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GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
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AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
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CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

Genevieve Salmonson, Interim Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

JUN 12 2013

Dear Ms. Salmonson,

With this letter, the Office of Conservation and Coastal Lands (OCCL) hereby transmits the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI) for the proposed Waikāne-Waiāhole Cacao Farm Pilot Project situated at Tax Map Key (1) 4-8-006:001 in the Ko'olaupoko District on the Island of Oahu for publication the next available edition of the *Environmental Notice*.

Enclosed is a completed OEQC Publication Form, one (1) copy of the notice of agency determination, one (1) copy of the DEA-AFONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Alex J. Roy, M.Sc. at (808) 587-0316 or via email at alex.j.roy@hawaii.gov

Sincerely,

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

CC: *Ōhulehule Forest Conservancy, LLC*

Attachments: *One (1) copy of DEA-AFONSI for CDUA OA-3677*
One (1) copy of OEQC Publication Form

APPLICANT ACTIONS
SECTION 343-5(C), HRS
PUBLICATION FORM (JANURARY 2013 REVISION)

Project Name: Draft Environmental Assessment for the Proposed Ōhulehule Forest Conservancy Commercial Cacao Farm Project

Island: Oahu

District: Ko'olaupoko

TMK: (1) 4-8-006:001

Permits: State of Hawaii, Conservation District Use Permit, National Pollutant Discharge Elimination Permit, as applicable, Noise Permit, as applicable, City and County of Honolulu Grading Permit

Approving Agency: Office of Conservation and Coastal Lands, Department of Land and Natural Resources, Kalanimoku Building, 1151 Punchbowl Street, Room 131, Honolulu, Hawaii 96813; Contact: Samuel J. Lemmo, Administrator; Telephone: (808) 587-0377

Applicant: Ōhulehule Forest Conservancy, LLC, 1236 A'alapapa Drive, Kailua, HI 96734; Contact: Paul Zweng, Managing Member; Telephone: (808) 377-1947

Consultant: Townscape, Inc. 900 Fort Street Mall, Suite 1600, Honolulu, HI 96813; Contact: Bruce Tsuchida, President; Telephone: (808) 244-2015

Status (check one only):

_X_DEA-AFNSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day comment period ensues upon publication in the periodic bulletin.
__FEA-FONSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov; no comment period ensues upon publication in the periodic bulletin.
__FEA-EISPN	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day consultation period ensues upon publication in the periodic bulletin.
__Act 172-12 EISPN	Submit the approving agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov. NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
__DEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.
__FEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__ Section 11-200-23 Determination	The approving agency simultaneous transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the applicant. No comment period ensues upon publication in the periodic bulletin.
__Statutory hammer	

Acceptance	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it failed to timely make a determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and that the applicant's FEIS is deemed accepted as a matter of law.
__Section 11-200-27 Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.
__Withdrawal (explain)	

Summary:

The Ōhulehule Forest Conservancy, LLC is proposing to create a five (5) acre pilot cacao agroforestry farm for future commercial operations. The project will consist of establishing basic site infrastructure such as roads and irrigation, developing and constructing a on-site plant nursery to establish cacao seedlings and other native plants, to develop a commercial fermentation and drying facility to process the harvested cacao and to prepare and develop a five (5) acre shaded cacao farm.

The overall goal of the cacao farm project is to operate a profitable, organically-based cacao farm using agroforestry principles. A secondary goal of the overall cacao farm project is the creation of a Waiāhole-Waikāne cacao appellation which may permit the cacao harvested in this area to command premium prices. The five (5) acre pilot farm project is also being proposed to provide the Ōhulehule Forest Conservancy vital information and data necessary to determine successful farming techniques in this area and to assess whether commercial cacao production in Waikāne Valley is feasible.

DRAFT ENVIRONMENTAL ASSESSMENT

FOR

ʻŌHULEHULE FOREST CONSERVANCY CACAO FARM

This document prepared pursuant to Chapter 343, HRS

Applicant: ʻŌhulehule Forest Conservancy

Approving Agency: Office of Conservation and Coastal Lands
State of Hawaiʻi Department of Land and Natural Resources

May 2013

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ACRONYMS

ADC	State of Hawaiʻi Agribusiness Development Corporation
ALISH	Agricultural Lands of Importance to the State of Hawaiʻi
amsl	Above Mean Sea Level
BMP	Best Management Practice
BWS	Honolulu Board of Water Supply
CWRM	State of Hawaiʻi Commission on Water Resources Management
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
DOH	State of Hawaiʻi Department of Health
EE/CA	Engineering Evaluation / Cost Analysis
EPA	Environmental Protection Agency
ESA	Endangered Species Act
HARC	Hawaiʻi Agricultural Research Center
HBMP	Hawaiʻi Biodiversity Mapping Program
HECO	Hawaiian Electric Company
HHFDC	Hawaiʻi Housing Finance and Development Corporation
HRS	Hawaiʻi Revised Statutes
KMWP	Koʻolau Mountains Watershed Partnership
LUO	Land Use Ordinance
MEC	Munitions and Explosives of Concern
MGD	Million Gallons per Day
mm	Millimeter
NPDES	National Pollutant Discharge and Elimination System
NRCS	Natural Resources Conservation Service
OCCL	Office of Conservation and Coastal Lands
RI/FS	Remedial Investigation / Feasibility Study
SCP	Sustainable Communities Plan
SI	Site Investigation
SMZ	Streamside Management Zone
SSBMPP	Site-Specific Best Management Practice Plan
TMDLs	Total Maximum Daily Loads
TMK	Tax Map Key
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
WQS	Water Quality Standards
WRCC	Western Regional Climate Center
WVWS	Waiāhole Valley Water System
WTA	Waikāne Training Area

1. INTRODUCTION

Project Name: ʻŌhulehule Cacao Farm

Applicant: ʻŌhulehule Forest Conservancy, LLC

Contact: Paul Zweng, Managing Partner

Approving Agency: Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands

Project Location: Waikāne Valley, Oʻahu

Property Owner: ʻŌhulehule Forest Conservancy, LLC

State Land Use Classification: Conservation District, Resource Subzone

Anticipated Determination of Environmental Assessment: Finding of No Significant Impact

Agencies and parties consulted:

Federal:
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Fish and Wildlife Service
- U.S. Army Environmental Division
- U.S. Army Corps of Engineers

State:
- DLNR Office of Conservation and Coastal Lands
- DLNR Commission on Water Resources Management
- DLNR Division of Forestry and Wildlife
- DLNR Historic Preservation Division
- Department of Health, Office of Environmental Quality Control
- Department of Agriculture, Agribusiness Development Corporation

Other Organizations:
- Waiāhole-Waikāne Community Association
- Kahaluʻu Neighborhood Board
- KEY Project
- Koʻolaupoko Hawaiian Civic Club
- Koʻolau Mountains Watershed Partnership
- The Nature Conservancy
- Hawaiʻi Plant Extinction Prevention Program
- Pacific Rim Conservation
- Hawaiʻiʼs 1000 Friends
- Oʻahu Island Land Trust

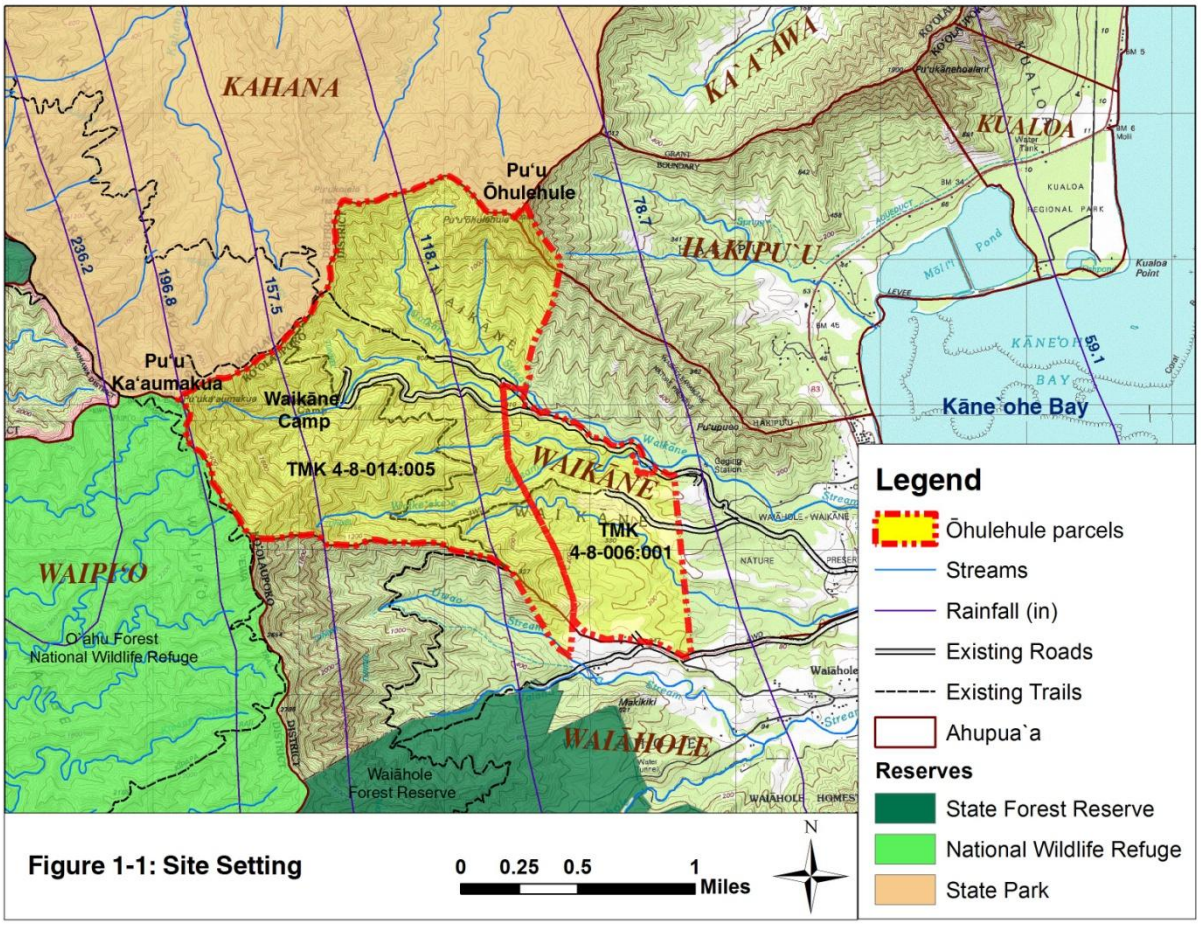


Figure 1-1: Site Setting

2. Summary of Proposed Actions

The proposed five-acre cacao-koa agroforestry project is located on the property owned by the ʻŌhulehule Forest Conservancy in Waikāne Valley. Waikāne Valley is in the northern portion of the Koʻolaupoko district on the windward side of Oʼahu. The property consists of two parcels: Tax Map Key (TMK) 4-8-014:005 is the *mauka* parcel containing 1,117 acres, and TMK 4-8-006:001 is the *makai* parcel containing 327 acres (see Figure 1). The proposed cacao farm is located within the *makai* parcel of the property. There are two access roads to the *makai* parcel: the paved Waiāhole Valley Road in the southern portion of the parcel and the unpaved Waikāne Valley Road in the northern portion. The proposed farm area is within the mesic climate zone and is currently largely overgrown with non-native invasive species.

Establishing the cacao farm will require the following actions, further described below and depicted in Figures 3-5, including:

- Establish basic site infrastructure, including agricultural water supply, road access, and base-yard facilities for land preparation and farming equipment.
- Develop a nursery to grow cacao and koa seedlings (the nursery will also be used to grow native plants for the forest restoration project on the property).
- Develop commercial cacao fermentation and drying facilities to process cacao beans.
- Prepare and develop a shaded, five-acre pilot cacao orchard.

