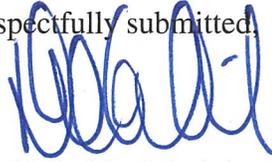
In accordance with Exemption List for the Division of Forestry and Wildlife and the Department of Land and Natural Resources, reviewed and concurred upon by the Environmental Council on June 12, 2008 and July 13, 2011, the proposed activities are exempt from the preparation of an environmental assessment. Specifically, the proposed activities fall under Exemption Class 1. “Operations, repairs or maintenance of existing structures, facilities, equipment, or topographical features, involving negligible or no expansion or change of use beyond that previously existing”; Exemption Class 3 “Construction and location of single, new, small facilities or structures and the alternation and modification of same and installation of new, small equipment facilities and the alternation and modification of same”; and Exemption Class 4. “Minor alternation in the condition of land, water, or vegetation.” This project is anticipated to have minimal or no significant negative impact on the environment.

RECOMMENDATIONS:

That the Board:

1. Approve the Āhualoa Homesteads Forest Stewardship management plan;
2. Approve cost-share support in the amount of **\$22,740** for the implementation of the Āhualoa Homesteads Forest Stewardship management plan;
3. Authorize the Chairperson to amend, finalize and execute a Forest Stewardship Agreement with Alan R. Everson to participate in the State Forest Stewardship Program subject to the following:
 - A. Availability of State Forest Stewardship funds; and
 - B. Review and approval as to form of the Forest Stewardship Agreement by the Department of the Attorney General.
4. Declare that, after considering the potential effects of the proposed dispositions provided by Chapter 343, HRS, and Chapter 11-200, HAR, this project will likely have minimal or no significant effect on the environment and is therefore exempt from the preparation of an environmental assessment.

Respectfully submitted,



David Smith, Administrator
Division of Forestry and Wildlife

Attachment: (Exhibit A and B)

APPROVED FOR SUBMITTAL:



Suzanne D. Case, Chairperson

**STATE OF HAWAII
FOREST STEWARDSHIP AGREEMENT**

This AGREEMENT, made this _____ day of _____, 20____, by and between the BOARD OF LAND AND NATURAL RESOURCES, STATE OF HAWAII (“STATE”), by its Chairperson, whose address is 1151 Punchbowl Street, Honolulu, Hawaii 96813, and _____, (“LANDOWNER”) whose address and federal and state taxpayer identification numbers are as follows: _____

Business address

Federal and state taxpayer identification numbers

RECITALS

WHEREAS, Chapter 195F, Hawaii Revised Statutes (HRS), provides for the establishment of a forest stewardship program to encourage and assist private landowners in managing, protecting, and restoring important watersheds, native vegetation, fish and wildlife habitats, isolated populations of rare and endangered plants, and other forest lands that are not recognized as potential natural area reserves; and

WHEREAS, in accordance with HRS Chapter 195F and Title 13, Subtitle 5, Part 1, Chapter 109 of the Hawaii Administrative Rules (HAR), the LANDOWNER has applied, and qualifies, for participation in the forest stewardship program; and

WHEREAS, the LANDOWNER has submitted a forest stewardship management plan, as set forth in Exhibit A hereto, that the STATE agrees is consistent with the policies, goals, and objectives of the forest stewardship program; and

WHEREAS, the STATE desires to assist the LANDOWNER in implementing the forest stewardship management plan with financial and other assistance; and

WHEREAS, money is available to fund this agreement pursuant to: Act 195, SLH 1993, Hawaii Revised Statutes, Section 247-7.

NOW, THEREFORE, in consideration of the promises contained in this AGREEMENT, the STATE and the LANDOWNER agree as follows:

Exhibit A

A. SCOPE OF SERVICES

The LANDOWNER hereby agrees to implement the forest stewardship management plan set forth in Exhibit A and the project described in the “Scope of Services” set forth in Attachment S1 in proper and satisfactory manner as determined by the STATE, both of which are hereby made a part of this AGREEMENT. The STATE hereby agrees to assist the LANDOWNER in implementing the forest stewardship management plan, all in accordance with the terms and conditions set forth in Attachments S1, S2, S3, S4, S5, and S6, attached hereto.

B. COMPENSATION

The LANDOWNER shall be compensated for performance of the project under this AGREEMENT according to the “Compensation and Payment Schedule,” set forth in Attachment S2, which is hereby made a part of this Agreement.

C. TIME OF PERFORMANCE

The performance required of the LANDOWNER under this AGREEMENT shall be completed in accordance with the “Time of Performance” set forth in Attachment S3, which is hereby made a part of this AGREEMENT.

D. CERTIFICATE OF EXEMPTION FROM CIVIL SERVICE

The “State of Hawaii Certificate of Exemption from Civil Service,” set forth in Attachment S4, is hereby made a part of the AGREEMENT.

E. OTHER TERMS AND CONDITIONS

The “State of Hawaii Special and General Conditions for Forest Stewardship Program Agreements,” set forth in Attachment S5, and the General Conditions attached hereto, are hereby made a part of this AGREEMENT. For the purposes of this AGREEMENT the term “CONTRACTOR” in the “General Conditions” shall mean the LANDOWNER.

Exhibit A

F. STANDARDS OF CONDUCT DECLARATION

The “Standards of Conduct Declaration” by LANDOWNER, set forth in Attachment S6, is hereby made a part of this AGREEMENT. For the purposes of this AGREEMENT the term “CONTRACTOR” in the “Standards of Conduct Declaration” shall mean the LANDOWNER.

Exhibit A

IN WITNESS WHEREOF, the parties execute this AGREEMENT by their signatures to be effective as of the date first above written.

STATE

By _____
Chairperson of the Board of Land and Natural
Resources

Print Name

Date _____

LANDOWNER

By _____

Print Name

Date _____

Approved by the Board of
Land and Natural Resources on

APPROVED AS TO FORM:

Deputy Attorney General

Exhibit A

LANDOWNER'S ACKNOWLEDGMENT

STATE OF HAWAII)
) SS.
COUNTY OF _____)

On this _____ day of _____, 20____, before me personally appeared _____, to me personally known, who being by me duly sworn, did say the he/she is the _____, the LANDOWNER named in the foregoing instrument, and the he/she is authorized to sign said instrument on behalf of the LANDOWNER, and acknowledges that he/she executed said instrument as the free act and deed of the LANDOWNER.

Notary Public, State of Hawaii

My Commission Expires: _____

Date of the Notarized Document: _____

Number of Pages: _____

Identification or Description of the Document being Notarized: _____

Printed Name of Notary: _____ Circuit

Notary's Signature and Notary's Official Stamp or Seal Date

**Hawaii Forest Stewardship Program
Forest Stewardship Management Plan
Āhualoa Homesteads**

I. Applicant and Property Information

Applicant Name: Alan Everson

Mailing Address:

45-205 Puali Koa Pl

Kaneohe, HI 96744

Email: areverson@gmail.com

Phone: 808 348-5205

Landowner name: Alan Everson

Address and Tax Map Key number of project location:

46-4085 Kahana Drive, Honokaa, HI 3-4-6-9-102

Āhualoa Homesteads Subdivision

State Land Use and County Zone designation: A-5A

Driving directions from the nearest highway: Near the junction of Mamalahoa Hwy and Kahana Drive.

From the junction, proceed east for .5 miles on Kahana Drive. Property is on the right side of Kahana Dr.

Property acreage: 19.8

Elevation 2530 to 2640 ft

Slope: 6%

Proposed acres in stewardship management area: 18

Streams and Gulches: An unnamed gulch transects the length of the property

Consultant's name, title, company, address, email, fax and phone number:

Name Aileen K. F. Yeh

Address 942 W. Kawilani St., Hilo, HI 96720

Phone (808) 936-2671

Date plan completed:

II. Forest Stewardship Plan Signature Page

Professional Resource Consultant Certification: I have prepared (revised) this Forest Stewardship Plan. Resource Professionals have been consulted and/or provided input as appropriate during the preparation of this plan.

Prepared by: _____
Professional Resource Consultant's Name: Aileen Yeh

Professional Resource Consultant's Signature: _____

Date: _____

Applicant Certification: I have reviewed this Forest Stewardship Plan and hereby certify that I concur with the recommendations contained within. I agree that resource management activities implemented on the lands described shall be done so in a manner consistent with the practices recommended herein.

Prepared for: _____
Applicant's Name: Alan Everson

Applicant's Signature: Alan Everson

Date: 7/21/14

State Forester's Approval: This plan meets the criteria established for Forest Stewardship Plans by Hawaii's Forest Stewardship Advisory Committee. The practices recommended in the plan are eligible for funding according to state of Hawaii Forest Stewardship Program guidelines and administrative rules.

Approved by: Lisa J. Hadway
State Forester's Name: Lisa J. Hadway

State Forester's Signature: Lisa J. Hadway

Date: 8/18/14

Forest Stewardship Advisory Committee Approval: This plan was reviewed and approved by the Forest Stewardship Advisory Committee on January 24, 2014 - M. Kim SMO

II. Forest Stewardship Plan Signature Page

Professional Resource Consultant Certification. I have prepared (revised) this Forest Stewardship Plan. Resource Professionals have been consulted and/or provided input as appropriate during the preparation of this plan.

Prepared by: Aileen Yeh
Professional Resource Consultant's Name: Aileen Yeh

Professional Resource Consultant's Signature: Aileen Yeh

Date: July 21, 2014

Applicant Certification: I have reviewed this Forest Stewardship Plan and hereby certify that I concur with the recommendations contained within. I agree that resource management activities implemented on the lands described shall be done so in a manner consistent with the practices recommended herein.

Prepared for: _____
Applicant's Name: Alan Everson

Applicant's Signature: _____

Date: _____

State Forester's Approval: This plan meets the criteria established for Forest Stewardship Plans by Hawaii's Forest Stewardship Advisory Committee. The practices recommended in the plan are eligible for funding according to state of Hawaii Forest Stewardship Program guidelines and administrative rules.

Approved by: _____
State Forester's Name: Lisa J. Hadway

State Forester's Signature: _____

Date: _____

Forest Stewardship Advisory Committee Approval: This plan was reviewed and approved by the Forest Stewardship Advisory Committee on _____

III. Introduction

Project Vision and Goals The long term-vision and goals for the property are to reforest and mimic the native ecosystem (Tall Stature Wet Koa-Ohia/Hapuu Forest) that was present before the property was converted into pasture (appendix 1, 2). At present there are few native plant species on the property. It is dominated by various introduced grasses, eucalyptus, cypress, ironwood and the invasive black wattle. We plan to eradicate the wattle which is pervasive throughout the property and plant koa, ohia and other native plants. We would like to encourage native forest birds to repopulate, along with any other native species that might have inhabited the area, including the endangered Hawaiian hoary bat and Hawaiian hawk. We plan to generate income on the property through aquaponics and limited terrestrial agriculture. Although not a part of the Forest Stewardship project, the aquaculture and aquaponics will be mutually beneficial. Reforestation will provide stable groundcover to improve soil stabilization and protect the water quality of nearby gulches and streams.

Description of the project property or the land area to be managed

The property is located in the Āhualoa Homestead Subdivision at an elevation of 2530 to 2640 ft and is 19.8 acres in size (figures 1-3). Property address is 46-4085 Kahana Dr. Honokaa. Slope is approximately 6%. An unnamed gulch transects the length of the property and the nearest waterway is Kainapahoa Gulch. Although it is an intermittent gulch, it does convey water during rain events.

The house site and aquaponics will be staged on 1.8 of the 19.8 acres, reserving 18 acres for the re-forestation project (figure 3). The property consists of converted pasture with overall condition varying from poor condition to weedy. Existing vegetation consists of a mix of introduced tree species and shrubs. The property was actively managed as pasture within the past 100 years. The Andrade family raised cattle and horses up until the 1970's. Once the property was subdivided and sold, active pasture management was no longer utilized. Although horses grazed the property after this time, the new owners did not employ any methods to control weeds or rotate the pasture use, so the property degraded and the invasive black wattle quickly spread.

We plan to start year1 reforestation in Section 4B (fig. 3). This area is already devoid of large trees and other woody vegetation and consists primarily of various grass species. This will provide a good place to test planting and weed removal techniques, without requiring extensive wattle removal.

Natural resource concerns that have been identified for the entire property include (1) Noxious and invasive species, (2) Inadequate cover for wildlife, (3) Wildlife habitat fragmentation, (4) Damage to plantings from wind.

The project will benefit the public by providing native ecosystem and biodiversity restoration, watershed improvement/protection, native wildlife habitat enhancement, and educational, recreational or ecotourism opportunities

IV. Land and Resource Description

Existing vegetation/forest cover types

Overstory:

The dominant overstory trees consist of mainly non-native tree species (appendix 3). The only native tree species observed were 'ohi'a lehua (*Metrosideros polymorpha*) and hapu'u (*Cibotium sp.*). A few large, mature trees which are not considered invasive are clustered together in the center portion of the property and other areas. These trees are mainly Swamp mahogany (*Eucalyptus robusta*) and Sugi/Japanese red cedar (*Cryptomeria japonica*). One large, old cypress of unknown species and a few silk oak (*Grevillea robusta*) are also present in the lower area.

Other canopy trees which will be removed are Black wattle (*Acacia mearnsii*), and Australian Blackwood (*Acacia melanoxylon*). Black wattle is scattered throughout the parcel, but also forms thick clusters in many areas. Another noxious, Acacia (*melanoxylon*) is found in the lower (makai) area, and is recruiting by seed and from root suckers. Padang cinnamon (*Cinnamomum burmanii*) is also found on the property, with some small seedlings also coming up under larger trees and along the fence lines. Strawberry guava (*Psidium cattleianum*) grows thickly along the fence lines.



Photo 1. Typical vegetation with black wattle in the foreground

Photo 2. Eucalyptus stand

Understory:

A few wild olive saplings are found under the *Eucalyptus robusta* trees in the upper (mauka) area, and Night cestrum (*Cestrum nocturnum*) is common throughout the property mixed with other weedy species. Groundcover in open areas consists of a mix of kikuyu, wainaku and pangola grasses, which has been replaced by Hilo grass in over grazed areas. False mallow (*Malvastrum coromendelianum*) is prevalent and dense in the lower part of the property, near the northern boundary

Existing forest health and function, including any invasive species, chronic disease, insect, rodent and/or fire threats

Except for 'ohi'a lehua and hapu'u, no native forest trees exist on the property. Existing 'ohi'a trees are in good health, growing robustly. One 'ohi'a sapling is growing on a live, mature Eucalyptus tree in the lower area. Despite the lack of native species, Hawaiian hawks are present in the area. The invasive black wattle is present throughout the property. A few wattle were noted to be dead or dying. Natural mortality of black

Exhibit B

wattle may be caused by a pathogen. Other potential invasives include wild olive, silk oak and guava. No evidence of insect, rodent, or pig damage was observed on any plant species. No evidence of the presence of pigs was observed.