Additional activities conducted by the ʻŌhulehule Forest Conservancy on the property will include: 1) restoration of native rainforest habitat and protection of the endangered ʻelepaio bird on the *mauka* parcel, 2) restoration of areas of native mesic forest on the *makai* parcel, and 3) work with local groups to restore historic loʻi for taro cultivation. A Conservation District Use Permit (CDUP) for the forest restoration project was approved by the DLNR on January 29, 2013. Per the OCCL letter dated May 2, 2012, we understand that the taro lo`i restoration is considered an existing non-conforming use not subject to Conservation District Use permitting. Figure 2 shows the long-term vision for the property.

The ʻŌhulehule Forest Conservancy prepared a Comprehensive Management Plan to guide the development of the cacao farm and forest restoration projects on the property. The plan describes important cultural and natural resources of Waikāne Valley and the proposed actions to protect those resources while developing a commercial cacao farm operation. Once a five-acre test plot for cacao has been established, we will be able to assess our records related to fruit production and fermentation methods, allowing us to judge whether commercial cacao production in Waikāne Valley is feasible. If determined to be feasible, then the areas in cacao cultivation will be progressively expanded to the full production scale, up to 50 acres. Expansion of the cacao farm beyond the initial five acres will be subject to DLNR approval of a Conservation District Use Permit (CDUP) and a Finding of No Significant Impact (FONSI) determination for the Environmental Assessment (EA) of the additional acreage.

The overall goal of the cacao farm project is to **operate a profitable, organically-based cacao farm using agroforestry principles**. A subsidiary goal of the cacao farm is **the creation of a Waiāhole-Waikāne cacao appellation**. The ʻŌhulehule Forest Conservancy has three objectives that will support these goals:

Objective 1: Organic Cacao Orchard

To develop viable production of high-quality, high-yield organic cacao in shaded orchards, with the aim to maximize productivity while minimizing agricultural inputs and environmental impacts.

Objective 2: Cacao Fermentation and Drying Facility

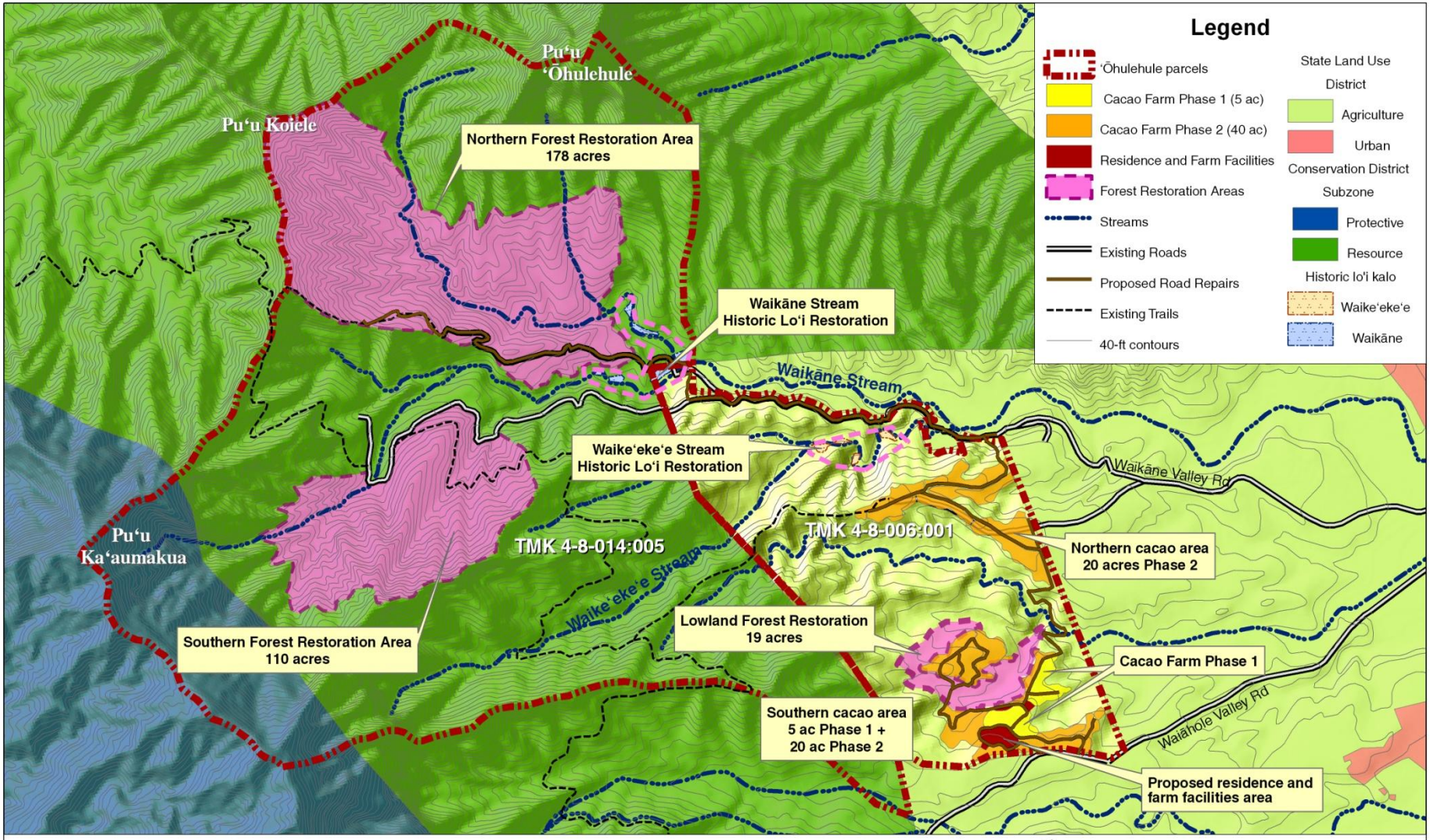
To develop cacao fermentation and drying facilities to process cacao beans. Fresh cacao beans cannot be stored for a long period of time and need to be fermented and dried before they can be used to make chocolate. Consequently, fermentation and drying facilities are critical for the long-term viability of the cacao farm.

Objective 3: Long-Term – Encourage Waiāhole-Waikāne Farmers to Grow Cacao

Should we be successful in demonstrating the economic viability of cacao production in Waikāne Valley, we plan to encourage other local farmers to produce high-quality, organically-grown cacao. The ultimate goal of this plan is to create the critical mass needed for a regional cacao appellation, which may then command premium prices for Waiāhole-Waikāne cacao.

The ʻŌhulehule Forest Conservancy became a member of the Koʻolau Mountains Watershed Partnership, in part, to gain advice and support for the proposed forest restoration activities. Additionally, we are working with the Division of Forestry and Wildlife Forest Stewardship Program, the US Department of Agriculture's Natural Resources Conservation Service (Conservation Resource Enhancement Program), and the US Fish and Wildlife Service (Partners for Fish and Wildlife Program). The ʻŌhulehule Forest Conservancy is also seeking the support of the local community in Waiāhole and Waikāne. Mr. Paul Zweng, the managing member of ʻŌhulehule Forest Conservancy, has become a member of the Waiāhole-Waikāne Community Association (WWCA) and currently serves on three subcommittees. Both the WWCA and the Kahalu`u Neighborhood Board have expressed written support for our proposed projects, as shown in the attached letters (See Appendix C).

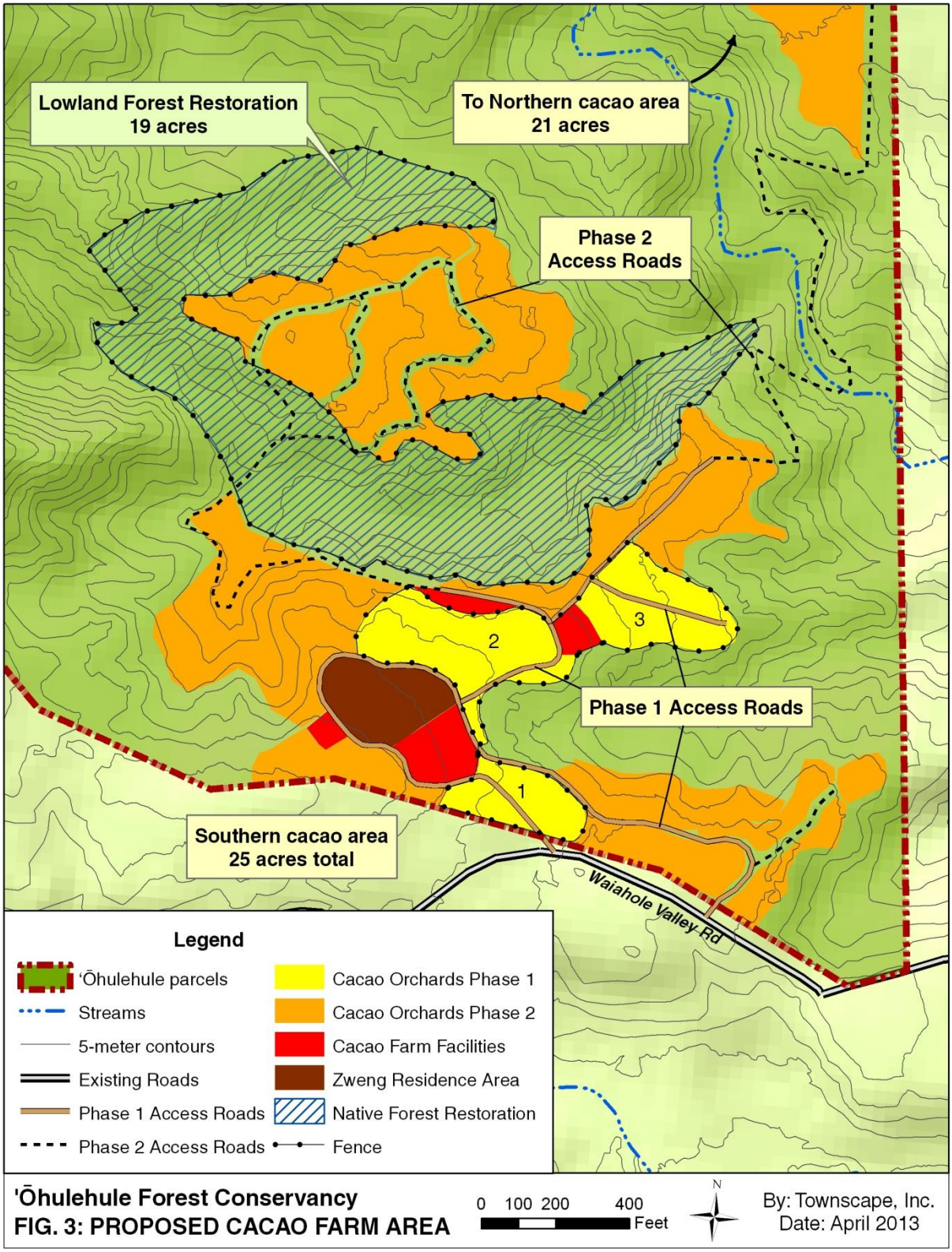
This Environmental Assessment summarizes proposed management actions described in the management plan and analyzes three alternatives: 1) implement proposed actions, 2) a no-action alternative, and 3) alternative crops. The proposed actions are expected to have primarily positive effects on the natural resources of the property as well as for the local community. No significant adverse effects are anticipated with regards to environmental and cultural resources, view planes, or access to properties in the vicinity of the proposed cacao farm.



'Ōhulehule Forest Conservancy

FIGURE 2. LONG-TERM VISION (20+ YEARS)

For: 'Ōhulehule Forest Conservancy
By: Townscape, Inc.
Date: March 2013



'Ōhulehule Forest Conservancy
FIG. 3: PROPOSED CACAO FARM AREA

1. Cacao Farm General Approach

Cacao (*Theobroma cacao*) is an understory tree (growing best beneath partial shade) native to the tropical region of the Americas. The fruit of the cacao tree is called a cacao pod, ovoid in shape, and measuring approximately 15 to 30 cm long. Each pod contains 20 to 60 seeds, usually called cacao "beans", which are harvested, processed, and used in the manufacture of chocolate. When properly managed, cacao crops are associated with low levels of environmental impact compared to other crops. Additionally, cacao trees are not invasive to native Hawaiian forests, unlike some other commercial crops (*e.g.*, coffee).

Cacao is a relatively rare crop in Hawaiʻi and therefore there is not an abundance of local production experience. Because of this, it is important for us to test our proposed production method before expanding to full scale so that any potential issues can be identified and corrected early in the process. Our first step is therefore to identify whether cacao production in Waikāne Valley is feasible and to determine optimal production methods in this environment.

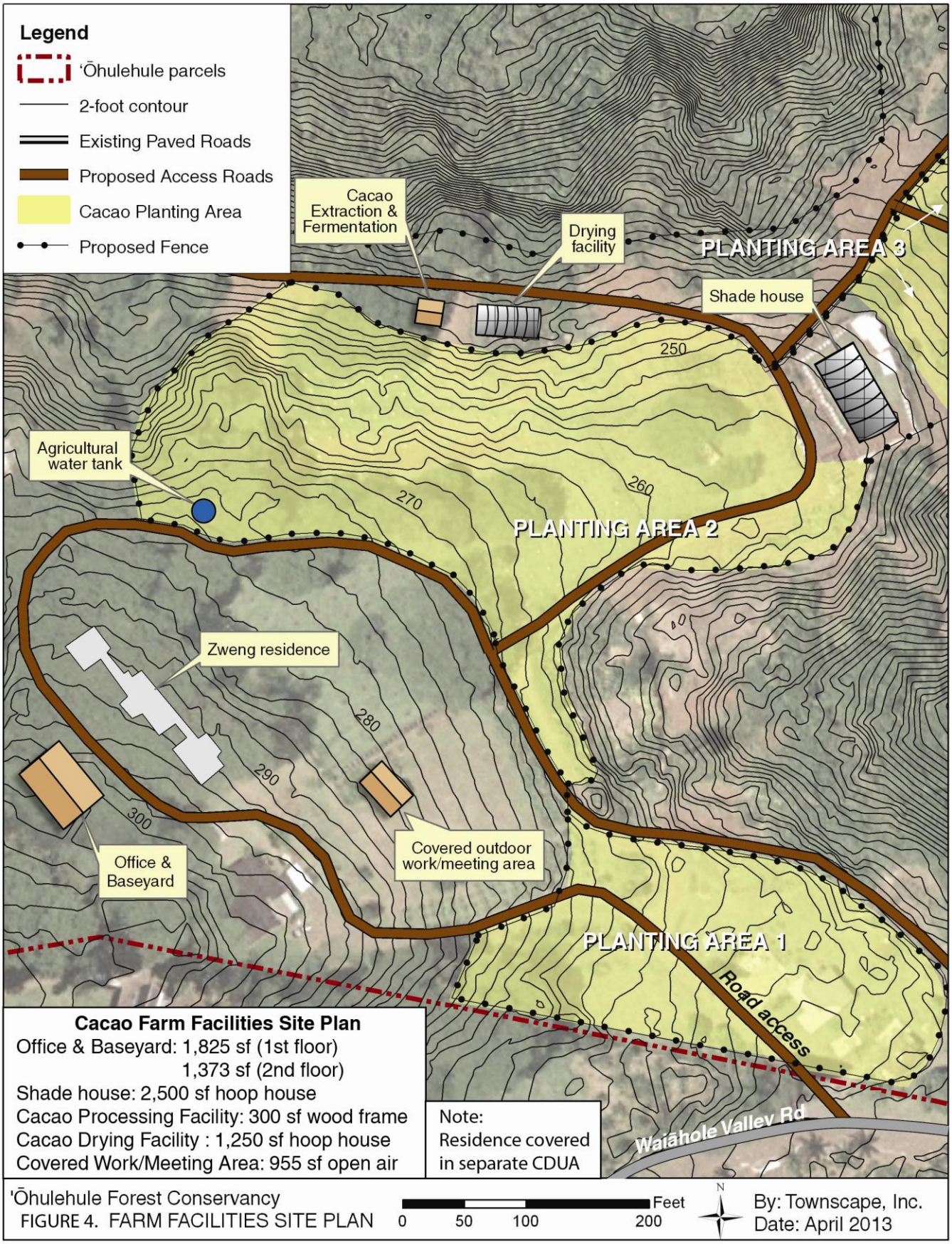
Although they can be grown in full sun, cacao trees do best under light shade (*i.e.,* 25-35% shade). We are proposing to develop an agroforestry farm using predominantly koa (*Acacia koa*) trees as in-field shade trees in the cacao orchard. Koa trees have the potential to provide many benefits to a cacao orchard, including nitrogen fixation, light shade, and wind protection. Additionally, establishing low-elevation wilt-resistant koa in the valley would bring ecosystem benefits as well. In Waikāne Valley's wet climate, this type of agroforestry system cultivation may only require limited supplemental irrigation and agricultural inputs for cacao cultivation.

Young cacao trees are expected to mature in about three to five years. It is during the first few years of tree establishment that cacao orchards will require the most labor—*e.g.,* monitoring, pruning, pest control, and irrigation. After the first three years, cacao crops are expected to be harvested one to four times per month during fruiting season (generally from December to June). The number of harvests per month depends on the size and maturity of the plants, as well as the time of year (*i.e.* peak, or tail end of harvest). The beans will need to be processed onsite, including fermentation and drying, so that they can be stored and shipped without spoiling.

Establishing the cacao farm will require the following short-term and long-term actions, further described below and depicted in Figures 3-5, including:

- Establish basic site infrastructure, including agricultural water supply, road access, and base-yard facilities for land preparation and farming equipment.
- Develop a nursery to grow cacao and koa seedlings (the nursery will also be used to grow native plants for the forest restoration project on the property).
- Develop commercial cacao fermentation and drying facilities to process cacao beans.
- Prepare and develop a shaded, five-acre pilot cacao orchard.

The proposed agroforestry actions are further described in Sections 2.2 and 2.3 and shown in Figure 3. **The initial five-acre test plot (Phase 1, shown in yellow) in Figure 3 is the only acreage covered by this EA.** This area was chosen because it is readily accessible and is located within a short distance from the existing water supply. Potential expansion of the cacao farm to the full production scale of 40-50 acres (Phase 2, shown in orange) is subject to further approval by the DLNR.


Legend
'Ōhulehule parcels
2-foot contour
Existing Paved Roads
Proposed Access Roads
Cacao Planting Area
Proposed Fence
Cacao Extraction & Fermentation
Drying facility
PLANTING AREA 3
Shade house
250
Agricultural water tank
260
270
PLANTING AREA 2
Zweng residence
280
290
300
Office & Baseyard
Covered outdoor work/meeting area
PLANTING AREA 1
Road access
Waiāhole Valley Rd
Cacao Farm Facilities Site Plan
Office & Baseyard: 1,825 sf (1st floor)
1,373 sf (2nd floor)
Shade house: 2,500 sf hoop house
Cacao Processing Facility: 300 sf wood frame
Cacao Drying Facility : 1,250 sf hoop house
Covered Work/Meeting Area: 955 sf open air
Note:
Residence covered in separate CDUA
'Ōhulehule Forest Conservancy
FIGURE 4. FARM FACILITIES SITE PLAN
0 50 100 200 Feet
N
By: Townscape, Inc.
Date: April 2013

2.1 Site Infrastructure and Five-Acre Test Orchard

2.1.1 Farm Buildings and Access

Several farm structures will need to be constructed in order to conduct day-to-day cacao farming activities. Those structures include (1) Office/Baseyard with secure base-yard facilities for storage of tools, equipment, farm vehicles, and farm implements on the first floor, and an office space for cacao farm operations and meetings on the second floor, (2) fermentation, drying, and storage facilities for cacao bean production (3) a plant nursery for growing cacao and koa seedlings (the nursery will also be used to grow native plants for the forest restoration project). Road access and parking areas will also be needed for these structures.

A Site-Specific Construction Best Management Practice Plan ("SSBMPP") will be assembled prior to beginning site construction activities, as required by DOH National Pollutant Discharge Elimination System (NPDES) regulations. The SSBMPP will be followed during construction activities. The SSBMPP will define Best Management Practice (BMP) objectives, identify appropriate BMPs for sediment control and contractor activities, and provide information on BMP installation and monitoring. BMPs related to building construction may include silt fences, compost socks, proper location of potential sediment sources, dust control, proper stockpile management, and/or other BMPs as needed.

Proposed farm structures that will need to be constructed are further described below. These include:

Office/Baseyard *(See Figures 6A-6D)*

1st Floor Base-Yard

- Purpose: secure covered storage of farming tools (including saws, clippers, augers, irrigation tools, *etc.*), farm vehicles (including tractor, forklift, ATV, truck, *etc.*), agricultural chemicals (including insecticides, herbicides, fertilizers, mechanical fluids, *etc.*), work space for maintenance and repair of farm tools and vehicles.
- Building size: 1,825 square feet (1st floor of office/baseyard facility).
- Paved and/or gravel parking spaces for up to four vehicles for anticipated daily use.
- The base-yard structure will have separate storage spaces for various equipment and chemicals. Base-yard floors will be concrete to help manage potential spills; additionally, any potentially harmful chemicals will be properly stored in secondary containment. Manure, which will be used as a fertilizer, will be properly stored under roof cover.
- The base-yard will have electrical (HECO) and water (WVWS) connections, as well as a septic system.
- On-going Best Management Practices: good housekeeping practices, spill prevention and control practices, emergency response kits present onsite.

2nd Floor Office Space

- Purpose: primary farm office where records will be stored and business will be conducted, including meetings.
- Building size: 1,373 square feet, with office space, small library/storage space, meeting room, and restrooms. (2nd floor of office/baseyard facility).
- Capacity: up to 15-20 persons (meeting room)
- The office will have electrical (Hawaiian Electric Company [HECO]) and water (Waiāhole Valley Water System) connections, as well as a septic system for wastewater disposal. Prior to construction of the septic system, we will submit the appropriate permit to the State Department of Health.
- Paved and/or gravel parking spaces for up to five vehicles for anticipated daily use for staff and visitors.

Covered outdoor work/meeting pavilion *(See Figures 7A and 7B)*

- Purpose: A covered and ventilated outdoor pavilion will accommodate cacao drying and processing, as well as meeting and work space.
- Building size: 955 square feet.

Cacao Extraction and Fermentation *(See Figures 8A and 8B)*

- Purpose: to prepare, ferment and dry harvested cacao, and to provide storage for the cacao bean production. After harvest, cacao pods are cracked and the seeds inside are fermented before being dried. The cacao processing facility will consist of a shaded area where cacao pods will be cracked, a fermentation house, and a covered and ventilated drying area.
- Structure size: 300 square feet preparation and fermentation house
- The fermentation structure will be a small building with double-wall construction to accommodate insulation for the retention of heat. The building will also have a collection system to capture the liquid resulting from the fermentation process (known as "sweatings"). The cacao fermentation process may produce a few gallons of sweatings per day at full production; sweatings contain sugars, alcohol, and acetic acid. Although not toxic, the sweatings are mildly corrosive and are likely to attract insects. The collection system will be connected to a reservoir that will be regularly emptied into the property's septic system.
- The cacao fermentation area will also have electrical (HECO) and water (WVWS) connection.

Drying facility

Purpose: covered and ventilated area for drying cacao as part of processing

Building size: 1,250 square-foot hoop house covered with shade cloth, similar to shade house/plant nursery construction.

Shade house/Plant Nursery *(See Figure 5)*

- Purpose: to grow seedlings of cacao and koa trees for orchard propagation; to grow seedlings of native and rare plants for propagation in the forest restoration area located on the *mauka* parcel of the property.
- Structure size: up to 2,500 square feet
- A hoop house will be used for the plant nursery. The hoop house will be covered with 4-millimeter ultraviolet-resistant plastic and shade cloth as needed. Gravel will be used as ground cover in the hoop houses to prevent weed growth. An overhead and/or drip irrigation system will be installed in the plant nursery; a fogger may also be used as needed.
- The plant nursery will have electrical (HECO) and water (WVWS) connections.
- The plant nursery will be approximately 35 feet wide by 70 feet long, with a 6-foot sidewall and total height of 15 feet. These are the standard dimensions of a shade house used by the U.S. Army for its native plant propagation program, which is available from local greenhouse supplier Island Growers. A shade house of this size can hold 700-1000 plants.
- The shade house facility will be similar to those developed by the U.S. Army, The Nature Conservancy, and the Lyon Arboretum for their native plant nurseries. It will follow requirements identified in the 2010 "Phytosanitation Standards and Guidelines" for nursery facility/adjacent growing area, equipment, pesticides, media and general sanitation. The facility design and phytosanitation procedures will help control and mitigate the threats to native plants both in the shade house and in forest restoration areas targeted for outplanting.