In December 2012, 50 koa seedlings were planted from dibble tubes obtained from the State tree nursery in Waimea. As of September of this year, about 90% of these have survived and many have grown over 2m in height.



Photo 3. Koa seedling planted Dec 2012



Photo 4. Hapu`u fern

Soils and their condition

Dominant soil types found on the property are Honokaa highly organic hydrous silty clay loam, 0 to 10 percent (~14.8 acres) and Honokaa highly organic hydrous silty clay loam, 10 to 20 percent slopes (~5 acres). See figure 4 for location information and full descriptions.

General slope and aspect

The property varies from 2530-2640 ft elevation over a distance of approximately 1800 ft, which translates to an average slope of approximately 6% (fig. 5)



Photo 5. Unnamed gulch

Water resources and their condition

Rainfall is approximately 80 inches per year (fig. 6). There are no permanent water resources located on the property. An unnamed gulch transects the length of the property, but remains dry except for periods of

Exhibit B

prolonged, heavy rainfall. The nearest named waterway is Kainapahoa Gulch; its two tributaries located just east and about .5 miles west of the property (fig. 7)

Timber resources

Although there are stands of mature eucalyptus, cypress and ironwood trees, these timber resources were never exploited and probably have limited commercial value. The black wattle makes excellent firewood and there is some potential to make this commercially available as the trees are removed.

Wetland resources

No wetland resources exist on the property.

Significant historic and cultural resources

Āhualoa, which is located several miles southeast of Honoka‘a, is a rural area originally settled by Portuguese and Japanese workers supporting the sugar plantation. Āhualoa also has a history of ranching, and was the site of a slaughterhouse that operated for a century before closing in 2008. Āhualoa was also the location for early plantings of coffee, which is still being grown there today.

The natural vegetation of this part of Hāmākua was most likely sub-montane rain forest dominated by ‘ōhi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*) (Gagne and Cuddihy 1990). These original communities, however, have been destroyed or heavily degraded by sugar cane cultivation, cattle grazing, and clearing for small farms and residences, and the vegetation of Āhualoa and Honoka‘a is now either managed vegetation (i.e., farms, pasture or landscaped grounds) or adventive “communities” of various alien weeds, with only small areas of remnant forest, mainly present in the upper areas of the Hāmākua coast.

It is likely that during precontact times the general area supported a forest canopy, perhaps interrupted in areas by long in linear dryland taro fields. The forest zone in Hāmākua was traditionally a location for collecting *wauke* and *mamaki* bark for fish nets and cloth, for bird catching to obtain feathers, and for harvesting koa canoe logs. Natural features such as caves as well as temporary open-air shelters were used as short-term habitations during resource extraction expeditions. Access to the upper forest areas would have been along repeatedly used trails, which may have left traces on the landscape.

A formal archeological survey has not been completed, but numerous, extensive site visits have not revealed any significant historic or cultural resources (source for all information in this section: Final EA: Āhualoa to Honoka‘a transmission waterline, August 2010).

Existing recreational and aesthetic values

The area was traditionally used as pasture, so it had little recreational or aesthetic value. It is anticipated that once reforestation is underway, the aesthetic value will increase and open up opportunities for the public to view the forest using a system of trails. These practices will be ongoing as the property is restored and are not included in the proposal.

Infrastructure and access conditions

At present property is vacant pasture with no existing infrastructure. As reforestation progresses, there are plans for access roads and trails to access the restoration areas. Eventually, this will include a water source and electrical power that will be constructed at the site to be utilized as restoration proceeds.

Existing wildlife

Kalij pheasant (*Lophura leucomelanos*) and wild turkeys (*Meleagris gallopavo*) are frequently observed on the property. Feral pigs (*Sus scrofa*) are also known to frequent the area, but have not been seen on the property, so their numbers are assumed to be low. None of these species are expected to impact the

Exhibit B

reforestation efforts, but selective fencing will be utilized to prevent damage to recently planted areas. At present, there are horses grazing on the property. The horses will be removed when the restoration begins.

Endangered species

Forests in this area are known habitat for the Hawaiian hoary bat (*Lasiurus cinereus*) and the Hawaiian hawk (*Buteo solitaries*). In addition, Blackburn's Sphinx moth (*Manduca blackburni*) and the Hawaiian owl (*Asio flammeus sandwichensis*) have also been observed in the surrounding area (refer to figure 8 for distribution information). Hawks have been seen on the property. Reforestation activities will promote the habitat for these species (appendix 4). We anticipate that once the forest is restored, many other endangered bird species found in this type of forest will return.

V. Management Objectives and Practices

The overall goal of the project is to convert the existing vegetation on the property (degraded pasture) to the native wet forest that existed before the property was turned into pasture. The property is dominated by the invasive black wattle *Acacia mearnsii*, which is pervasive throughout each management unit (appendix 5).

A major goal of the project will be to eradicate the wattle and other invasives including wild olive, silk oak, guava and establish a native overstory in each unit.

The specific management objectives include: (1) *Native species restoration and habitat improvement*, (2) *Wildlife habitat improvement-native birds*, (3) *Watershed protection and improvement* and (4) *Forest recreation enhancement*. We envision planting 1.8 acres a year for 10 years including periodic weeding and thinning, with ongoing maintenance after this planting period. Plantings will consist of a mix of native trees and shrubs based on recommendations from local forestry and native plant experts. Although rainfall in the area averages 80 inches per year, irrigation (hand watering) will be available for initial planting, if needed.

Table 1
Āhualoa Subdivisions
Conservation Plan Timetable

Year 1 - Section 4B

Management Practice – Fencing, tree and shrub establishment, weed control, tree and shrub site preparation, ground cover establishment, invasive species removal.

General plan is to remove black wattle and other invasives from these areas, plant windbreak species along the fence line, plant koa, ohia and other appropriate native trees. Trees will be planted in 10 x10 densities, approximately 40% koa, 40% ohia, 20% other species. Once trees are established (starting at around 3 years after planting), native shrubs, groundcover and other understory vegetation will be planted (see appendix I for recommended species). Invasive plant removal will be prioritized in these areas, but will also take place in other areas if the opportunity exists. Fences to keep out feral ungulates from planting area will be used on an as needed basis. Feral pigs have been observed in the project area, but they are not present in large numbers and aren't expected to significantly negatively impact the project. Other feral ungulates are not present; managed livestock will be excluded from planting areas. Maintenance of established areas (weed control, thinning, and invasive species removal) will also be undertaken on a regular basis after the initial planting. Each Section is approximately 1.8 acres.

Year 2 - Section 3B

Year 3 - Section 1B

Year 4 - Section 1A

Year 5 - Section 2A

Year 6 - Section 2B

Year 7 - Section 3A

Year 8 - Section 4A

Year 9 - Section 5A

Year 10 - Section 5B

Management Practice – Fencing, tree and shrub establishment, weed control, tree and shrub site preparation, wood residue treatment, mulching, ground cover establishment, invasive species removal.

Continue preparation and planting as in Year 1. Evaluate each year's results and modify as necessary.

Management practices that we will employ include Tree and Shrub Site Preparation, Fencing, Nutrient Management, Tree and Shrub Establishment, Ground Cover Establishment, Irrigation, Mulching, Thinning, Weed Control, Windbreak, Monitoring and Maintenance. Table below gives an overview of practices and estimated costs.

Tree and Shrub Site Preparation

Pre-plant site preparation will include mowing or weed whacking, as necessary and/or removal of invasive woody plants to facilitate planting of desirable species. Large areas of exposed soils will be avoided to prevent erosion and further spread of non-native weedy species.

If removal of brush is done by machine and there is soil disturbance, sowing of a low growing groundcover grass or legume such as clover or birdsfoot trefoil will be done to prevent the soil from being exposed, and to keep other weeds from establishing.

Prior to planting in grassy areas, a broad spectrum herbicide such as glyphosate will be used as a chemical control to kill weedy species following label recommendations. Grass residue will be left in place to serve as mulch. An initial spraying will be done at least two months prior to planting, with a follow up spray to control any regrowth at least two weeks prior to planting. Weed control will be implemented in late summer/fall, prior to the winter wet season.

Depending on the size and target species, woody tree species will be treated via a combination of

Exhibit B

cut stump, basal bark spray, foliar, and herbicide incision point injection application. For larger woody species, trees and saplings we will explore the use of triclopyr, glyphosate, Streamline and Milestone applied to cut surfaces (basal bark treatments and girdling (stripping the bark) combined with chemical applications).

Tree and Shrub Establishment

An auger and shovel will be used to create individual holes for planting, which minimizes the area of exposed soil and reduces effort needed to plant. Plants will be obtained in dibble tubes and nursery pots. The larger potted plants will require more extensive site preparation, so emphasis will be placed on obtaining dibble tubes whenever possible. Hand weeding will be used initially to suppress weed growth. Mulch will be obtained by chipping the larger, removed woody species and will be incorporated into the weed control regime. We will also explore the use of rubber tree rings and weed suppressing blankets to control weeds. Once the tree over-story is established, the shrubs and ferns will be added to each management unit at approximately 3 years after initial planting.

We will plant a combination of native trees, shrubs and ferns. During year 1, we will use a combination of planting, mulching, and fertilizing techniques to determine the best, most cost effective methods to be used in future plantings. We will use only approved organic fertilizers recommended for a particular plant species. Soil will be tested prior to planting to determine what nutrients will be needed. Thinning of existing plantings will be performed as needed to maximize tree growth and will probably begin after year 2 depending on the growth rate of the planted trees. Dominant tree species for this type of forest ohia lehua (*Metrosideros polymorpha*) and koa (*Acacia koa*). Optimal spacing for each individual planting location will be determined prior to project implementation in consultation with a professional forester familiar with the area, but trees will generally be planted at 10 x 10 spacing. Understory species will be planted around year 3, once adequate overstory has been established at 20 x 20 spacing. See appendices 1 and 2 for a full list of plant species and suggested densities that will be used.

Fencing

Fencing will be utilized on an as needed basis. The perimeter of the property is fenced with barbed wire cattle fencing. This will exclude large managed and feral ungulates. Although wild pigs have been seen in the area, their numbers are thought to be fairly low. If fencing is determined to be necessary after initial clearing and planting, the appropriate fencing will be added around the entire perimeter. Material and construction of the fencing will be per the *PIA-NRCS 382-Fence Specification*. Special consideration will be made to ensure the top wire of the fence is smooth to prevent injury to Hawaiian bats.

Irrigation

Although it is not anticipated that supplemental irrigation will be necessary, plant condition will be monitored on a regular basis and hand watering will be used as needed.

Weed Control

This includes controlling weeds in areas that have been planted to ensure that weeds do not out compete the native plantings. Hand weeding, as well as selective herbicides will be used.

Monitoring and Maintenance

Monitoring will take place on a monthly basis to ensure optimum growth, to track success of different planting methods, perform weed removal and to check for the presence of disease and predators. Although the area receives fairly abundant rainfall, initial plantings will be hand watered and closely monitored to determine if additional watering is necessary during the dry season or periods of drought. Active maintenance will begin in year 3. It is expected that the need for maintenance will increase as plants become established. This is noted in the budget table.

VI. Practice Implementation Schedule

Practice Component YEAR 1 & 2 (Unit 4B and 3B)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimated CREP Cost- Share
Tree and Shrub Site Preparation	3.6	1000	3.6	3600	1800		1800
Fence	18	\$7/ft	4000ft	28000	14000	14000	
Nutrient Management	3.6	200	3.6	720	360		360
Tree and Shrub Establishment	3.6	3.76	4,356 plants	16378.56	8189.28		8189.28
Irrigation		Labor for hand watering		500	250	250	
Mulching	3.6	55.56	3.6	200.016	100.008	100.008	
Weed Control	3.6	200	3.6	720	360		360
Monitoring and Maintenance	3.6	50	3.6	180	90	90	
TOTALS				\$50,299	\$25,149	\$14,440	\$10,709

Sections 1B-5B will require additional funds for weed control and monitoring/maintenance as subsequent sections are planted. Weed control may decrease in cost as the forest canopy is established.