The small seedlings will receive water through mist irrigation, then by hand-watering once they grow larger. This type of irrigation allows for minimal water and nutrient loss. The shade house will have electric power and water supply. The plants in the shade house will be watered using drip systems with timers. The ground will have a slight slope, allowing for water to drain away from the "footprint" of the shade house so as to prevent/mitigate against bacteria, algae, and fungal-related problems. Plastic benches of 3 feet by 8 feet (at least 19 inches above the ground) will be used to create two 16-foot bench rows with a center aisle. Gravel and weed mats will be used as ground cover in the shade house to prevent weed growth.

We will work with the University of Hawaiʻi College of Tropical Agriculture and Human Resources (CTAHR) extension service to develop an integrated pest management system (IPM) for the shade house. The pests

that we expect to confront while propagating native Hawaiian plants in the shade house include (but are not limited to) ants, aphids, mealybugs, whiteflies, slugs, spidermites, scale, and thrips. These pests will be managed using a combination of the following: systemic pesticides, neem oil, soap spray, mitecides, and/or horticultural oil. Insecticides such as Avid™ (active ingredient Abamectin) and Marathon™ (imidacloprid) will be used to control insects, with attention to issues such as the potential impact of imidacloprid on local bee populations. Neem oil and soap sprays will be used to control fungal infection, since they are proven to be effective and are safer for human health than more toxic fungicides. For slugs, Sluggo™ (food bait containing 1% iron phosphate) works well and is an organic product.

Seedlings may be fertilized through foliar feeding on a monthly basis using Miracle Gro™ (15-30-15). When/if leaves turn yellow from lack of nitrogen and/or iron, we will foliar feed the seedlings using Miracid™ (30-10-10). Also, granular slow-release fertilizers such as Nutricote™ 16-16-16 Multi-purpose Plant Food and Peter's™ Water-soluble Fertilizer may be applied to the potting soil. Pesticides and fertilizers will be used minimally according to directions on the labels to minimize potential impacts.

Even when fertilization and irrigation factors are optimized, the shade house may generate a small amount of runoff containing traces of pesticides and elevated amounts of nitrogen, phosphorus, and potassium from fertilizers. Any runoff will be diverted into a nearby bioretention swale, a vegetated depression that aids water percolation into the soil. The swale will be planted with common native plants that help to remove chemicals from the shade house runoff through phytoremediation.

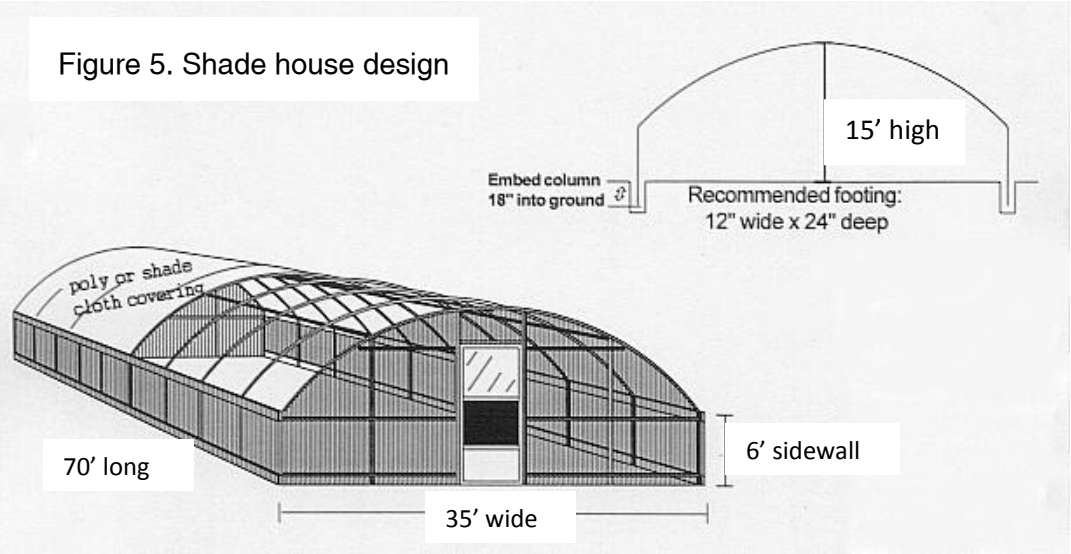


Figure 5. Shade house design

GLAI GEOFFREY LEWIS ARCHITECT, INC.

Figure 6A. Office/baseyard Front Elevation

Scale: 1/8” = 1’-0”
5/6/2013

FIGURE 6A. Office/Baseyard Front Elevation

GLAI GEOFFREY LEWIS ARCHITECT, INC.

Figure 6B. Office/baseyard SideElevation

Scale: 1/8" = 1'-0"
5/6/2013

FIGURE 6B. Office/Baseyard Side Elevation

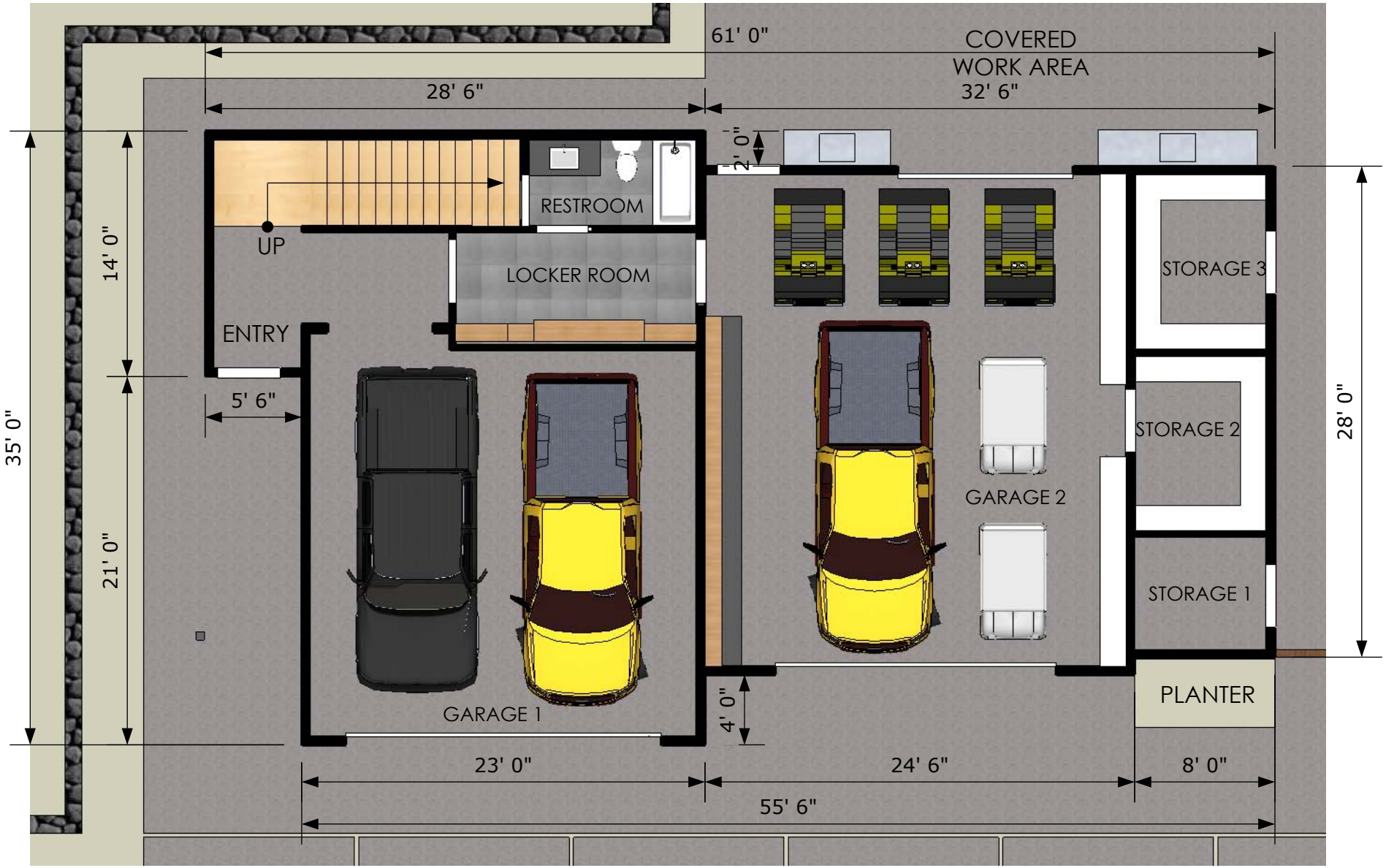


Figure 6C. Office/baseyard 1st Floor Plan

FIGURE 6C. Office/Baseyard 1st Floor Plan

Scale: 1/8" = 1'-0"

5/6/2013

GLAI GEOFFREY LEWIS ARCHITECT, INC.

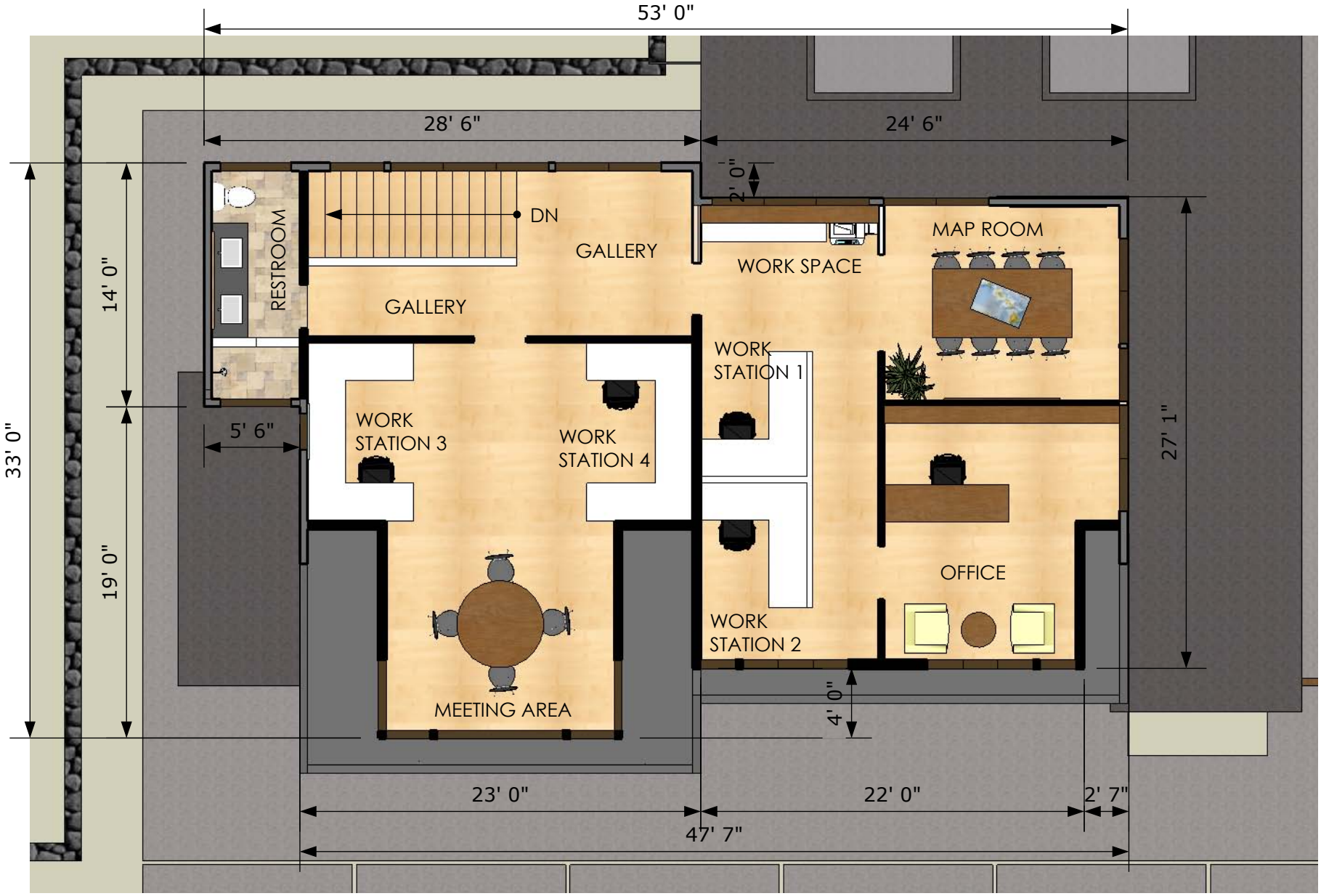


FIGURE 6D. Office/Baseyard 2nd Floor Plan

Figure 6D. Office/baseyard 2nd Floor Plan

Scale: 1/8" = 1'-0"
5/6/2013

GLAI GEOFFREY LEWIS ARCHITECT, INC.

FRONT

SIDE

GLAI GEOFFREY LEWIS ARCHITECT, INC.

Figure 7A. Drying Pavilion/ Meeting Area Elevations

Scale: 1/8” = 1’-0”
5/6/2013

FIGURE 7A:

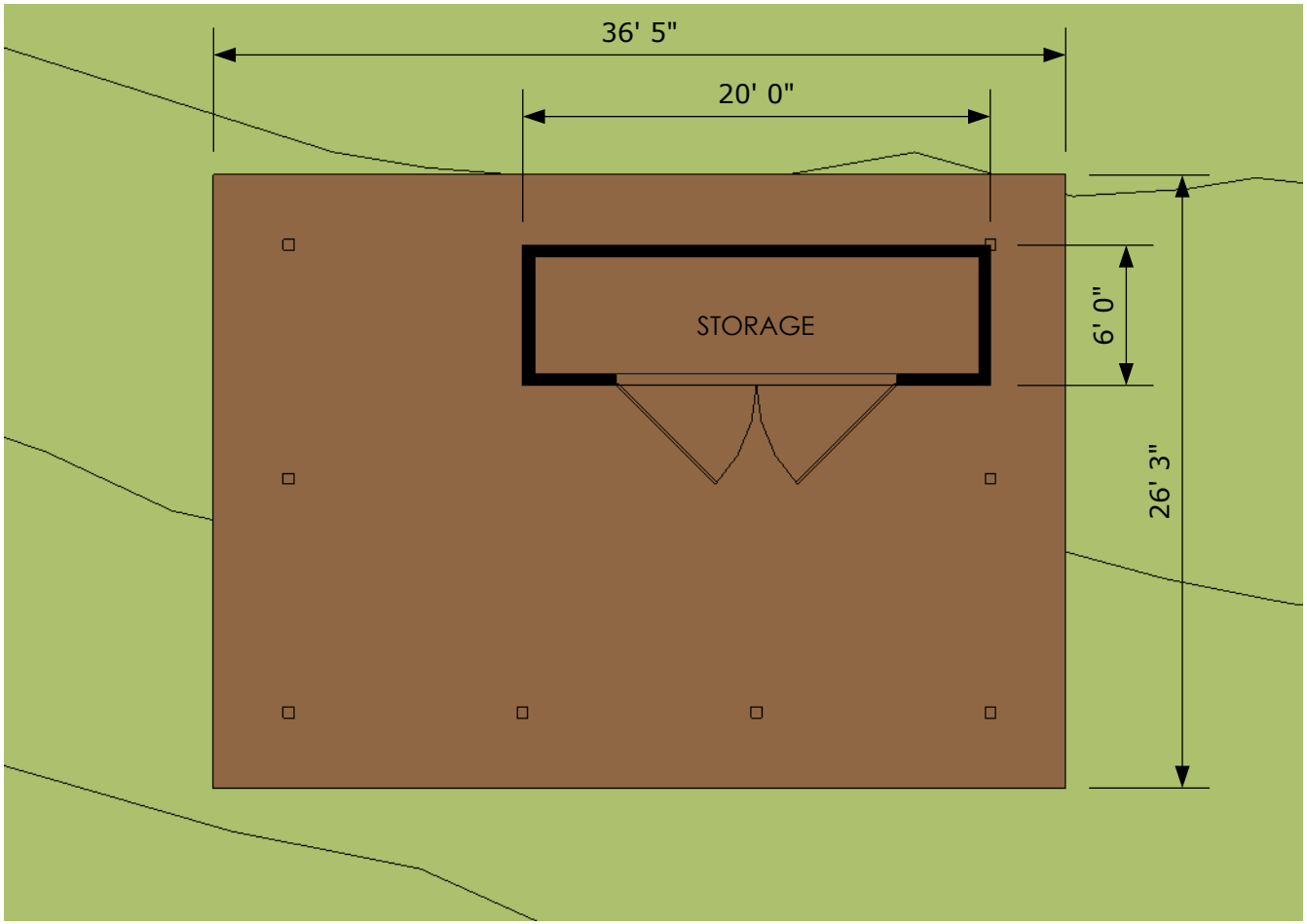
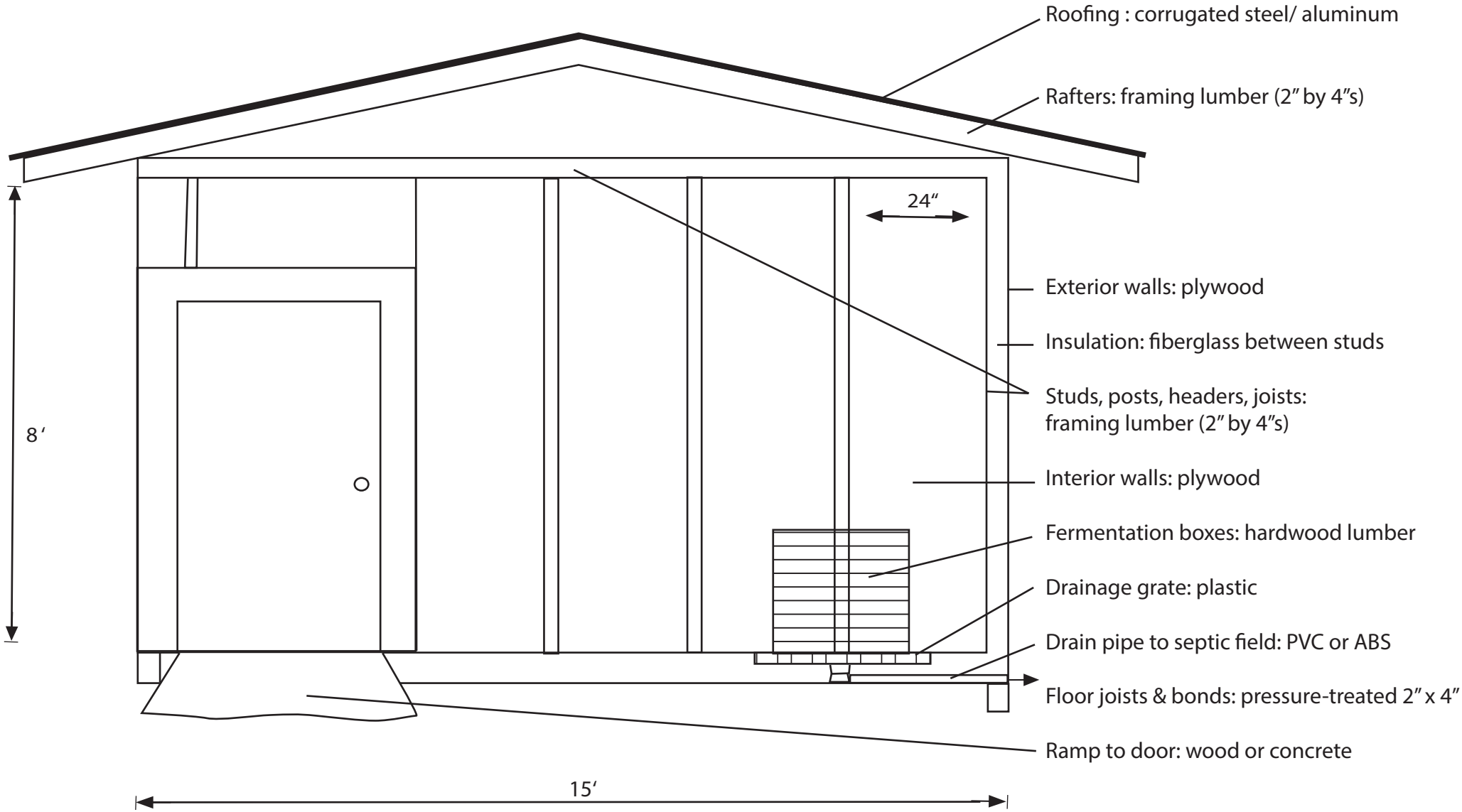


Figure 7B. Drying Pavilion/ Meeting Area Floor Plan

Scale: 1/8” = 1’-0”
5/6/2013

GLAI GEOFFREY LEWIS ARCHITECT, INC.

FIGURE 7B:



Front view
length = 20 '
width = 15'
h = 8'

Additonal features:
Electric supply and breaker box (two 20-amp circuits)
Lights (fluorescent -- approx. 160 watts) or small window
Heaters (1500 - 3000 watts)
Thermostat
Exhaust fan (20 - 60 watts)
Water supply (3/4 " hose bibbs) and hose

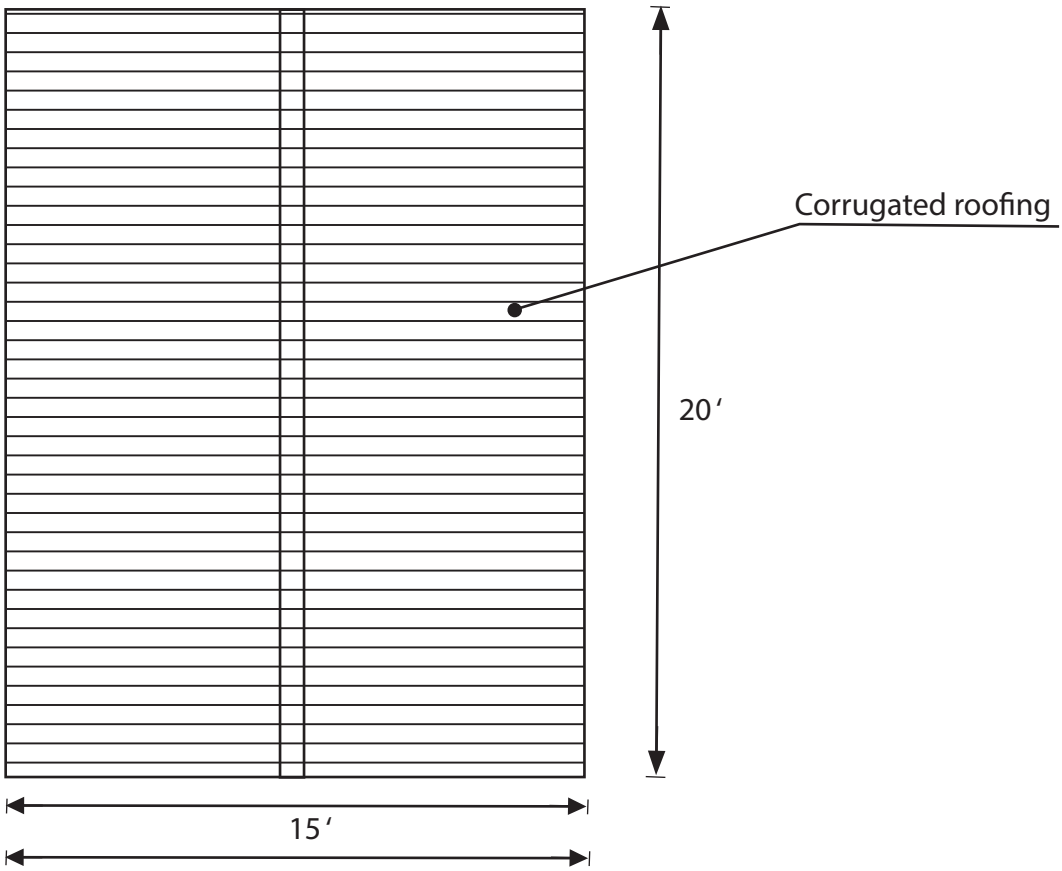
'Ohulehule Forest Conservancy
Figure 8A. Cacao Extraction/Fermentation Facility Front Elevation