Practice Component YEAR 3 (Unit 1B)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000	1.8	1800	900		900
Nutrient Management	1.8	200	1.8	360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	5.4	200	5.4	1080	540	360	180
Monitoring and Maintenance	5.4	50	5.4	270	135	135	
TOTALS				\$11,472	\$5,736	\$745	\$4,991

Practice Component YEAR 4 (Unit 1A)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000	1.8	1800	900		900
Nutrient Management	1.8	200	1.8	360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	7.2	200	7.2	1440	720	540	180
Monitoring and Maintenance	7.2	50	7.2	360	180	180	
TOTALS				\$11,922	\$5,961	\$970	\$4,991

Exhibit B

Practice Component YEAR 5 (Unit 2A)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	3.6	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	7.2	200	7.2	1440	720	540	180
Monitoring and Maintenance	9	50	9	450	225	225	
TOTALS				\$12,372	\$6,186	\$1,195	\$4,991

Practice Component YEAR 6 (Unit 2B)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	1.8	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	5.4	200	5.4	1080	540	360	180
Monitoring and Maintenance	10.8	50	10.8	540	270	270	
TOTALS				\$12,102	\$6,051	\$1,060	\$4,991

Practice Component YEAR 7 (Unit 3A)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	1.8	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	3.6	200	3.6	720	360	180	180
Thinning	1.8	200		360	180	180	
Monitoring and Maintenance	12.6	50	12.6	630	315	315	
TOTALS				\$12,192	\$6,096	\$1,105	\$4,991

Exhibit B

Practice Component YEAR 8 (Unit 4A)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	1.8	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	3.6	200	3.6	720	360	180	180
Thinning	1.8	200		360	180	180	
Monitoring and Maintenance	14.4	50	14.4	720	360	360	
TOTALS				\$12,282	\$6,141	\$1,150	\$4,991

Practice Component YEAR 9 (Unit 5A)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	1.8	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	1.8	200	1.8	360	180		180
Thinning	1.8	200		360	180	180	
Monitoring and Maintenance	16.2	50	16.2	810	405	405	
TOTALS				\$12,012	\$6,006	\$1,015	\$4,991

Practice Component YEAR 10 (Unit 5B)	Acres	Cost/Mgmt Unit	Frequency or # of acres	Actual Total Cost	Estimated Landowner Cost-share	Estimated FSP Cost- share	Estimate d CREP Cost- Share
Tree and Shrub Site Preparation	1.8	1000		1800	900		900
Nutrient Management	1.8	200		360	180		180
Irrigation	1.8	labor hand watering		500	250	250	
Tree and Shrub Establishment	1.8	3.76	1570 plants	5903.2	2951.6		2951.6
Groundcover Establishment	1.8	200		360	180	180	
Tree and Shrub Establishment: Mid-story planting	1.8	3.76	388 plants	1458.88	729.44		729.44
Mulching	1.8	55.56	1.8	100	50		50
Weed Control	1.8	200	1.8	360	180		180
Thinning	1.8	200		360	180	180	
Monitoring and Maintenance	18	50	18	900	450	450	
TOTALS				\$12,102	\$6,051	\$1,060	\$4,991

Exhibit B

VII. Budget Summary

YEAR	Total Budget	Landowner Share	FSP Share	CREP share
Year 1 & 2	\$50,299	\$25,149	\$14,440	\$10,709
Year 3	\$11,472	\$5,736	\$745	\$4,991
Year 4	\$11,922	\$5,961	\$970	\$4,991
Year 5	\$12,372	\$6,186	\$1,195	\$4,991
Year 6	\$12,102	\$6,051	\$1,060	\$4,991
Year 7	\$12,192	\$6,096	\$1,105	\$4,991
Year 8	\$12,282	\$6,141	\$1,150	\$4,991
Year 9	\$12,012	\$6,006	\$1,015	\$4,991
Year 10	\$12,102	\$6,051	\$1,060	\$4,991
TOTALS	\$146,755	\$73,378	\$22,740	\$50,638

VIII. Required Maps



Figure 1. Map of project site showing location on Hawaii Island

Exhibit B

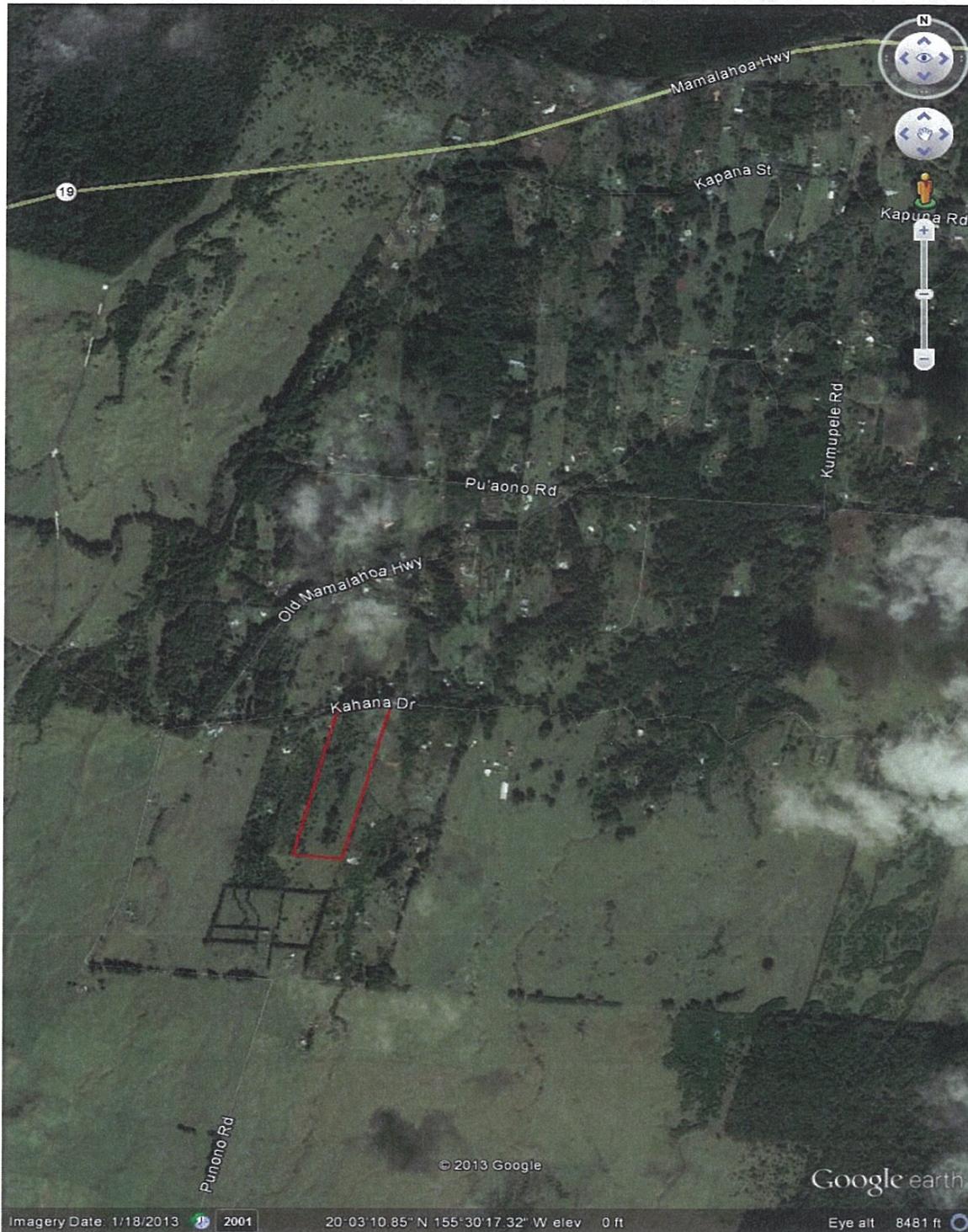


Figure 2. Map of project site showing location off Kahana Dr. Honokaa, HI.
(Project site outlined in red)

Exhibit B

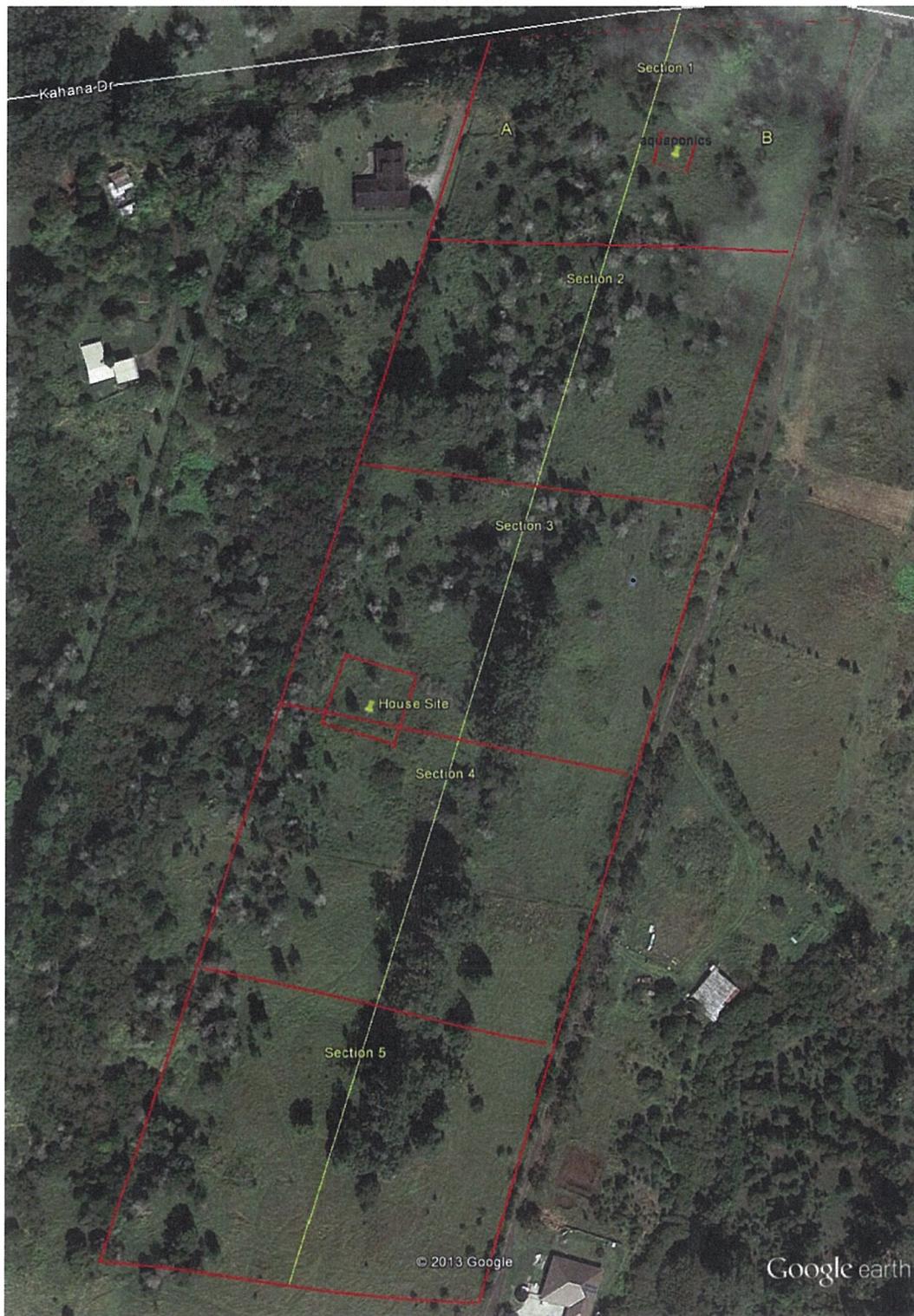


Figure3. Map of project site showing various management units, house site and aquaponics.

Exhibit B

TMK # 3-4-8-009:102

Assisted by S. Jill Ficke-Beato

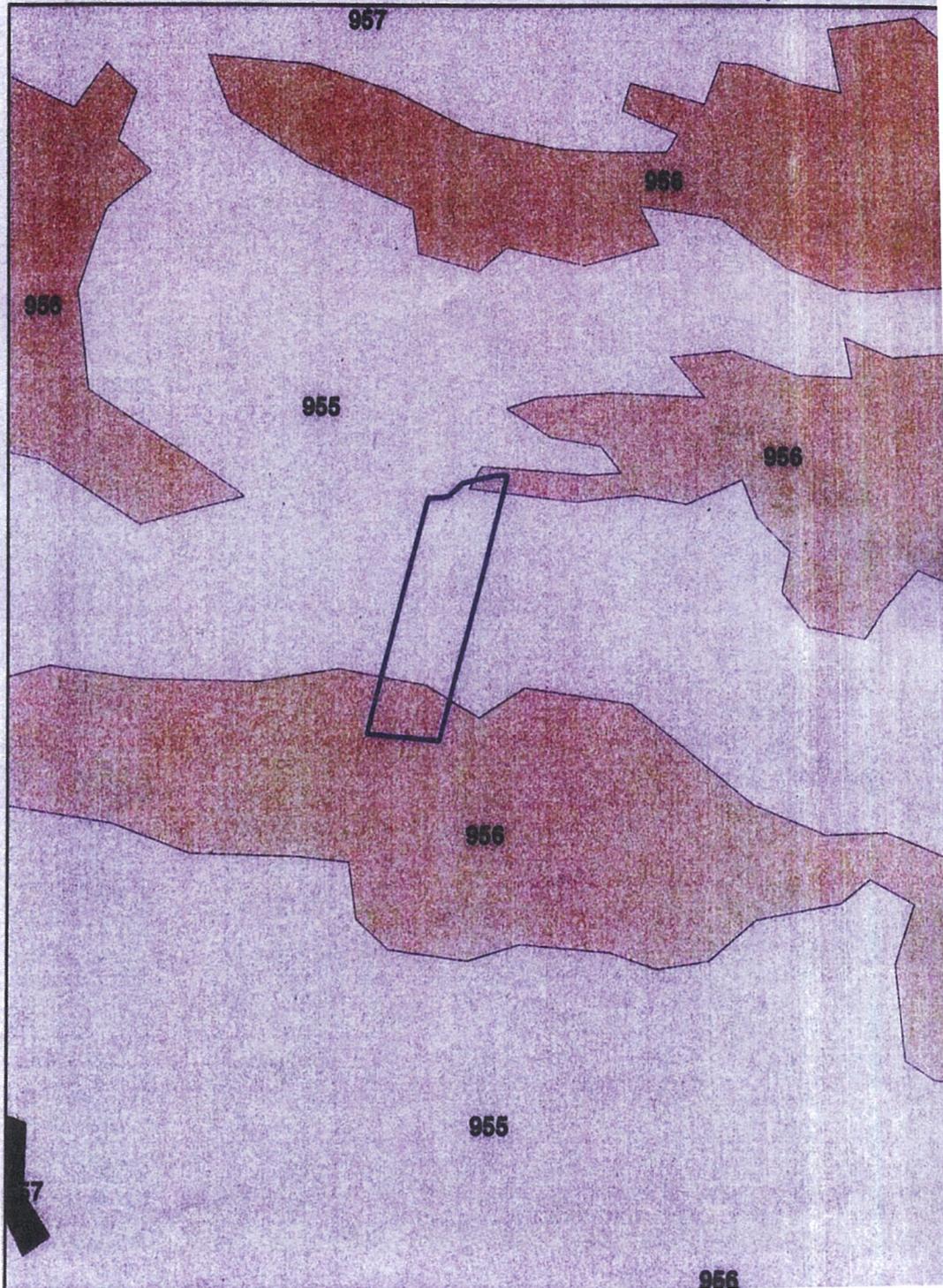


Figure 4. Soils map and descriptions

Exhibit B

955 Honokaa highly organic hydrous silty clay loam, 0 to 10 percent

Setting

Landscape: Islands, shield volcanoes
Elevation: 2100 to 4000 feet
Mean annual precipitation: 79 to 150 inches
Mean annual air temperature: 61 to 68 degrees F
Frost-free period: 365 to 365 days

Composition

Honokaa and similar soils: 85 percent
Minor components: 15 percent

Description of Honokaa

Setting

Landform: Ash fields on lava flows
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Down-slope shape: Linear
Across-slope shape: Convex, linear
Parent material: Basic volcanic ash

Properties and Qualities

Slope: 0 to 10 percent
Surface area covered with stones and boulders: 4.0 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.57 to 1.98 in/hr)
Calcium carbonate maximum: 0 percent
Gypsum maximum: 0 percent
Available water capacity: Very high (about 18.0 inches)