1' 2' 5'

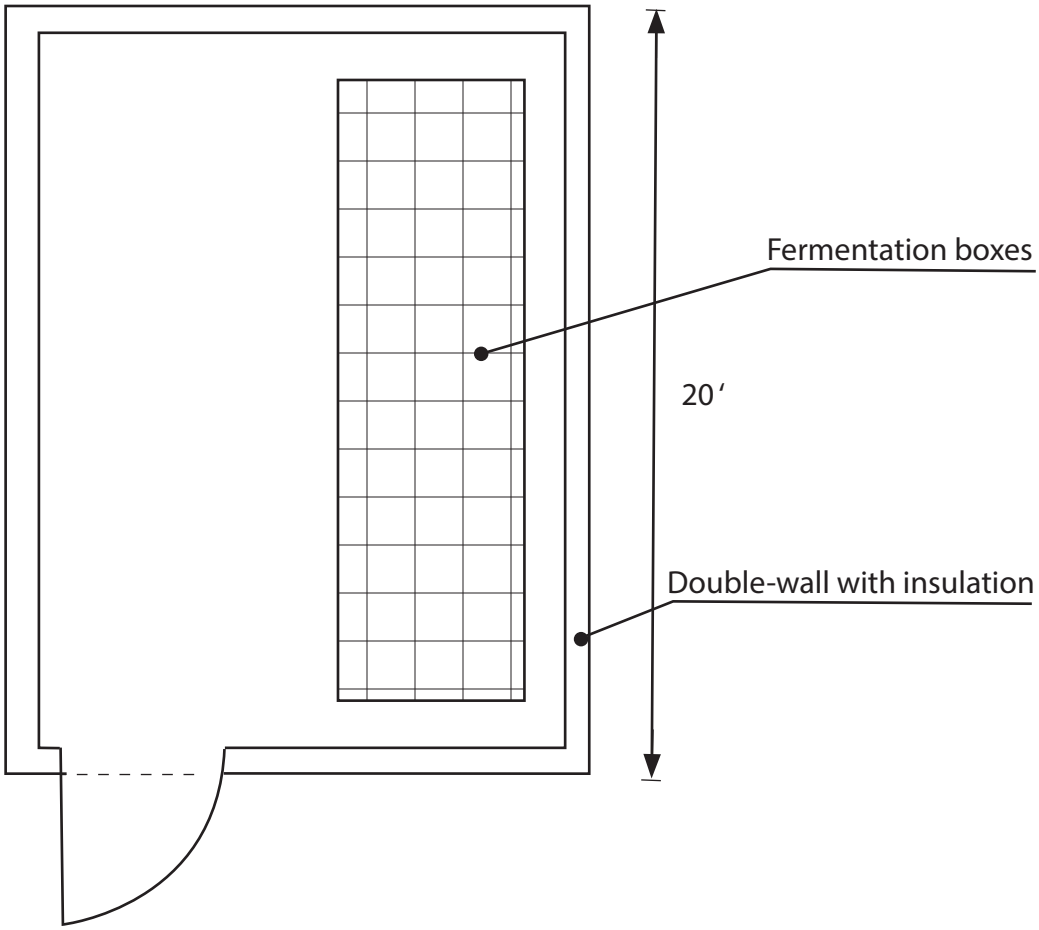
By: Daniel O'Doherty and Townscape, Inc.
Date: April 2013

CACAO EXTRACTION AND FERMENTATION STRUCTURE

ROOF PLAN



FLOOR PLAN



‘Ohulehule Forest Conservancy
Figure 8B. Cacao Extraction/Fermentation Floor Plan

1’ 2‘ 5’ 10’

By: Townscape, Inc.
Date: April 2013

Access Road Repairs

There are several existing unimproved jeep trails on the *makai* parcel of the property, including several trails established by recreational off-road vehicles that trespass on the property. There are a number of challenges associated with the jeep trails on the *makai* parcel, including water ponding and poor drainage in gulch areas, soil erosion, and steep slopes. Jeep trails will need to be repaired using established BMPs to provide safe access for farming vehicles between cacao orchards while minimizing environmental impacts such as soil erosion.

The ʻŌhulehule Forest Conservancy will work with a licensed forester and/or the USDA Natural Resource Conservation Service to plan and to oversee road restoration work, and obtain a National Pollutant Discharge Elimination System (NPDES) permit before conducting activities that disturb more than one acre of land. A Conservation Plan approved by the Windward Soil and Water Conservation District (SWCD) in January 2013 provides further detail on road repair work.

The location of access roads is shown in Figure 3. Restored farm access roads will be unpaved and 8 to 12 feet wide for use by light farming vehicles. Cacao farming does not require heavy farming machinery. Vehicles that will be utilizing the restored roads will include light trucks and small tractors. Road restoration work will be conducted using a backhoe excavator and will follow the design principles outlined below and shown in Figures 9 and 10:

1. Road general locations and general profiles:

    - <u>Side-hill locations:</u> up-slope armored ditch and broad-based diversion ditches to transfer water from up-slope-ditch to down-slope area. Road profile may be crowned or in-sloped.

    - <u>Flat bench section</u>: diversions, ditches and broad-based ditches as required to control any water insertion from adjacent area. Road profile predominantly crowned or in-sloped.

2. Minimize disturbed area and soil exposure during construction.

3. Protect any denuded slopes created during road restoration by installing temporary erosion-control blankets (ECBs) and seeding slopes with erosion-control vegetation.

4. General water flow control to minimize soil erosion and maintain road structure:

    - All water insertion points identified will be directed across road as soon as practical. All insertion points and road crossings will be armored against erosion and water released in a non-eroding flow. Insertion points are draws or other topographic feature that tends to focus water flow or collect water flow but are not streams or other water bodies. These insertion points must be stabilized and water flow must be controlled to maintain road structure and to minimize soil erosion.

    - Geotextile fabric will be placed between the aggregate surfacing materials and the subgrade soils to increase the load-carrying capacity of the road in areas susceptible to rutting.

- Road surface sloping or crowning with armored roadside ditches so as to direct runoff off the road surface. Drainage features such as armored broad-based diversion dips or water bars will be placed at adequate intervals to direct runoff out of roadside ditches and road surface downslope, where it can be absorbed and dispersed. Ditches will be armored using various options including permanent geotextiles, rock armor or possibly concrete block.

- Broad-based diversion ditches will transfer water from one side of road to the other and intercept any water which may collect and travel down the road running surface. The broad-based diversion ditches may be armored with stone, concrete block segments or similar non erosive and minimally wearing material. Broad-base locations and construction materials will be field determined and Forestry BMP guidance for spacing will be utilized.

- Water which has been collected or diverted will be released in a dispersed manner, reducing the energy of the water flow. Use of stone level-lip spreaders, geotextiles, geo-grids, vegetation, settling ponds or a combination may be utilized.

- Road surface may not be armored with gravel, stone or other material on slopes less than 5%. On slopes between 5% and 10% the road will be surfaced with material similar to or better than 3-inch minus. Road sections exceeding 10% slopes will be minimized. If any road sections exceed 10% slope, they will require full armored travel section. The travel surface will consist of any individual or combination of techniques that provide road surface protection from erosion. Examples of, but not limited to, include: articulated cable concrete blocks, individually set concrete blocks, recycled concrete of approximately 8-inch minus or stone similar to 8-inch minus. These options may require the associated use of geo-grid to assist in added stabilization of the sub-grade.

- Residual slopes from cut or fills are targeted to a 2:1 slope where possible. Slopes will be stabilized by erosion control blankets or similar method.

BMPs that may be implemented in various areas to minimize environmental impacts and increase the life of agricultural roads include conducting road work during clement weather, road crowning, broad-based diversion ditches, water bars, streamside zone management practices, and other erosion-control techniques. Erosion-control blankets and/or ground cover vegetation will be used to stabilize steep slopes on road banks. The section of this CDUA addressing Best Management Practices includes a table with access road BMPs.

Some of the drainage control Best Management Practices that will be followed for proposed road repairs by the ʻŌhulehule Forest Conservancy are illustrated in Figures 9 and 10 below:

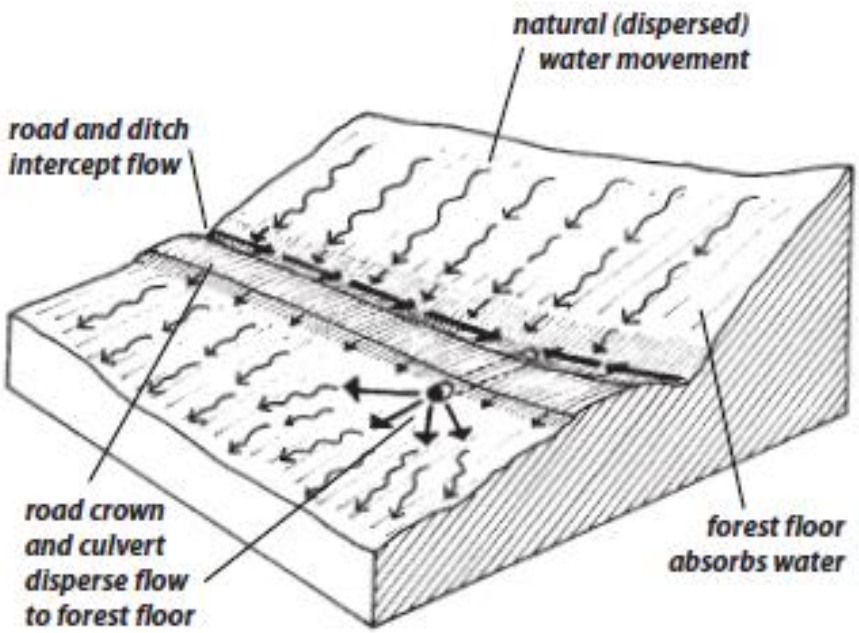


Figure 9. Road planning and drainage management

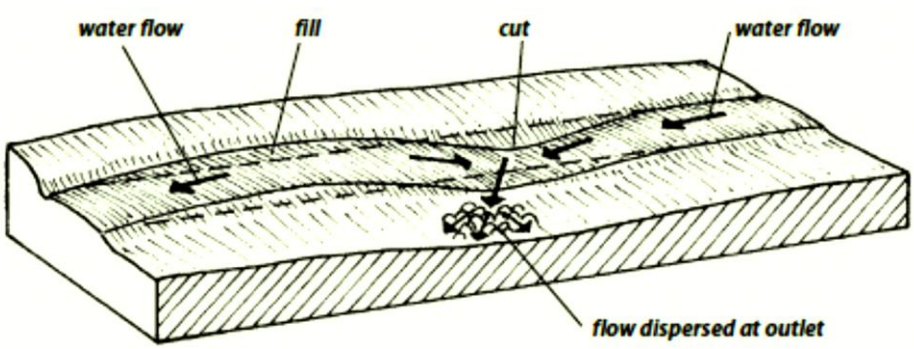
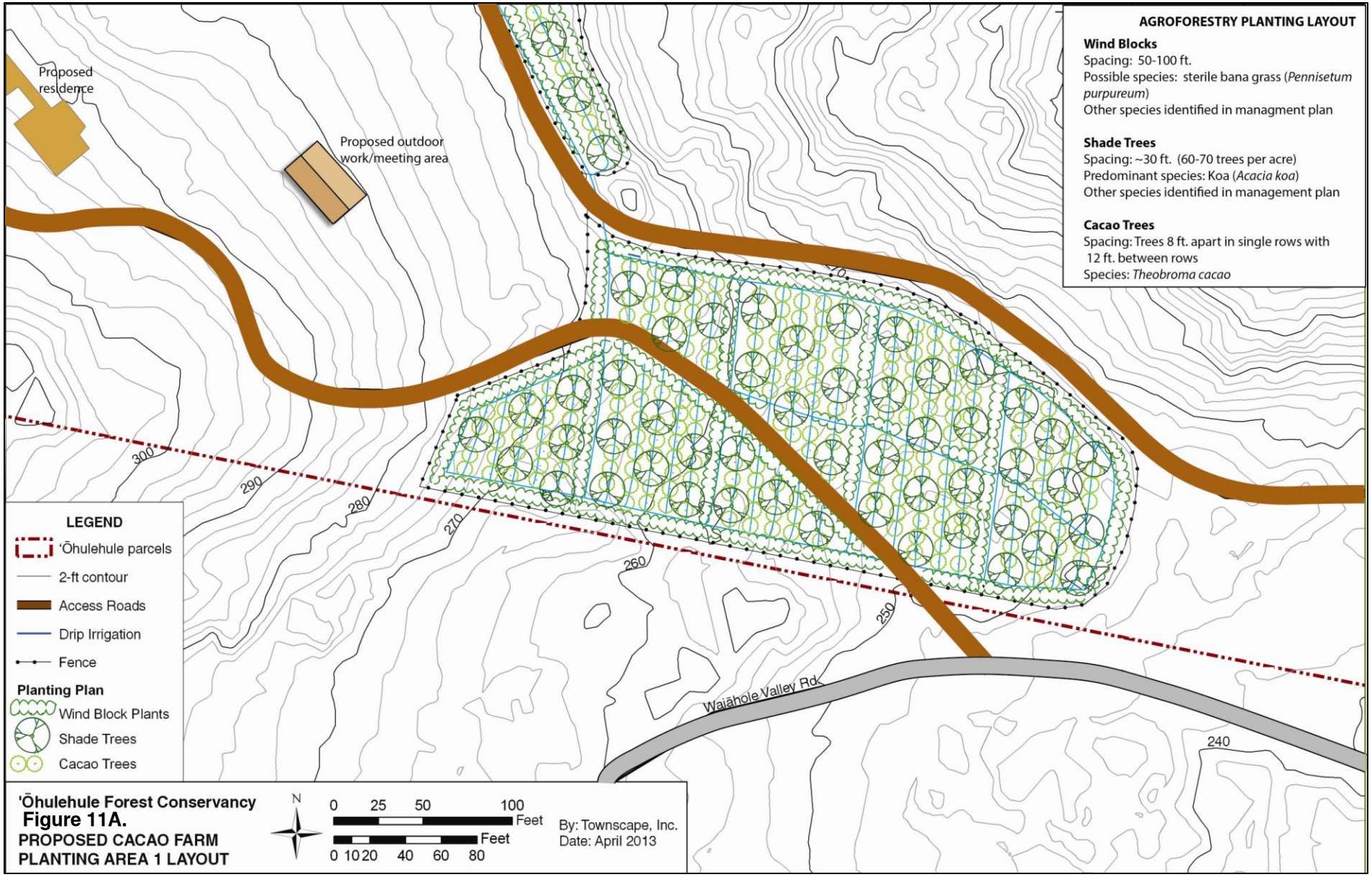
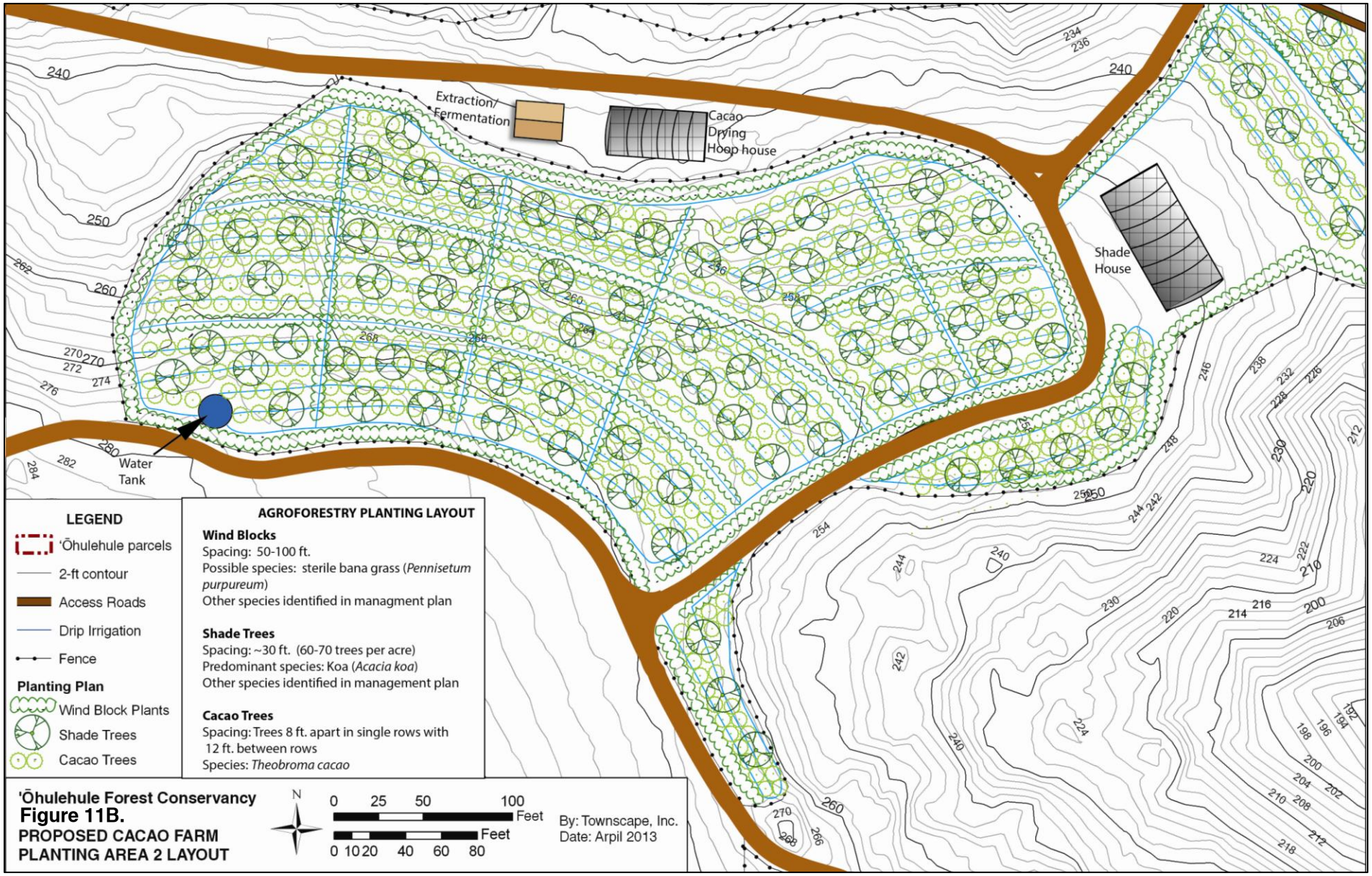
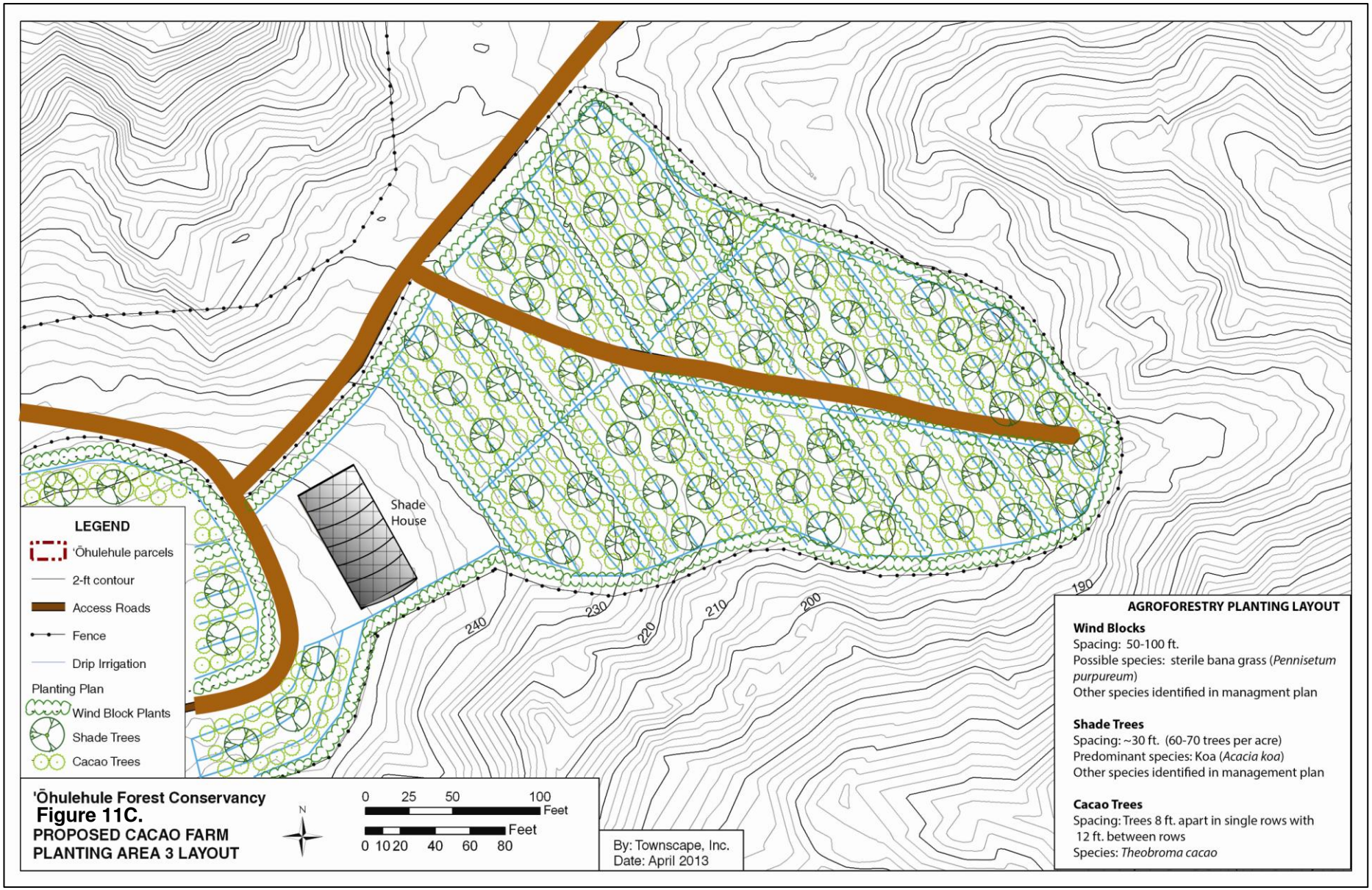


Figure 10. Broad-based diversion channel



'Ōhulehule Forest Conservancy
Figure 11A.
PROPOSED CACAO FARM PLANTING AREA 1 LAYOUT


Extraction/
Fermentation
Cacao
Drying
Hoop house
Shade
House
Water
Tank
LEGEND
'Ōhulehule parcels
2-ft contour
Access Roads
Drip Irrigation
Fence
Planting Plan
Wind Block Plants
Shade Trees
Cacao Trees
AGROFORESTRY PLANTING LAYOUT
Wind Blocks
Spacing: 50-100 ft.
Possible species: sterile bana grass (Pennisetum purpureum)
Other species identified in managment plan
Shade Trees
Spacing: ~30 ft. (60-70 trees per acre)
Predominant species: Koa (Acacia koa)
Other species identified in management plan
Cacao Trees
Spacing: Trees 8 ft. apart in single rows with 12 ft. between rows
Species: Theobroma cacao
'Ōhulehule Forest Conservancy
Figure 11B.
PROPOSED CACAO FARM
PLANTING AREA 2 LAYOUT
N
0 25 50 100 Feet
0 10 20 40 60 80 Feet
By: Townscape, Inc.
Date: Arpil 2013