Interpretive Groups

Land capability classification (irrigated): 3e
Land capability (non irrigated): 3e
Ecological site: Acacia koa Metrosideros polymo (F159AY500HI)

Typical Profile

0 to 7 inches: highly organic hydrous silty clay loam
7 to 25 inches: hydrous silty clay loam
25 to 28 inches: hydrous silty clay loam
28 to 65 inches: hydrous silty clay loam

Minor Components

Honokaa, gullies soils

Percent of map unit 8 percent
Landform: Ash fields, gullies
Down-slope shape: Linear
Across-slope shape: Concave, convex, linear

Rock outcrop, basalt

Percent of map unit 5 percent
Landform: Gulches
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across slope shape: Concave, convex, linear

Akaka soils

Percent of map unit 2 percent
Landform: Ash fields on lava flows
Landform position (two dimensional): Backslope, toeslope
Down-slope shape: Linear
Across-slope shape: Convex, linear



Exhibit B

956 Honokaa highly organic hydrous silty clay loam, 10 to 20 percent slopes

Setting

Landscape: Islands, shield volcanoes
Elevation: 2100 to 4000 feet
Mean annual precipitation: 79 to 150 inches
Mean annual air temperature: 61 to 68 degrees F
Frost-free period: 365 to 365 days

Composition

Honokaa and similar soils: 85 percent
Minor components: 15 percent

Description of Honokaa

Setting

Landform: Ash fields on lava flows
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Down-slope shape: Linear
Across-slope shape: Convex, linear
Parent material: Basic volcanic ash

Properties and Qualities

Slope: 10 to 20 percent
Surface area covered with stones and boulders: 4.0 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.57 to $\bar{1}$.98 in/hr)
Calcium carbonate maximum: 0 percent
Gypsum maximum: 0 percent
Available water capacity: Very high (about 18.0 inches)

Interpretive Groups

Land capability classification (irrigated): 4e
Land capability (non irrigated): 4e
Ecological site: Acacia koa-Metrosideros polymo (F159AY500HI)

Typical Profile

0 to 7 inches: highly organic hydrous silty clay loam
7 to 25 inches: hydrous silty clay loam
25 to 28 inches: hydrous silty clay loam
28 to 65 inches: hydrous silty clay loam

Minor Components

Honokaa, gullies soils
Percent of map unit: 8 percent
landform: Ash fields, gullies
Down-slope shape: Linear
Across-slope shape: Concave, convex, linear

Rock outcrop, basalt

Percent of map unit: 5 percent
Landform: Gulches
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Concave, convex, linear

Akaka soils

Percent of map unit: 2 percent
landform: Ash fields on lava flows
Landform position (two-dimensional): Backslope, footslope, toeslope
Down-slope shape: Linear
Across-slope shape: Convex, linear



Exhibit B

Detailed Soil Map Units

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description indicates the composition of the map unit and selected properties of the components of the unit.

Soils that have profiles that are almost alike make up a "soil series." Except for differences in texture of the surface layer, all the soils of a series have *major* horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into "soil phases." Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A "complex" consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An "association" is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An "undifferentiated group" is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include "miscellaneous areas." Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Additional information about the map units described in this report is available in other Soil Data Mart

reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.



Exhibit B

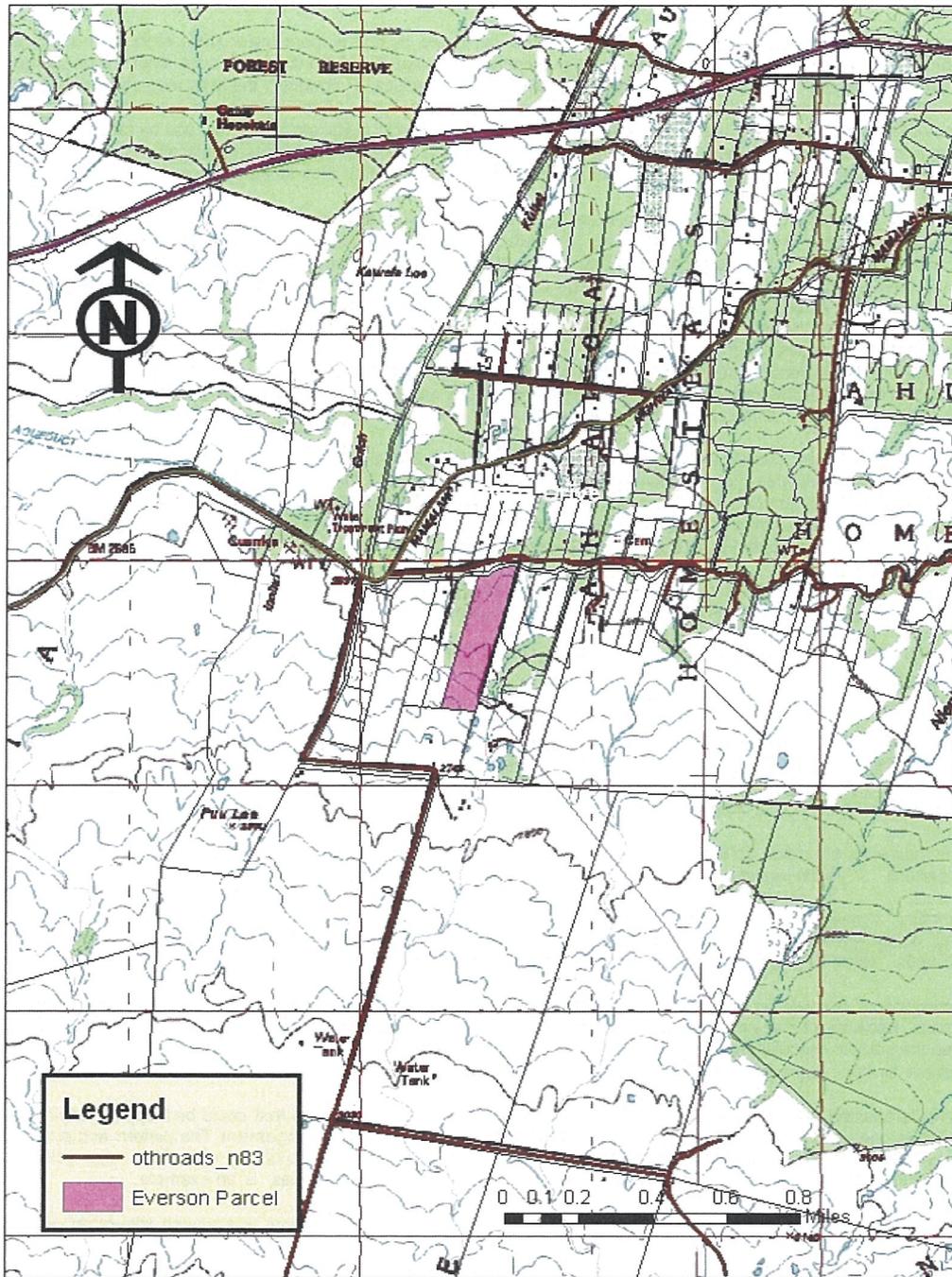


Figure 5. Topographic map of project area

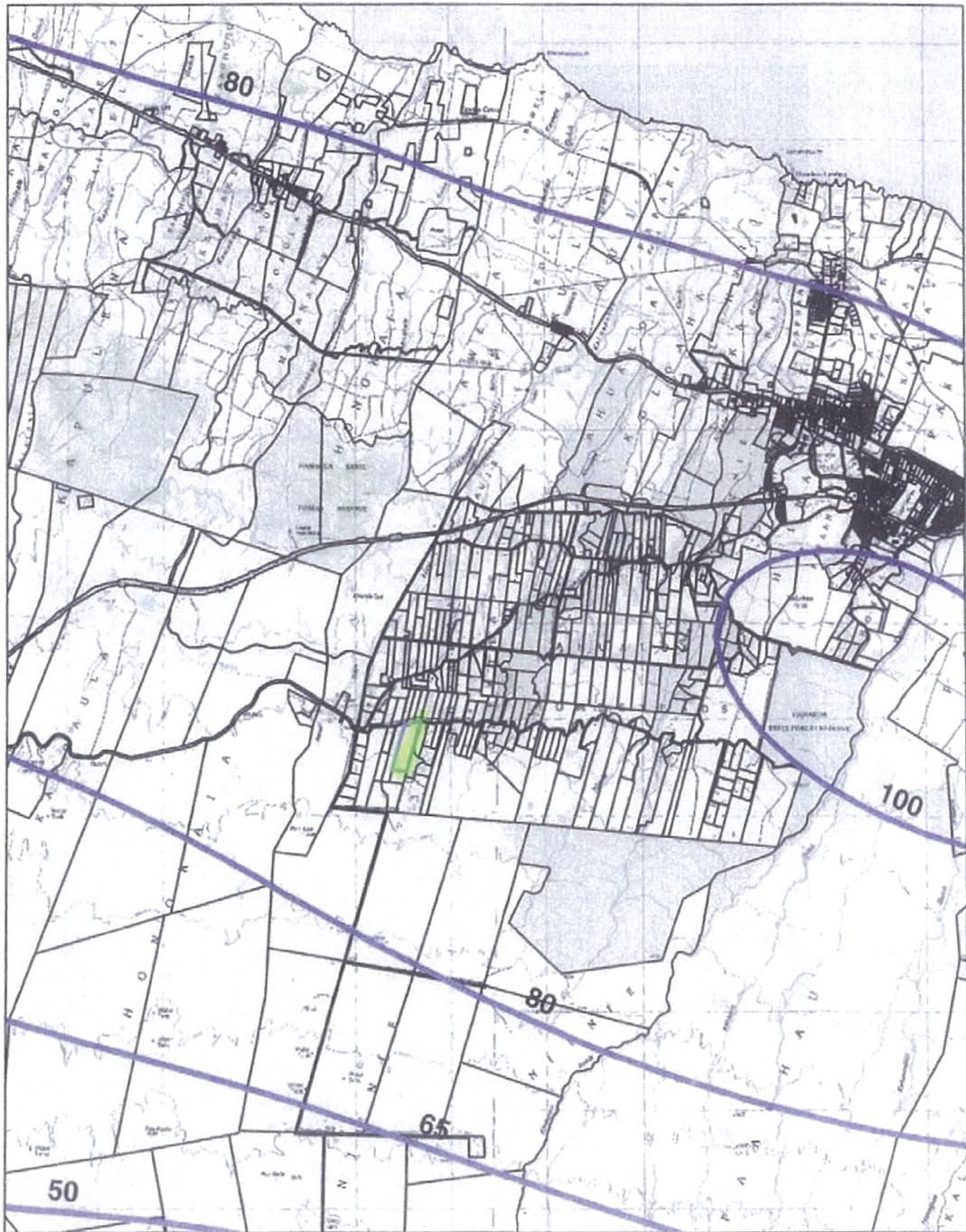


Figure 6. Average rainfall in project area

Exhibit B

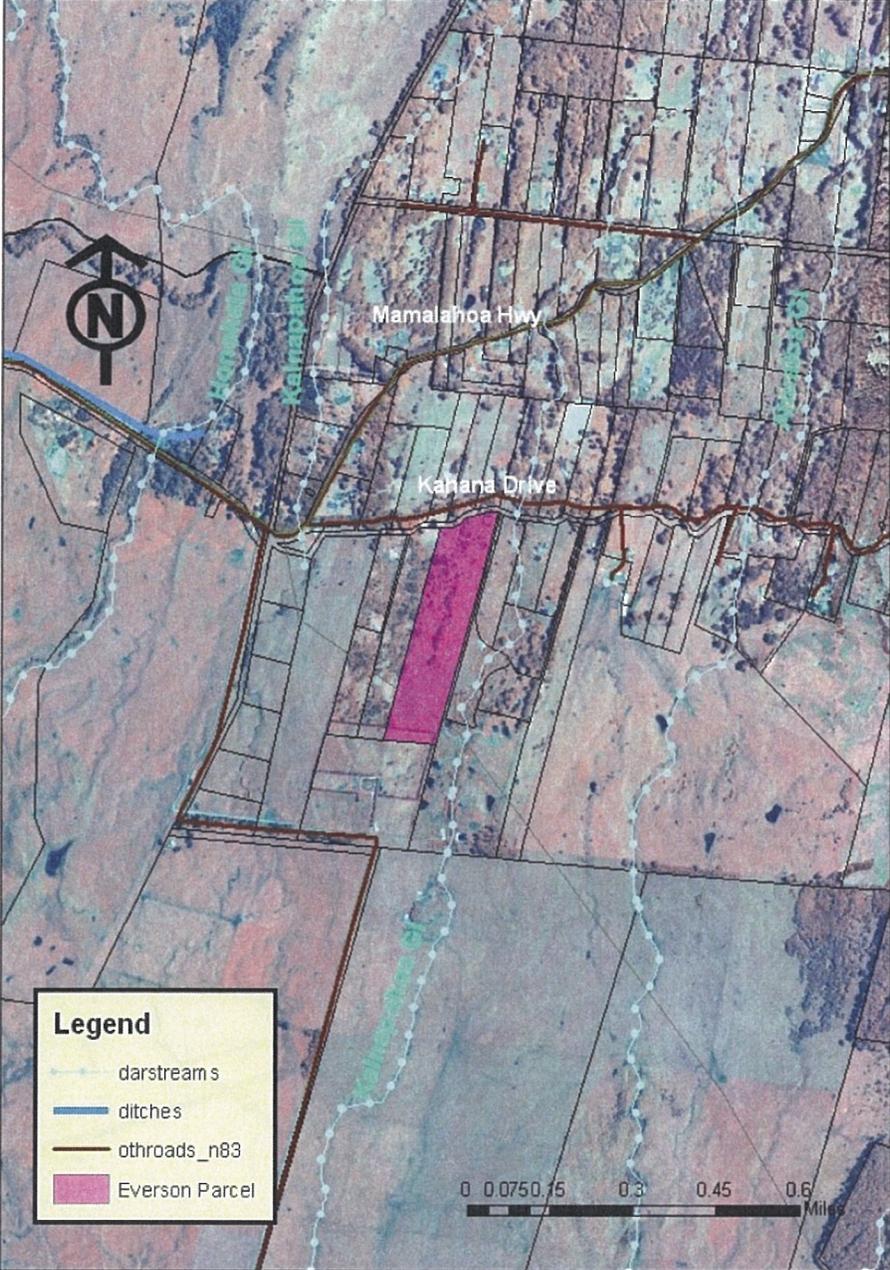


Figure 7. Waterways located in the project vicinity

Exhibit B

TMK # 3-4-6-009:102

Assisted by S. Jill Ficke-Beator

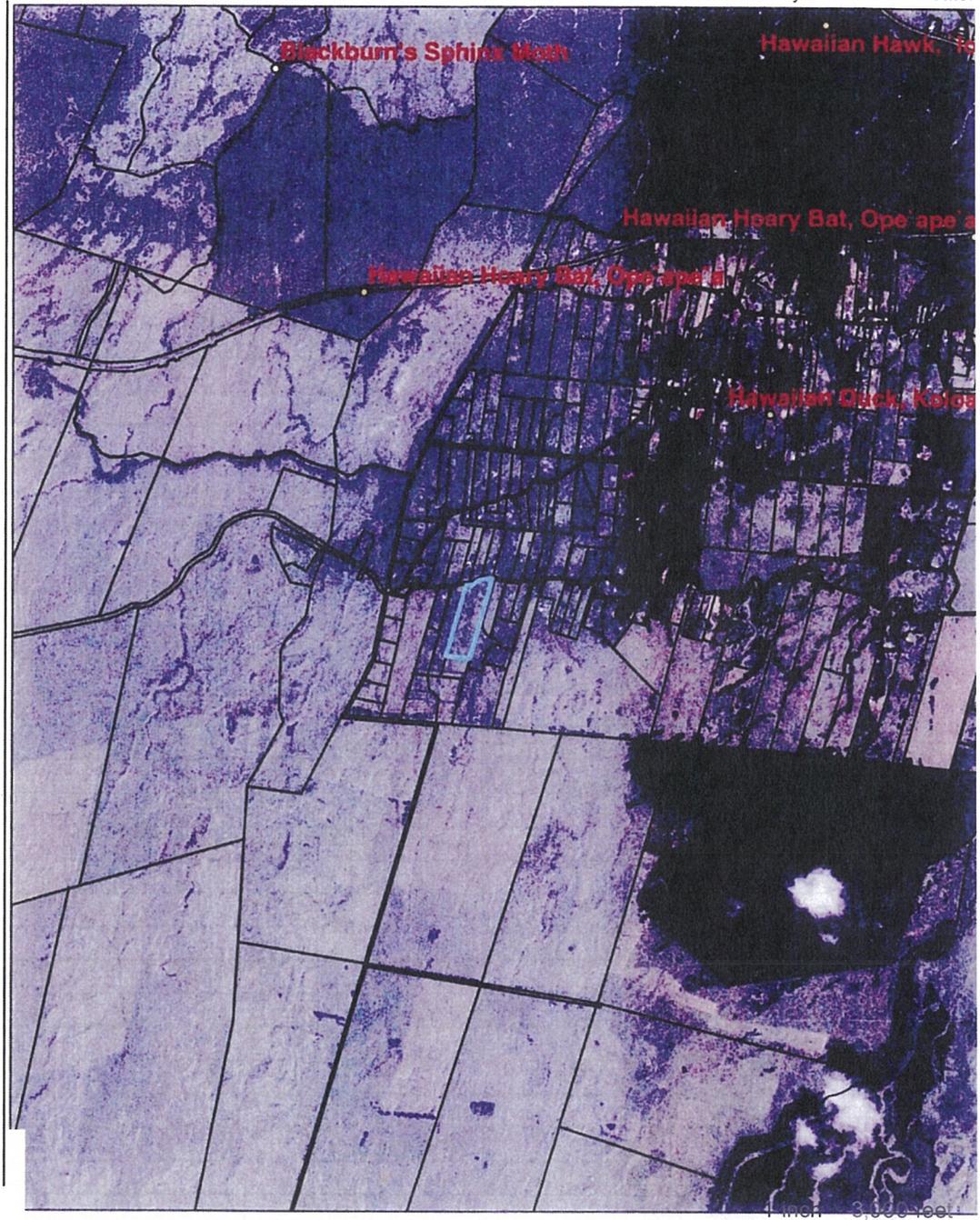


Figure 8. Map of Threatened and Endangered Species in project area.

Exhibit B

Appendix 1

Species recommendations for Hamakua (ESD F159AY500HI Tall Stature Wet Koa-Ohia-
Prepared for current and prospective CREP clients

Plant Type and Scientific Name	Common Name	% of total plants
Trees	77	
Acacia koa	koa	12
Acacia koaia		1
Antidesma platyphyllum	hame	1
Antidesma pulvinatum	hame	1
Cheirodendron trigynum	olapa	6
Cibotium glaucum or menziesii	hapuu	1
Cibotium chamissoi	hapuu	1
Coprosma rhynchocarpa	pilo	6
Hedyotis terminalis	manono	1
Ilex anomala	kawau	6
Metrosideros polymorpha	ohia	15
Myrsine sandwicensis	kolea lau lii	1
Myrsine lessertiana	kolea lau nui	6
Perrottetia sandwicensis	olomea	1
Pisonia brunoniana	pāpala kēpau	3
Pisonia umbellifera	pāpala kēpau	3
Pittosporum hosmeri	hoawa	1
Pritchardia lanigera	loulu	1
Pritchardia beccariana	loulu	1
Psychotria hawaiiensis or mauiensis	kopiko	1
Psydrax odorata	alahee	5
Rauvolfia sandwicensis	hao	1
Santalum paniculatum	sandalwood	1
Sapindus saponaria	a`e	1
Shrubs	20	
Broussaisia arguta	kanawao	1
Cyrtandra platyphylla	kanawao	1
Dodonaea viscosa	aalii	5
Hibiscus kokio subsp. kokio		1
Nototrichium sandwicense	kulu`i	1
Osteomeles anthyllidifolia	`ūlei	1
Pipturus albidus	mamaki	5
Rhus sandwicense	neneleau	1
Sadleria cyatheoides (fern)	amau	1
Scaevola chamissoniana	mountain naupaka	1

Exhibit B

Wikstroemia sandwicensis	`ākia	1
Vaccinium calycinum	ohelo	1
Rubus hawaiiensis	akala	1
Vines		3
Alyxia oliviformis	maile	1
Cocculus orbiculatus	huehue	1
Stenogyne calaminthoides	mint	1
Total percent:		100

Appendix 2

Ecological Site Description

ECOLOGICAL SITE CHARACTERISTICS

Site Identification

Site Type: Forestland	Site ID: F159AY500HI	MLRA: 159A
Colloquial Site Name: Tall Stature Wet Koa – Ohia/Hapu`u Forest		
Official Site Name: <i>Acacia koa-Metrosideros polymorpha/Cibotium menziesii/Freycesnetia arborea</i>		

Soils data from 1973 survey pending new soil survey.

Physiographic Features

This ecological site occurs on volcanic ash flows on sloping mountainsides of shield volcanoes. Ash flows range from deep to very deep on the underlying lava.

Landform: (1) volcanic ash flow Landform: (2) Landform: (3)	Minimum	Maximum
Elevation (feet):	1200	6400
Slope (percent):	0	35
Water Table Depth (inches):	--	--
Flooding: Frequency:	none	none
Duration:	--	--
Ponding: Depth (inches):	--	--
Frequency:	--	--
Duration:	--	--
Runoff Class:	low	medium
Aspect: (1) E Aspect: (2) N		

Climatic Features

Average annual precipitation ranges from 50 to 140 inches. Most of the precipitation falls from November through April, with April being the wettest month. Average annual temperature ranges from 54 to 71 degrees F. The climate generally can be classified as udic and tropical in nature.

Climate chart

	Minimum	Maximum
Frost Free Period (days):	365	365
Freeze Free Period (days):	365	365
Mean Annual Precipitation (inches):	50	140

Monthly Precipitation (inches) and Temperature (°F)												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Avg.	14.0	19.0	21.2	22.8	17.4	9.7	15.1	18.3	10.5	15.5	21.2	21.1
Temp. Max.	73.1	72.6	72.7	73.4	74.2	75.9	76.3	76.9	77.6	77.0	75.4	72.9
Temp. Min.	60.7	59.7	60.1	61.4	62.4	63.7	64.3	65.2	64.6	64.2	63.1	61.3
Climate Station: (1)	Honomu Mauka 138, 1949-1978											

Influencing Water Features

This ecological site contains perennial streams in very deep, steep-sided gulches. The sides and bottoms of these gulches are dominated by alien trees, particularly African tulip tree (*Spathodea campanulata*), Alexandrian palm (*Archontophoenix alexandrae*), kukui (*Aleurites moluccana*), and gunpowder tree (*Trema orientale*).

Representative Soil Features

Typical soils are deep to very deep basic volcanic ash deposited over `a`a lava or pahoehoe lava. Landscape surfaces in this ecological site are 11,000 to 300,000 years old. Soils are moderately well or well drained. Available water capacity ranges from x to x inches. Available water capacity refers to the volume of water available to plants in the upper 40 inches of soil, including rocks, at field capacity. Permeability is moderately rapid to rapid. Runoff potential ranges from low to moderate. Moist surface colors range from dark reddish brown to very dark brown. Soil reactions (pH in CaCl₂) range from slightly to extremely acid in surface horizons and slightly to extremely acid in subsurface horizons. Soil temperature regimes are isothermic. Soil moisture regimes are udic (soil moisture control section is not dry in any part for as long as 90 cumulative days in normal years).

Predominant Parent Materials: basic volcanic ash Kind: deposited over `a`a lava or pahoehoe lava Origin:	Surface Texture: (1) silt loam Surface Texture: (2) silty clay loam Subsurface Texture Group: --	
Surface Fragments <=3" (%Cover): 0-10 Surface Fragments >3" (%Cover): 0-10	Rock Fragments <=3" (%Volume):0-10 Rock Fragments >3" (%Volume): 0-10	
Drainage Class: moderately well to well	Permeability Class: moderately rapid to rapid	
	Minimum	Maximum
Depth (inches):	50	>60
Electrical Conductivity (mmhos/cm):	0	2
Sodium Adsorption Ratio:	0	0
Calcium Carbonate Equivalent (percent):	0	0
Soil Reaction (1:1 Water):		
Soil Reaction (.0-1M CaCl ₂):		
Available Water Capacity (inches):		

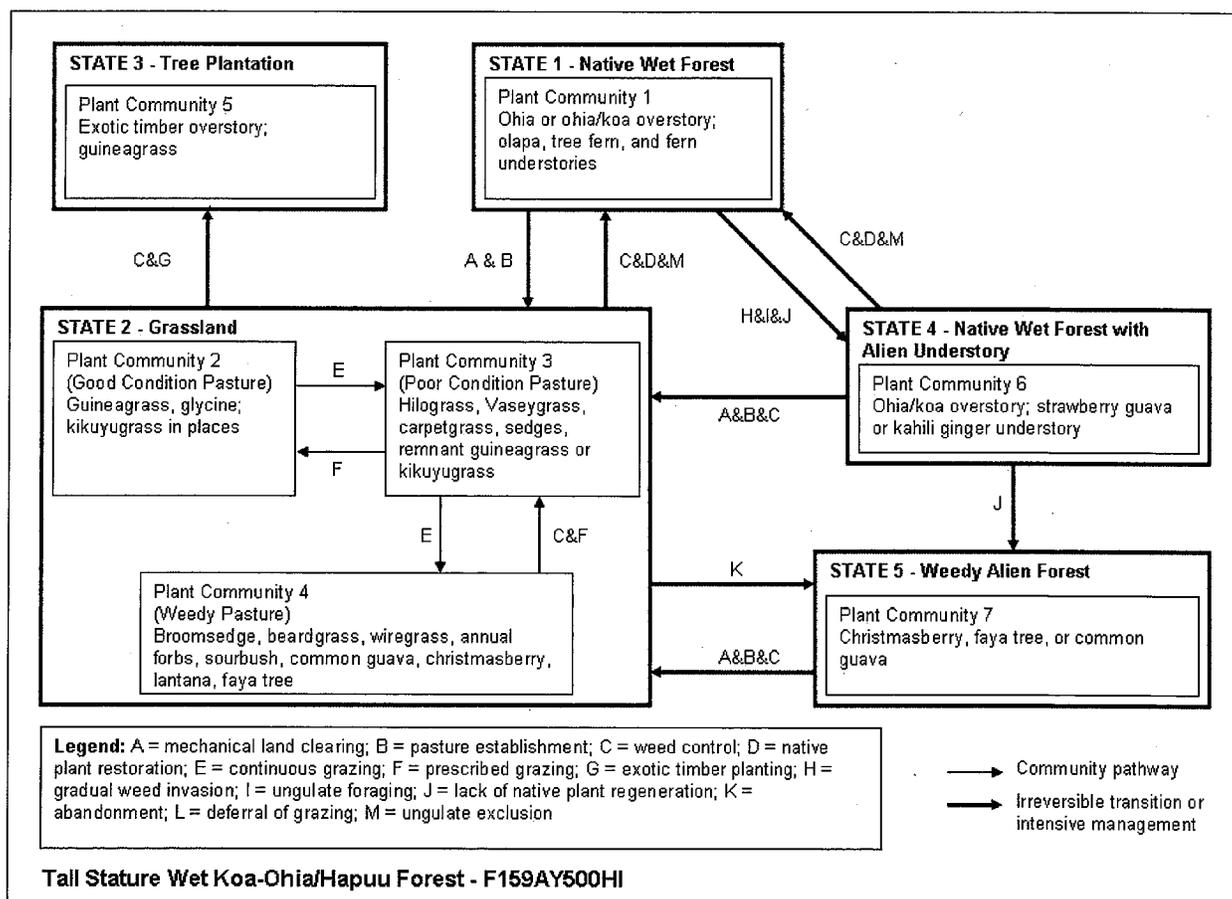
PLANT COMMUNITIES

Ecological Dynamics of the Site

This ecological site occurs on a soils formed in volcanic ash in warm, moist to wet regions of Hamakua, North Hilo,

and South Hilo Districts of the Island of Hawai'i. Plant communities evolved without the presence of large mammals or the regular occurrence of fires. Much of the original forest area remains as native forest. However, the native plant community has disturbed and, in some areas, removed due to agriculture, urban development, establishment of exotic timber trees, domestic and feral ungulate foraging, and alien species invasion. Foraging by cattle, pigs, and/or goats, or clearing and abandonment accelerate invasion by alien weeds. However, alien weeds appear able to successfully invade native stands regardless of human or ungulate disturbances. Major weeds include strawberry guava, christmasberry, kahili ginger, and alien grasses. Guineagrass and kikuyugrass pastures become infested with unpalatable grasses and shrubs under conditions of improper pasture and grazing management.

State and transition diagram



State 1 – Native Wet Forest

Plant Community 1

This state represents the Historic Climax Plant Community. The general aspect is a forest of tall overstory with an open or closed upper canopy of ohia or ohia and koa trees up to 100 feet tall, a secondary canopy of diverse trees species 30 to 60 feet tall, a dense tree fern canopy 10 to 30 feet tall, and a diverse understory of shrubs and ferns. Vines are common both on the ground and on trees. All three Big Island tree fern species are present; they frequently have very tall trunks. These forests have standing live timber of 800 to 5700 cubic feet per acre, with a representative value of about 3000 cubic feet per acre. Typical low values are about 1500 cubic feet per acre.

Overstory tree canopy cover of ohia and koa can vary from about 10% to 80%. However, understory composition is controlled by the cover of the secondary canopy of medium-stature, secondary canopy tree species and especially by the cover of tree ferns, which is usually in the range of 60% to 90%. Koa and ohia do not reproduce successfully in the typically shady understory of intact Native Wet Forest. Tree ferns, medium-stature trees such as olapa, kopiko, kolea lau nui, kawa'u, hame, and olomea, and shrubs such as kanawao and clermontia reproduce well in the understory. The ground layer of small ferns is typically very dense when ungulates are not present.

The dominant tree canopy can be ohia trees or a combination of ohia and koa trees. We were unable to discern any consistent correlation between dominant tree canopy composition and soil type, rainfall, elevation, or any other environmental variable (PENDING NEW SOIL SURVEY OF THE HAMAKUA AREA). It is probable that long-term disturbance history controls koa occurrence. Koa is a fast growing, opportunistic species that is able to take advantage of temporary openings in the dense forest canopy.

Pathways from this state/plant community

To State 2, Grassland, via "A and B":

A = mechanical land clearing; B = pasture establishment.

Native Forest can be converted to Grassland by clearing the forest with heavy machinery; most pastures in this ecological site were originally cultivated for sugar cane and later converted to pasture. At higher, cooler elevations kikuyugrass and/or pangolagrass have been planted. At lower elevations where pastures are on old sugarcane plantations, guineagrass (a former weed in the plantations) has volunteered.

To State 4, Native Wet Forest with Alien Understory, via "H&I&J":

H = gradual weed invasion; I = ungulate foraging; J = lack of native plant regeneration.

Native Forest can convert to Native Forest with Alien Understory by gradual replacement of the understory by alien shrubs, vines, and small trees that outcompete the native understory species. This process is accelerated by ungulate foraging that disturbs the soil surface and directly destroys native plants and prevents their regeneration.

Plant species listed in the following tables have been observed in the course of field work or are derived from reliable records.

Abbreviations:

Origin: n = native (endemic or indigenous); a = alien (introduced by humans).

Type: t = tree; tf = tree fern; s = shrub; h = herb (forb); v = vine; f = fern; g = grasslike (grasses, sedges, rushes).

Composite representation of State 1, Plant Community 1, Native Wet Forest.

Scientific name	%Canopy cover by height class (ft)						Total Cover	Local common name	NRCS common name	Origin	Type	NRCS Code
	0.1 - 2	2.1 - 4.5	4.6 - 13	13.1 - 40	40.1 - 80	80.1 - 120						
<i>Metrosideros polymorpha</i>	tr	tr	tr	tr	20	1	20	'ohi'a lehua	'ohi'a lehua	n	t	MEPO5
<i>Acacia koa</i>	tr	tr	tr	tr	20	1	20	koa	koa	n	t	ACKO
<i>Cheirodendron trigynum</i>	1	1	1	5	1		10	olapa	olapalapa	n	t	CHTR2
<i>Perrottetia sandwicensis</i>	tr	tr	1	1			1	olomea	olomea	n	t	PESA3
<i>Ilex anomala</i>	tr	tr	1	1	tr		1	kawa'u	Hawai'i holly	n	t	ILAN
<i>Myrsine lessertiana</i>	tr	tr	1	5			5	kolea lau nui	kolea lau nui	n	t	MYLE2
<i>Psychotria</i> sp.	tr	1	1	1			1	kopiko	wild coffee	n	t	PSYCH
<i>Charpentiera</i> sp.	tr	1	1				1	papala	papala	n	t	CHARP
<i>Coprosma rhynchocarpa</i>	tr	1	1	5			5	pilo	woodland mirrorplant	n	t	CORH
<i>Antidesma platyphyllum</i>	tr	1	1	tr			1	hame,ha'a	ha'a	n	t	ANPL2
<i>Antidesma pulvinatum</i>	tr	1	1	tr			1	hame	hame	n	t	ANPU2
<i>Gardenia remyi</i>	?	?	?	?			?	nanu	Remy's gardenia	n	t	GARE
<i>Hedyotis terminalis</i>	tr	tr	1				1	manono	variable starviolet	n	t	HETE21
<i>Pritchardia lanigera</i>	?	?	?	?			?	loulu	lou'ulu	n	t	PRLA4

<i>Ureera glabra</i>	tr	tr	1	1			1	opuhe	hopue	n	t	URGL
<i>Myrsine sandwicensis</i>	tr	tr	tr				tr	kolea lau li'i	kolea lau li'i	n	t	MYS2
<i>Platydesma remyi</i>	?	?	?				?	pilo kea	Hawai'i pilo kea	n	t	PLRE4
<i>Cibotium glaucum</i>	1	1	20	40			50	hapu'u	hapu'u	n	tf	CIGL
<i>Cibotium menziesii</i>	1	1	5	10			20	hapu'u 'i'i	hapu'u li	n	tf	CIME8
<i>Cibotium chamissoi</i>	tr	tr	tr	1			1	hapu'u	Chamisso's manfern	n	tf	CICH
<i>Clermontia lindseyana</i>	?	?	?				?	'oha wai	hillside clermontia	n	s	CLLB

Composite representation of State 1, Plant Community 1, Native Wet Forest.

Scientific name	%Canopy cover by height class (ft)						Total Cover	Local common name	NRCS common name	Origin	Type	NRCS Code
	0.1 - 2	2.1 - 4.5	4.6 - 13	13.1 - 40	40.1 - 80	80.1 - 120						
<i>Clermontia peleana</i>	?	?	?				?		pele clermontia	n	s	CLPE2
<i>Clermontia sp.</i>	1	1	1				1	'oha wai	clermontia	n	s	CLERM
<i>Cyrtandra tintinnabula</i>	?	?					?	ha'iwale	Laupahoehoe cyrtandra	n	s	CYTI
<i>Pipturus albidus</i>	tr	tr	1				1	mamaki	Waimea pipturus	n	s	PIAL2
<i>Broussaisia arguta</i>	tr	1	5				5	kanawao	kanawao	n	s	BRAR6
<i>Eurya sandwicensis</i>	?	?					?	anini	anini	n	s	EUSA6
<i>Vaccinium calycinum</i>	1	1	1				1	ohelo	ohelo kau la'u	n	s	VACA8
<i>Styphelia tameiameia</i>	tr	tr					tr	pukiawe	pukiawe	n	s	STTA
<i>Trematolobelia grandifolia</i>	?	?	?				?		largeflower false lobelia	n	s	TRGR8
<i>Cyanea platyphylla</i>	?	?	?				?	haha	Puna cyanea	n	s	CYPA7
<i>Cyanea tritomantha</i>	?	?	?				?	'aku	'aku'aku	n	t	CYTR6
<i>Cyrtandra giffardii</i>	?	?					?		forest cyrtandra	n	s	CYGB
<i>Cyrtandra platyphylla</i>	1	1					1	'ilihia	'ilihia	n	s	CYPL5
<i>Cyrtandra sp.</i>	tr	1					1	ha'iwale	Cyrtandra	n	s	CYRTA
<i>Peperomia sp.</i>	1						1	'ala'ala wai nui	peperomia	n	h	PEPER
<i>Astelia menziesiana</i>	1						1	kaluaha	pua'akuhinia	n	h	ASME4
<i>Phytolacca sandwicensis</i>	tr	tr					tr	popolo ku mai	Hawai'i pokeweed	n	h	PHSA2
<i>Joinvillea ascendens</i>	?	?					?	'ohe	'ohe	n	h	JOAS
<i>Korthalsella sp.</i>	1						1	hulumoa	korthal mistletoe	n	h	KORTH
<i>Stenogyne calamithoides</i>	1						1		bog stenogyne	n	v	STCA9
<i>Stenogyne macrantha</i>	?						?		Hawai'i stenogyne	n	v	STMA3
<i>Stenogyne scrophularioides</i>	?						?		mohihi	n	v	STSC4
<i>Phyllostegia floribunda</i>	?						?		Hawai'i phyllostegia	n	v	PHFL6
<i>Phyllostegia racemosa</i>	?						?		kiponapona	n	v	PHRA6
<i>Phyllostegia vestita</i>	?						?		streambed phyllostegia	n	h	PHVE4
<i>Phyllostegia warshaueri</i>	?						?		Laupahoehoe phyllostegia	n	v	PHWA3
<i>Rubus hawaiiensis</i>	1	1					1	'akala	Hawai'i blackberry	n	v	RUHA
<i>Smilax melastomifolia</i>	1						1	hoi kuahiwi	Hawai'i greenbrier	n	v	SMME
<i>Freyenetia arborea</i>	1						1	'ie'ie	'ie'ie	n	v	FRAR
<i>Alyxia oliviformis</i>	1	1					1	maile	maile	n	v	ALOL2
<i>Embelia pacifica</i>	1						1	kilioe	kilioe	n	v	EMPA
<i>Athyrium microphyllum</i>	1						1	'akolea	akolea	n	f	ATMI
<i>Sadleria sp.</i>	1	1	1				1	'ama'u	Sadleria	n	f	SADLE
<i>Adenophorus</i>	1						1		graceful kihifern	n	f	ADPI

pinnatifidus												
Adenophorus tamariscinus	1						1	wahini noho mauna	wahini noho mauna	n	f	ADTA
Asplenium schizophyllum	1						1		fringed spleenwort	n	f	ASSC8
Coniogramme pilosa	1						1	lo'ulu	loulu	n	f	COPI3
Dicranopteris linearis	1						1	uluhe	Old World forkedfern	n	f	DILI
Diplazium sandwichianum	1	1					1	ho'i'o	Hawai'i twinsorus fern	n	f	DISA3
Dryopteris hawaiiensis	1						1		Hawai'i woodfern	n	f	DRHA
Dryopteris sandwicensis	1	1					1		Pacific woodfern	n	f	DRSA
Dryopteris wallichiana	1	5					5	'i'o nui	alpine woodfern	n	f	DRWA
Grammitis tenella	1						1	kolokolo	kolokolo	n	f	GRTE
Lepisorus thunbergianus	1						1	pakahakaha	weeping fern	n	f	LETH6
Lycopodiella cernua	tr						tr	pakahakaha	weeping fern	n	f	LETH6

Composite representation of State 1, Plant Community 1, Native Wet Forest.

Scientific name	%Canopy cover by height class (ft)						Total Cover	Local common name	NRCS common name	Origin	Type	NRCS Code
	0.1	2.1	4.6	13.1	40.1	80.1						
Mecodium recurvum	1						1	'ohi'a ku	ohiaku	n	f	HYRE
Nephrolepis exaltata	1						1	Boston swordfern	Boston swordfern	n	f	NEEX
Nothoperanema rubiginosum	1						1		island lacefern	n	f	NORU
Ophioderma pendulum	1						1	puapuamoa	Old World adder's tongue	n	f	OPPEP
Pneumatopteris sandwicensis	1	1					1	ho'i'o kula	Hawai'i airfern	n	f	PNSA
Psilotum complanatum	1						1	moa nahele	flatfork fern	n	f	PSCO3
Psilotum nudum	1						1	moa	whisk fern	n	f	PSNU
Pteridium aquilinum	tr						tr	brackenfern	western brackenfern	n	f	PTAQ
Pteris cretica	1						1	'oali	Cretan brake	n	f	PTCR2
Pteris excelsa	1						1	waimakanui	waimakanui	n	f	PTEX
Sticherus owbyensis	1						1	uluhe	Hawai'i umbrella fern	n	f	STOW
Diplopterigium pinnatum	tr						tr	uluhe lau nui	scrambling fern	n	f	DIP3
Elaphoglossum crassifolium	1						1	stag's tongue, 'ekaha	royal tonguefern	n	f	ELCR2
Elaphoglossum palaeaceum	1						1	maku'e	ekaha	n	f	ELH3
Sphenomeris chinensis	tr						tr	pala'a	Chinese creepingfern	n	f	ODCH
Microlepis strigosa	1	1					1	palapalai	palapalai	n	f	MIST4
Asplenium sp.	1	1					1		spleenwort	n	f	ASPLE
Asplenium normale	1						1		rainforest spleenwort	n	f	ASNO4
Vandenboschia sp.	1						1	vandenboschia	vandenboschia	n	f	VANDE
Uncinia uncinata	1						1		Hawai'i birdcatching sedge	n	g	UNUN
Carex wahuensis	1						1		Oahu sedge	n	g	CAWA
Carex alligata	1						1		Hawai'i sedge	n	g	CAAL12
Grasslike	1						1					
Native Forbs	1						1					
Exotic Forbs												
Native Vines/Epiphytes	5	1					5					
Exotic Vines												
Small ferns	20	10	1				30					

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Site Description Approval

Author	Date	Approval	Date
David Clausnitzer	07/07/2008	David Clausnitzer	07/07/2008
Joseph May	2003		
Loretta J. Metz	07/07/2008	Loretta J. Metz	07/07/2008

Appendix 3
Ahualoa Homesteads
Vegetation inventory

Trees

Common name

Black Wattle
Australian Blackwood
Cinnamon, Padang Cassia
Ironwood
Silk Oak, Silver oak
Paper bark
Strawberry guava
Guava
Swamp mahogany
Hapu'u
Ohia

Shrubs

Seashore vervain, joeo
Cane tibouchina
Wild Olive
Night cestrum
False mallow
Thimbleberry
Joeo, blue rattail

Grasses

Napier
Wainaku
Guinea
Hilo
Kikuyu
Pangola

Herbaceous weeds

Fireweed
Ageratum
Hononhono
sedges
rose
Ferns
Sword fern

Species

Acacia mearnsii
Acacia melanoxylon
Cinnamomum burmanii
Casuarina sp.
Grevillea robusta
Melaleuca quinquenervia
Psidium cattleianum
Psidium guajava
Eucalyptus robusta
Cibotium sp.
Metrosideros polymorpha

Verbena litoralis Kunth
Tibouchina herbacea
Olea europaea L.
Cestrum nocturnum
Malvastrum coromendelianum
Rubus rosifolius
Stachytarpheta dichotoma

Pennisetum purpureum
Panicum repens L.
Panicum maximum Jacq.
Paspalum conjugatum
Pennisetum clandestinum
Digitaria eriantha

Senecio madagascariensis
Ageratum conyzoides
Commelina diffusa

Appendix 4
TECHNICAL NOTE

USDA NATURAL RESOURCES CONSERVATION SERVICE PACIFIC ISLANDS AREA

Biology Technical Note No. 17

HAWAIIAN HAWK HABITAT ENHANCEMENT AND MANAGEMENT*



Figure 1. In Hawaiian culture ʻIo are regarded as ʻaumakua or ancestral guardian spirits (Photo USFWS).

ʻIo are 13% smaller and 29% less in weight than females (common characteristic of raptors). ʻIo have two color morphs: (1) **Light** morph adults have a dark brown head and back and white throat, breast, and belly with varying amounts of brown flecking (Fig. 1). Juveniles are similar except the head and breast are orange/white (Fig. 4B); (2) **Dark** morph adults are dark brown all over. Juveniles differ slightly by having mottled (orange/white) mixed with the dark feathers on the head and upper chest. The color of the cere (fleshy area at base of beak) and legs is yellow in adults and bluish-green in juveniles. ʻIo is a Federal and State endangered species.

PURPOSE

To provide an introduction to the habitat requirements of Hawaiian Hawk or ʻIo and guidance on conservation practices to enhance and manage ʻIo habitats.

INTRODUCTION

The ʻIo is Hawaii's only resident hawk, and it is found nowhere else in the world. The ʻIo is a raptor (bird of prey) from the family Accipitridae (hawks, kites, eagles, and allies). Recent studies indicate that ʻIo is closely related to the Short-tailed Hawk of the Americas with whom it shares a common ancestor; most likely, a South American long-distance migrant, comparable to the Swainson's Hawk, which could reach remote islands. Though similar in appearance, male

Species Profile

Hawaiian Hawk, ʻIo (pronounced "EEoh")
Federal listing: Endangered
Scientific name: *Buteo solitarius*
Length: male 15.5 inches (39.4 cm); female 18.0 inches (45.7 cm)
Weight: male 15.5 oz (441 g); female 21.4 oz (606 g)
Range: 0-8500 ft (2590 m) elevation on Hawai'i; rare sightings on Maui, O'ahu, and Kaua'i
Breeding season: March - August
Female age at first breeding: 3-4 years
Clutch size: usually 1 egg (range 1-3)
Incubation period: at least 38 days
Age at fledging: 56-63 days
Nest sites: 30-6200 ft (10-1890 m) elevation, open and closed-canopy native forests, exotic forests, and agricultural areas with >0.5 ac (0.2 ha) patches of large trees; prefers mature ʻōhiʻa trees for nesting
Food habits: Carnivorous; majority of diet includes birds, mice, rats, and invertebrates
Population estimate: 1450
Longevity: up to 17 years

STATUS AND DISTRIBUTION

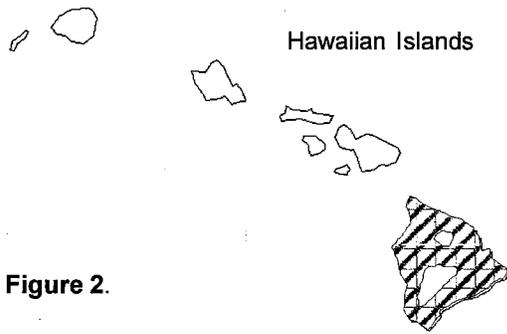


Figure 2.

Based on the fossil record, the former range of `lo included the islands of Hawai`i, Moloka`i, and Kaua`i. Today, an estimated 1450 birds are found only on the Island of Hawai`i (Fig. 2) with rare sightings on Maui, O`ahu, and Kaua`i. `lo occur from sea level to 8500 ft (2590 m) elevation (although rarely seen above 5500 ft [1676 m]) in protected areas, developed lands, and agricultural lands. Non-protected areas support about 68% of the population, and most habitats supporting high densities of `lo are on private lands; thus, the cooperation of private landowners and availability of private land to `lo remains an important aspect in the species' recovery.

ANNUAL CYCLE

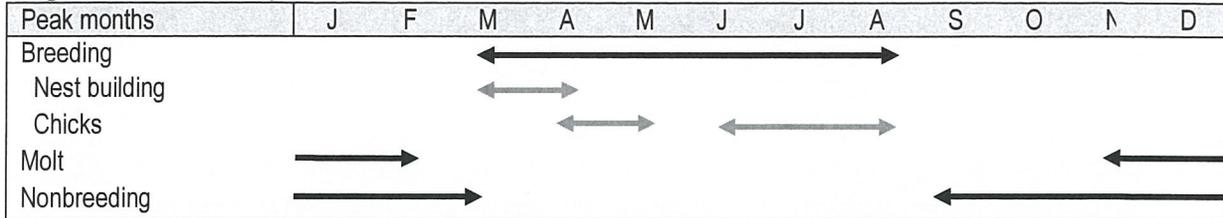
Mate and site fidelity is high in `lo (pairs typically remain together in the same territory throughout the year). Nests may be reused during consecutive breeding seasons or vacated for a year or more before reuse. Courtship and aerial displays, such as mutual soaring, diving, and foot-touching, are observed year-round, but more often prior to breeding. `lo breed during the spring and summer (the majority of breeding occurs March to August). Most nest building occurs March to April and egg laying April to May. Chick activity is greatest June to August (Fig. 3). Both sexes contribute to nest building which begins several weeks prior to the laying of usually a single egg. The female does most of the incubating (although this is variable) and takes breaks to stretch, preen, and receive food from the male. The chick is altricial (born with little to no down, immobile, and totally dependent on its parents for survival). After hatching, the female is primarily responsible for brooding (protecting and warming the chick), feeding, other rearing activities, and the male is responsible for capturing food for the young.

The chick is fed several times per day, and over a 10-week period the average feeding rate is 0.9 oz/h (25.2 g/h; equal to about one House Finch per hour). The chick develops rapidly and ventures out of the nest to adjacent branches ready to fly at 8-9 weeks of age. There's a peak in fledging activity (chicks taking their first flight) in mid-August. The parental care period for `lo is among the longest recorded for its genus (*Buteo*) and up to 10 times longer than temperate-zone raptors. The juvenile receives food from adults 6-10 months after fledging, but in the next year the juvenile will depart from its parents and start a life of its own.

An important job of a wildlife manager is to provide new, improved opportunities for at-risk species to survive, reproduce, and maintain sustainable breeding populations. If existing conditions are unsuitable, alternative treatments are recommended which are often manipulations needed to meet landowner and NRCS conservation goals guided by the Io Recovery Plan. If existing conditions are suitable, the landowner and NRCS may decide to forego manipulations, maintain existing conditions, and protect

the area from disturbance.

Figure 3. `lo annual cycle



Adapted from Clarkson & Laniawe (2000)



Figure 4. **A:** Two-week-old `lo chick with dark and light morph parents (Photo © J. Jeffrey); **B:** Light morph juvenile `lo in mature `ōhi`a forest (Photo J. Klavitter).

HABITAT REQUIREMENTS

`lo occur in almost every vegetated landscape with some large tree component. It's easier to describe what is *not*, rather than what is, `lo habitat. `lo rarely use māmane-naio forest, lava fields, orchard monocultures, and urban areas. Primary habitats include native forests with a grass understory, fallow sugarcane fields, and orchards with structural diversity (e.g., tree hedgerows, forest edges). **Of these, large areas of mature `ōhi`a forest are most important for the perpetuation of `lo.** Habitats include:

- Forest
 - Native
 - Native – exotic
 - Exotic
- Agricultural lands
 - Fallow sugarcane
 - Orchards
 - Grazing lands
- Developed
 - Rural
 - Suburban/Exurban

Today, `lo prey on native species but their diet consists mostly of nonnative mammals, birds, and invertebrates, showing lo's ability to adapt to a changing prey base. `lo hunt from perches, but will also use aerial pursuits. Prey is taken from the ground or tree branches or intercepted in mid-air.

Food. Prior to human contact, the `lo diet consisted primarily of native birds and insects.

There are at least 15 bird and 6 mammal species known to be eaten by `Io. The most common foods delivered to `Io chicks in nests were rats, mice, the Japanese White-eye, Common Mynah, and House Finch. Native birds consumed by `Io include Pacific Golden-Plover, `Apapane, Common `Amakihi, `I`iwi, and the endangered Hawaiian Crow or `Alalā. `Io will also take Kalij Pheasant (which weighs more than `Io), domestic chickens, and mongooses as well as scavenge feral cats. Cockroaches, spiders, hawk moths, dragonflies, and other invertebrates supplement the diet. As with other native predators, `Io play an important role in controlling rodents, nonnative birds, and insects.

Cover (nesting). Nests are located in trees of native, mixed native-exotic, and exotic forest and agricultural areas. Canopy cover varies greatly from closed, `ōhi`a-dominated forests (60-85%) to open, mixed forests (20-60%) to scattered `ōhi`a and koa in pasture (<20%). Both native and exotic trees are used for nesting, but the majority of nests are built in mature `ōhi`a trees. Other nest trees include lama, koa, kōlea, eucalyptus, common ironwood, Christmas berry, coconut, macadamia nut, and mango (See Appendix A for native species list).

Cover (foraging). Varies widely, but generally consists of a patchwork of tall trees and open grassy fields that supports bird and mammal populations (Fig. 5). Snags (standing, dead or dying trees; Fig. 6) or other trees with exposed limbs are important for scoping and hunting.



Figure 5. `lo nesting and foraging habitat in **A:** open-canopy native forest with a grass understory (`ōhi`a; Photo K. Uyehara) and **B:** mixed native-exotic forest and pasture (o`hi`a-guava, ironwood; Photo B. Shontell).



Figure 6. At this koa forest and plantation on `Umikoa Ranch in Hamakua, koa snags were intentionally left to provide perching sites for `lo (Photo K. Uyehara).

Grazing lands offer unique opportunities to enhance `lo habitat. Pasturelands with forested gulches, mature windbreaks, and remnant forest or adjacent to a forest reserve or tree plantation provide better foraging habitat than pastures with few or no large trees. Many of these areas could be improved by simply protecting `lo roosting and nesting areas and increasing habitat diversity.

Water. Foods presumably meet water requirements. `lo are frequently observed soaring above or perched in trees in the vicinity of wetlands and riparian zones.

Minimum habitat size. `lo is a wide ranging species capable of high altitude and interisland flight. Adults defend their territory year-round, but do so more aggressively during the breeding season. Adults will attack and chase intruders and soar over the defended territory. Home range, which varies by habitat type, averages 1134 ac (459 ha). Thus, `lo require large protected areas and landscapes that encompass multiple landowners.

Home range by habitat type	Size - ac (ha)
Closed-canopy `ōhi`a forest	1300 (526)
Open-canopy `ōhi`a forest	1134 (459)
Open-canopy `ōhi`a forest (S. Kona)	292 (119)
Mid-elevation pasture	1196 (484)
Papaya-guava orchard	119 (48)

Clarkson & Laniawe (2000), Klavitter (2000)

Breeding. `lo nest from 30-6200 ft (10-1890 m) elevation in native and exotic forests and

pasture and orchards with large trees. Nests are bulky structures made of sticks (~0.25 x 12 inches [0.6 cm x 30 cm]), twigs, and leaves, with a cup at the center. Nest cups are lined with green-leaved twigs, fresh `ōhi`a leaves, koa leafstalks, fern fronds, or other greenery. Nests are built on stable platforms on bird's nest ferns, trunk crotches, or where branches meet the trunk (Figs. 7-8).

Nonbreeding. Little is known about the nonbreeding or subadult habitats of `Io. Subadults may congregate in lowland exotic forests and agricultural areas prior to first breeding. Observations of `Io in atypical habitats suggest a seasonal change in distribution.



Figure 7. `Io nest constructed of small branches in an `ōhi`a tree (Photo J. Klavitter).



Figure 8. Small woody debris from an `ōhi`a tree available to `Io for nest-building (Photo K. Uyehara).

THREATS

Landowners can also benefit `Io by minimizing the following threats:

- Habitat loss and degradation
 - Conversion of native forest to grasslands, monocultures, large-scale orchards, or urban development
 - Spread of invasive plant species (i.e., guava, Christmas berry) that shade out `ōhi`a and other natives
 - Lack of suitable nesting habitat
- Harassment and direct mortality
 - Disturbance at nest and roost sites
 - Vehicle collisions
 - Birds are occasionally shot or harmed for a variety of reasons which include `Io preying upon pets and domestic chickens
- Potential threats
 - Environmental contaminants
 - Avian diseases
 - Introduced predators (fledglings are occasionally attacked by domestic and feral cats and dogs)
 - Drowning in cattle troughs
 - `Ōhi`a rust (*Puccinia psidii*)

Nest characteristics	Average size
Nest diameter	25 inches (65 cm)
Nest depth	12 inches (31 cm)
Nest cup diameter	9 inches (24 cm)
Nest cup depth	2 inches (4 cm)
Nest site characteristics	Average size
Nest tree height	52 ft (range 33-79 ft) 16 m (range 10-24)
Nest tree dbh	20 inches (min 4 inches) 50 cm (min 10 cm)
Nest height in tree	31 ft (range 11-59 ft) 9 m (range 4-18 m)

Griffin et al. (1998)

Habitat loss and degradation. The primary factor limiting `lo population growth is lack of suitable habitat. `lo are currently restricted to the Island of Hawai`i where they appear to occupy useable habitats covering about 59% of the island. Loss of mature `ohi`a and `ohi`a-koa forests to human development, invasive species, fire, disease, and natural die-backs decreases the amount of suitable habitat.

Although Hawaii's forests have been drastically reduced, `lo is proving to be an adaptable species able to take advantage of forest edges created by logging and grazing and opportunistically feeding on nonnative species. `lo can coexist with moderate levels of forest fragmentation; however, if `ohi`a-dominant forests continue to decline, the `lo population will likely decline.

Harassment and direct mortality. Although it's against Federal and State law to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect `lo or attempt to engage in any of these activities, an unknown number of `lo are harassed or shot each year. Even if this number is low, such losses could effect the `lo population because adult survival is the most important factor regulating the population.

Harassment of `lo at nest sites can alter normal feeding and breeding patterns or result in nest or chick abandonment. Nest disturbance can expose chicks to inclement weather or predators or cause juveniles to leave familiar territory prematurely. Harassment could also be unintentional. For example, loud, irregular, unpredictable activities such as using heavy equipment or building a structure near an `lo nest may cause nest failure. This can be a problem for `lo because pairs may not reneest when their nest fails and may not nest every year.

Greater efforts to raise public awareness about the habitat requirements of Hawaii's endangered hawk would reduce inadvertent harassment.

Potential threats. There is little or no evidence that environmental contaminants (pesticides), avian diseases (avian pox, avian malaria, *Toxoplasmosis gondii*), or introduced predators limit the `lo population. Studies on secondary rodenticide (Diphacinone) poisoning concluded that the threat to `lo is minimal. However, young `lo are vulnerable to cats, dogs, and mongooses, and West Nile Virus, Avian Influenza, and other diseases could devastate the `lo population if they reach Hawai`i. Thus, ongoing evaluation and monitoring is prudent due to changing environmental conditions. We recommend proactive conservation practices to help prevent these factors from becoming a problem for `lo in the future.

What to do with a sick, injured, or dead lo?

1. Note the bird's condition, behavior, and exact location
2. Call the Division of Forestry & Wildlife (DOFAW) as soon as possible for guidance (phone numbers below)

Summary of `lo habitat components

Habitat component	Habitat characteristics
Food	<ul style="list-style-type: none"> Small mammals, birds, and invertebrates (e.g., rats, mice, Japanese White-eyes, Common Mynahs, House Finches, cockroaches, dragonflies)
Cover – nesting	<ul style="list-style-type: none"> Range in elevation for nesting 30-6200 ft (10-1890 m) Large areas of mature `ōhi`a forest are important Mature `ōhi`a trees apparently preferred for nesting, but a variety of large native and exotic trees are also used (nest trees average 52 ft [16 m] high and 20 inches [50 cm] dbh) Small woody debris (sticks ~0.25 x 12 inches [0.6 cm x 30 cm] and twigs) and foliage used for nesting materials
Cover – foraging	<ul style="list-style-type: none"> Range in elevation is 0-8500 ft (2590 m); most birds occur 2000-5300 ft (610-1615 m) Native forest with a grass understory, fallow sugarcane fields, orchards with a tree component (e.g., hedgerow, woodland edge), or other habitats with similar structure that support bird and mammal populations Snags or other tall trees with exposed limbs for perching and hunting prey
Water	<ul style="list-style-type: none"> Foods presumably provide adequate water in diet
Minimum habitat area	<ul style="list-style-type: none"> The average home range is 1134 ac (459 ha) per pair, but this varies by habitat type and territories may overlap (see home range table above)

Limiting Factors

When planning for `lo habitat conservation, properties within the species' range near a protected area or in an area where there is potential to work with multiple landowners should be given priority. Use the table below to subjectively rate the availability and quality of `lo habitat within a planning area, based on the above habitat characteristics. Habitat components absent or rated low are likely limiting `lo habitat quality.

Habitat component	Quality / Availability			
	High	Medium	Low	Absent
Food				
Cover – nesting				
Cover – foraging				
Minimum habitat area				

Management Recommendations

Management treatments should address the habitat components that appear to limit habitat potential for `lo. Management options are listed below that may increase the quality or availability of each habitat component. NRCS Conservation Practices and various programs that may provide financial or technical assistance to carry out practices are also listed.

Habitat component	General management options for increasing habitat quality or availability	Conservation Practices
Food	<ul style="list-style-type: none"> Preserve snags and other tall trees with exposed limbs (particularly "favorite" trees of `lo) near grassy fields by excluding areas from or minimizing activities related to resource extraction, grazing, or traffic 	382, 472, 528, 643, 645
	<ul style="list-style-type: none"> Plant 1-ac (0.4-ha) patches of `ōhi`a and koa trees for `lo to hunt from; increase native species diversity; fence to prevent ungulate damage (also see Cover – foraging below) 	382, 550, 612, 643, 645
	<ul style="list-style-type: none"> Minimize any secondary and tertiary effects (e.g., reduction in prey and prey habitat) of pesticides by developing an integrated pest management plan to reduce use of pesticides; include `lo as a natural pest control agent 	595, 645

Habitat component	General management options for increasing habitat quality or availability	Conservation Practices
Cover – nesting	<p><i>If `lo is known or suspected to be nesting in area:</i></p> <ul style="list-style-type: none"> ▪ Preserve or enhance nest trees and surrounding habitat by excluding areas from or minimizing activities related to resource extraction, grazing, or traffic ▪ Minimize activities to manicure lawns and “clean” farms to ensure sticks (~0.25 x 12 inches [0.6 cm x 30 cm]) and twigs are readily available to construct nests 	382, 472, 528, 643, 645
	<p><i>If `lo is known or suspected to be nesting in area or using but not known to be nesting in area:</i></p> <ul style="list-style-type: none"> ▪ Protect, enhance, or restore `ōhi`a-dominant forests and scattered native trees, particularly mature `ōhi`a trees (See Appendix A for other native nest trees) ▪ Consult with NRCS Biologist or Plant Materials Center on best sources, spacing, care, and maintenance of plants; when possible strive to restore native plant community structure and function not just native species 	314, 380, 382, 472, 550, 595, 612, 643, 645, 650
	<ul style="list-style-type: none"> ▪ Control invasive plants, particularly those that threaten the continued existence of `ōhi`a forests (e.g., Christmas berry shades out native understory plants and prevents recruitment; fountain grass communities can develop high fine fuel loads) ▪ In addition to standard treatments, consider girdling invasive trees to maintain, shade, moisture, and erosion control during restoration activities; use an ax or chainsaw to remove a 2-inch ring of bark and cambium layer at base of tree to disrupt nutrient flow; girdle trees that have no native bird nesting activity and are far from human activity (do not create a hazard); spread mulch over root zone to prevent regrowth 	314, 383, 528, 595, 643, 645, 666
	<ul style="list-style-type: none"> ▪ Protect `ōhi`a forest and scattered native trees from fire by establishing fuel breaks or from intentional overgrazing by developing a prescribed grazing plan 	382, 383, 528, 643, 645
Cover – foraging	<ul style="list-style-type: none"> ▪ Maintain a patchwork of woodland and open grassy fields by mowing or grazing where appropriate 	528, 645, 647
	<ul style="list-style-type: none"> ▪ In riparian zones, establish riparian buffers through fencing, planting `ōhi`a and other native species adapted to riparian conditions, selective removal of invasive plants, managing access, removing feral ungulates, and prescribed grazing 	314, 382, 391, 472, 528, 550, 560, 575, 595, 612, 643, 645
	<ul style="list-style-type: none"> ▪ In orchards, increase horizontal and vertical vegetative structure by planting shelterbelts that contain `ōhi`a and koa; configure plantings in undulating rows or large, irregularly-shaped patches 	380, 650, 643, 645
	<ul style="list-style-type: none"> ▪ In tree plantations, maintain cover by avoiding large clearcuts; consider selective harvest techniques that leave young and middle-aged trees and snags 	314, 645, 666
	<ul style="list-style-type: none"> ▪ In marginal pasture, restore `ōhi`a-dominant forest in 0.25–1.0 ac (0.1–0.4 ha), irregularly-shaped patches at 3-5 sites; exclude grazing animals by fencing to ensure future tree recruitment; weed control may be needed 1-2 times per year to allow for tree establishment ▪ In addition, consider planting similar-sized patches of faster-growing, noninvasive, nonnative trees to be used for nesting until `ōhi`a-dominant forest stands can support nesting; could also function as windbreaks or shelterbelts (consult with NRCS Biologist or Plant Materials Center) 	314, 380, 382, 550, 595, 612, 643, 645, 650
	General management options for increasing habitat quality or	Conservation

Habitat component	availability	Practices
Minimum habitat area	<ul style="list-style-type: none"> ▪ Allow at least 300-1300 ac (120-525 ha) per pair; area requirements vary by habitat type and territories may overlap (see home range table above) ▪ Consider relationship of planning area to habitat components on neighboring lands 	643, 645
Human impact	<ul style="list-style-type: none"> ▪ Maintain a no-activity buffer, 300 ft (100 m) or more, around nest trees during the breeding season (Mar-Aug) ▪ Minimize human disturbance near nest trees (Mar-Aug); for example, schedule major construction activities during the nonbreeding months (Sep-Feb) ▪ Reduce or disallow recreational use near nesting areas during the breeding season ▪ Keep domestic cats and dogs away from nest trees, especially when chicks are fledging ▪ Control feral cats and mongooses around nest trees; plan layout of traps or bait stations such that pets and predators are not lured to nest trees by baits ▪ Remove mosquito breeding sites (e.g., old tires) to prevent the spread of mosquito-transmitted bird diseases ▪ Cover cattle tanks or float a 3-ft (1-m) section of 2 x 6 inch board in them to prevent accidental `lo drowning ▪ Avoid cutting `ōhi`a for firewood or fence posts; instead use fast-growing nonnative species such as eucalyptus, guava, or ironwood ▪ Avoid conflicts with `lo by confining young chickens and small pets (i.e., kittens) to protect them from `lo predation 	472, 528, 560, 595, 568, 575, 643, 645

Conservation Practices: **314** Brush Management, **380** Windbreak/Shelterbelt Establishment, **382** Fence, **383** Fuel Break, **391** Riparian Forest Buffer, **472** Use Exclusion, **484** Mulching, **528** Prescribed Grazing, **550** Range Planting, **560** Access Road, **568** Recreation Trail and Walkway, **575** Animal Trails and Walkways, **595** Pest Management, **612** Tree/Shrub Establishment, **643** Restoration and Management of Rare or Declining Habitats, **645** Upland Wildlife Habitat Management, **647** Early Successional Habitat Development/Management, **650** Windbreak/Shelterbelt Renovation, **666** Forest Stand Improvement (More info: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=HI)

NRCS Conservation Programs that apply: **CREP** Conservation Reserve Enhancement Program (administered by Farm Service Agency); **CSP** Conservation Security Program; **EQIP** Environmental Quality Incentives Program; **WHIP** Wildlife Habitat Incentives Program; **WRP** Wetlands Reserve Program (More info: <http://www.hi.nrcs.usda.gov/programs/>)

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Common and scientific and names of animals and plants in text

Animals

Apapane (*Himatione sanguinea*)
Common `Amakihi (*Hemignathus virens*)
Common Mynah (*Acridotheres tristis*)
Hawaiian Crow or `Alalā (*Corvus hawaiiensis*)
Hawaiian Hawk or `Io (*Buteo solitarius*)
House Finch (*Carpodacus mexicanus*)
House Mouse (*Mus musculus*)
`I`iwi (*Vestiaria coccinea*)
Japanese White-eye (*Zosterops japonicus*)
Kalij Pheasant (*Lophura leucomelanos*)
Pacific Golden-Plover or Kōlea (*Pluvialis fulva*)
Rat (*Rattus* spp.)
Short-tailed Hawk (*Buteo brachyurus*)
Small Indian mongoose (*Herpestes auropunctatus*)
Swainson's Hawk (*Buteo swainsoni*)

Plants

Bird's nest fern (*Asplenium nidus*)
Christmas berry (*Schinus terebinthifolius*)
Coconut (*Cocos nucifera*)
Common ironwood (*Casuarina equisetifolia*)
Eucalyptus (*Eucalyptus* spp.)
Fountain grass (*Pennisetum setaceum*)
Guava (*Psidium* spp.)
Koa (*Acacia koa*)
Kōlea (*Myrsine lanaiensis*)
Lama (*Diospyros sandwicensis*)
Macadamia nut (*Macadamia integrifolia*)
Mango (*Mangifera indica*)
Māmane (*Sophora chrysophylla*)
Naio (*Myoporum sandwicense*)
`Ōhi`a (*Metrosideros polymorpha*)
Papaya (*Carica papaya*)

For more information on lo contact:

NRCS State Biologist

(808) 541-2600 Honolulu, O`ahu

U.S. Fish & Wildlife Service

(808) 792-9400 Honolulu, O`ahu

DOFAW

(808) 974-4229 Hilo, Hawai`i

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Appendix 5
Invasive Species Fact Sheet
Black wattle (*Acacia mearnsii*)

Pacific Islands Area

Invasive Species Fact Sheet 09
Pacific Islands Area, October 2011

- Scientific name & Code:** *Acacia mearnsii*, De Wild., **ACME80**
Synonyms – *Acacia decurrens* (Wendl. F.) Willd. var. *mollis* Lindl.
- Family:** Fabaceae – Pea Family
- Duration/Growth Habit:** Perennial Tree/Shrub
- Common names:** English – black wattle, tan wattle, green wattle
- Origin:** Australia Introduced to Lana'i from California.
- Description:** Trees, 9-15 m tall. Branchlets are angular with fine gray-white hairs (tomentose). Leaves are gray pubescent, pinnate (6-30 pairs), 0.5-5.5 cm long. Leaflets 10-68 pairs, dense, linear, 0.7-6 x 0.4-0.8 mm. Raised glands occur at and between the junction of the leaflet pairs. Heads globe shaped, 6-7 mm diameter arranged in axillary racemes or terminal panicles. Flowers yellowish to white. Legume black, oblong, flat, 5-10 cm x 4-5 mm, pubescent, flattened between seeds. Seeds black, shiny, ovoid.
- Propagation:** Produces numerous viable seeds, resprouts by basal shoots following fire. Aggressive suckering spreads infestations.
- Distribution:** Identified in Hawaii (Hawai'i, Kaho'olawe, Kaua'i, Lana'i, Maui, Moloka'i, O'ahu).
- Habitat/Ecology:** Grows in disturbed dry to mesic (moist) habitats up to 4000 feet elevation including riparian areas, coastal scrub, forests, and grasslands. Generates numerous suckers resulting in monotypic thickets.
- Environmental impact:** Highly invasive; aggressive colonizer, canopy closes-in pastures and displaces natives in natural areas. Considered a noxious weed in Hawaii.
- Management:** Physical – Cutting ineffective unless suckers and/or basal bark are treated.
Chemical – Saplings sensitive to triclopyr, dicamba, glyphosate, and picloram applied to cut surfaces. Sensitive to basal bark treatments and to girdling (stripping the bark) combined with chemical applications.
Biological – None known. Unpalatable to grazing animals.

PIER Risk Assessment: High Risk, score: 15