LEGEND
'Ōhulehule parcels
2-ft contour
Access Roads
Fence
Drip Irrigation
Planting Plan
Wind Block Plants
Shade Trees
Cacao Trees
Shade House
240
230
220
210
200
190
AGROFORESTRY PLANTING LAYOUT
Wind Blocks
Spacing: 50-100 ft.
Possible species: sterile bana grass (Pennisetum purpureum)
Other species identified in managment plan
Shade Trees
Spacing: ~30 ft. (60-70 trees per acre)
Predominant species: Koa (Acacia koa)
Other species identified in management plan
Cacao Trees
Spacing: Trees 8 ft. apart in single rows with 12 ft. between rows
Species: Theobroma cacao
'Ōhulehule Forest Conservancy
Figure 11C.
PROPOSED CACAO FARM PLANTING AREA 3 LAYOUT
N
0 25 50 100 Feet
0 10 20 40 60 80 Feet
By: Townscape, Inc.
Date: April 2013

2.1.2 *Five-acre Test Orchard*

The five-acre cacao orchard will be located within the southern cacao area (see Figure 3, Phase 1 in yellow). This area was chosen because it is readily accessible and is located within a short distance from the existing water line. The following activities will be conducted to establish and manage the orchard and are further described below:

1. Land clearing and preparation (soil amendments, erosion control and irrigation system)
2. Establishment of wind blocks and shade trees
3. Cacao tree establishment
4. Fencing (if needed for pig control)
5. Pest control
6. Nutrient management
7. Water management

1. Land Clearing and Preparation

Approximately three of the five acres proposed for cacao orchard development are located on land that needs to be cleared of alien trees and shrubs. The following steps will be used in conducting clearing, to minimize erosion and sedimentation impacts:

Activities	Best Management Practices
Land clearing work period:	1. Land clearing will be conducted outside of the wettest months, which typically are December through March. To the extent possible, we will conduct land clearing during clement weather in order to minimize potential erosion. 2. Trees taller than 15 feet will be cleared outside of the Hawaiian hoary bat pupping season from June 1 through September 30.
Prior to beginning land clearing activities:	1. Cultural Surveys Hawai‘i, Inc. conducted an archaeological inventory survey of the property and confirmed that no historic sites are present in the proposed cacao orchard areas. Based on these findings no cultural or historic sites will be impacted by the cacao orchard establishment. 2. We will conduct a site reconnaissance before the start of land clearing activities to identify the presence of any native trees and plants to preserve during land clearing, preparation, and planting. 3. We will collect soil samples to identify whether any soil amendments need to be added as part of land preparation when clearing is completed.
Land clearing activities:	1. We will clear strawberry guava thickets and small shrubs using a small bulldozer. We will use a portable chipper to mulch the cleared vegetation. The mulch will be stored in prescribed locations and covered with a tarp to solarize for 4 to 6 weeks to kill weed seeds. The mulch produced will be used to control weeds and erosion in the orchards.

	2. We will remove invasive trees with trunk diameters larger than 4 inches using a backhoe excavator to excavate soil around the root mass and push the tree over. 3. The trunks of larger trees that cannot be mulched will be cut into logs and laid across hill slopes on the edges of the cacao orchard for slope stabilization and erosion control.

Land preparation, irrigation system establishment, and erosion-control and weed-suppression practices will be conducted immediately upon completion of land clearing to (1) improve site conditions for establishing orchards and (2) to minimize erosion and weed germination. These practices are outlined below:

Action	**Best Management Practices**
Land Preparation	Land preparation activities include disking and soil amendment. "Disking" involves rolling a set of metal plates behind a tractor for the purpose of amending the soil with fertilizer. The disks "slice" the topmost portion of the ground/soil. Disking is an efficient method of land preparation, and causes significantly less ground disturbance than rototilling. Soil amendments may include (1) application of lime to raise the soil pH to 5-7, which is optimal for cacao cultivation, and (2) application of organic fertilizers, as needed.
Erosion control and weed-suppression	We will test three erosion-control and weed-suppression methods to determine their relative effectiveness: 1) ground-cover cloth on 1.5 acres, 2) mulch on 2 acres, and 3) vegetative conservation cover on 1.5 acres. 1. In the ground-cover-cloth test plot, we will establish the ground-cover cloth about the base of the trees and sow conservation cover vegetation (*e.g.*, sunn hemp [*Crotolaria juncea*] and/or perennial peanut [*Arachis pintoi*]) between tree rows. Once established, the conservation cover will be maintained by mowing on a regular basis. 2. In the mulch test plot, mulch will be spread within and between tree rows during the initial establishment of windbreak, shade and cacao trees. Mulching helps conserve soil moisture, control erosion, suppress weed growth and facilitate the establishment of vegetative cover. 3. In the vegetative conservation cover test plot, conservation cover vegetation (*e.g.*, sunn hemp [*Crotolaria juncea*] and/or perennial peanut [*Arachis pintoi*]) will be sowed within and between tree rows.
Micro-irrigation system establishment	A surface micro-irrigation ("drip irrigation") system will be constructed along the tree rows with emitters at the base of each tree.

The overall management plan for the cacao farm was developed with an agricultural consultant specializing in cacao in Hawai'i, and the decision to pursue an agroforestry model is aligned with the 'Ohulehule Forest Conservancy's conservation philosophy. To determine the proposed planting layout for the cacao farm, we consulted with Mr. H.C. "Skip" Bittenbender, Ph.D. Extension Specialist for Cacao at the University of Hawai'i at Manoa College of Tropical Agriculture and Human Resources (CTAHR), Mr. Niklos Dudley of the Hawaii Agricultural Research Council (HARC), staff members from the Natural Resources Conservation Service (NRCS), and a number of active cacao farmers.

4. Establishment of Wind Blocks and Shade Trees

Cacao trees are particularly sensitive to wind and must be protected from trade (and other) winds by establishing perimeter and in-field wind blocks in place before planting of the cacao trees. Wind blocks will also help to reduce soil erosion from wind and rain, as well as promote conditions that are conducive to cacao tree pollination. Plant species that work well as wind blocks for cacao orchards include: panax (*Polyscias guilfoylei*), neem (*Azadirachta indica*), sterile bana grass (*Pennisetum purpureum*), soursop (*Annona muricata*), hibiscus (*Hibiscus spp.),* and bananas (*Musa acuminate x paradisiaca)*. Several non-invasive wind-block species are being contemplated for testing on the first five acres of cacao orchards to determine relative effectiveness and adaptation to site conditions. See Figures 11A, 11B, and 11C for diagrams of the proposed planting layout of wind blocks, shade trees and cacao trees.

Wind blocks will be planted in rows along the contour, approximately 50-100-feet apart and around the perimeter of each cacao field. Rows of wind block may also be planted perpendicular to the contour, creating a box-like configuration. Larger wind block species such as neem can be planted at the end of cacao rows, with shorter species such as panax and banagrass planted between the larger species. Relatively dense wind blocks are recommended at least during establishment of the cacao seedlings. Temporary wind block rows (*e.g*., bana grass, banana) can be alternated with rows of permanent windbreak (*e.g*., neem trees). As the permanent windbreak develops in height and density, and the cacao canopy fills in, some of the temporary windbreaks can be removed and replanted with cacao. Wind blocks will be irrigated using drip irrigation for the first 6 to 12 months of establishment and may also require occasional irrigation during the dry season.

The Hawai'i Agricultural Research Corporation (HARC) has been conducting selection of koa trees with genetic resistance to the koa wilt (*Fusarium oxysporum*) on the windward side of O'ahu. These trees have higher survival rates at low elevations than non-selected koa trees. We will use these "low-elevation" koa trees, as well as koa trees produced from seed from Waikāne koa trees, as the dominant in-field shade trees. We plan to plant koa seedlings at approximately 30foot intervals within alternating rows of cacao trees, and to irrigate using drip irrigation for the first six months of establishment with additional watering as needed during drought periods. HARC recommends a relatively close spacing of koa trees to allow for the expected mortality of 25-30% and eventual thinning as needed. The final desired planting density is approximately 60-70 koa trees per acre. Since there are no existing

agroforestry models for koa that we are aware of, some degree of experimentation and adjustment is to be expected.

Because we anticipate that some portion of the koa trees will be lost to koa wilt, we anticipate planting other shades trees in addition to the koa trees. These additional trees may not be native Hawaiian trees, but will be carefully selected to include non-invasive characteristics. Candidate shade trees to supplement the koa include, but are not limited to, *Leucaena esculenta x L. leucocephala – 'KX4'*, and *Gliricidia sepium*. Both of these potential non-koa shade trees also have a light canopy, and tolerate heavy pruning compared to koa. These trees will be carefully monitored and shaped as needed to provide light shade similar to that provided by koa trees.

We plan to plant wind blocks and shade trees approximately 12 months in advance of cacao seedling planting. The windbreak and shade trees, especially fast-growing species like bana grass, are expected to provide sufficient protection if planted 12 months before cacao is transplanted. Additionally, we may use the protective "cages/tubes" which afford additional shade and wind protection for 6 months (or longer) after planting. The combination of windbreaks, shade trees, and cages/tubes would allow a total of 18 months for windbreak development to occur before the cacao seedlings are completely exposed.

5. Cacao Tree Establishment – Contour Orchard

After establishment of wind blocks and shade trees, cacao seedlings (at least six months old) would then be ready for transplanting to the prepared fields. We plan to plant cacao trees in rows along the contour, with approximately eight feet between trees in each row, and twelve feet between rows. The resulting density will be approximately 400-525 trees per acre. Trees in each row will be staggered relative to the adjacent row to create a triangular layout and to maximize the growing space for each tree. This spacing has been successful on other cacao farms in Hawai'i, and is expected to help maximize yields. It will also allow adequate access to the trees for harvesting and pruning once the trees are mature.

Cacao seedlings may be planted by augering a planting hole and planting one seedling in each hole. While using an auger is more efficient than digging holes with a shovel during wet periods the auger can glaze the sides of the hole and make it difficult for the seedling to root. Initially, some seedlings may be planted by hand and some by auger. The cacao seedlings will be monitored and compared to determine which planting method is better. In test plots with ground-cover cloth, a hole is cut in the ground cover cloth prior to digging/augering of the planting hole. Shade trees, wind blocks, and cacao trees are then planted on, or near, the contour.

Cacao trees generally require three to five years to mature. Weekly monitoring and maintenance will be needed during these early years. In-field conservation cover management and weed control involve mowing on a regular basis during this period. If needed, we may place a steel-wire cage covered with greenhouse film around each seedling. These covered cages are expected to provide a shaded and humid microclimate around each seedling and to protect them from wind and insect damage. This protection is expected to foster early establishment of the orchard.

6. Fencing

Fence installation may be needed if it is determined that feral pigs are impacting the orchard. If needed, a hog-wire/panel fence will be established around the orchard area to protect tree seedlings from feral pigs. We are aware of at least one instance in Waiāhole Valley where cacao seedlings were uprooted and damaged by feral pigs. Fence construction will include the following steps:

1. Planning and staking the fence route: to the extent possible, the fence corridor will follow natural topographical features such as ridges and will avoid the steepest slopes, stream channels, and sensitive plant communities. Fencing is not anticipated to cross any streams in the *makai* parcel.

2. Fence corridor clearing and fence installation: we will clear a corridor approximately 3-to-4-feet wide to allow for the fence installation. We will avoid cutting mature native trees. Non-native invasive trees that are cut to install the fence will be poisoned using approved herbicides to prevent re-sprouting. An experienced contractor will install and anchor the skirted hog-wire fence or modular panel fence. The type of fence that will be installed will depend on site constraints. It is the desire of ʻŌhulehule Forest Conservancy that the contractor will use local labor, to the extent possible, for the fence installation project.

The proposed fence line will be constructed with 16’ x 42” galvanized livestock panels or hogwire fencing, depending on the terrain. The fence material will be supported by steel fence posts and treated wood posts placed approximately 7 to 8-feet apart the entire length of the fence line. Shorter galvanized steel pins will be used as anchors where necessary. The fence will have an apron of hogwire laid horizontally along the ground and attached along the fence at least 1-1.5 feet up outside the fence to prevent pigs from digging under. The shorter galvanized steel pins will also be used to anchor the skirting. The fence alignment will be cleared by hand to a width of no more than 6 feet. The fence will not utilize any barbed-wire. Figure 12 below shows details of the fence materials, and Figure 13 shows the proposed fence design.

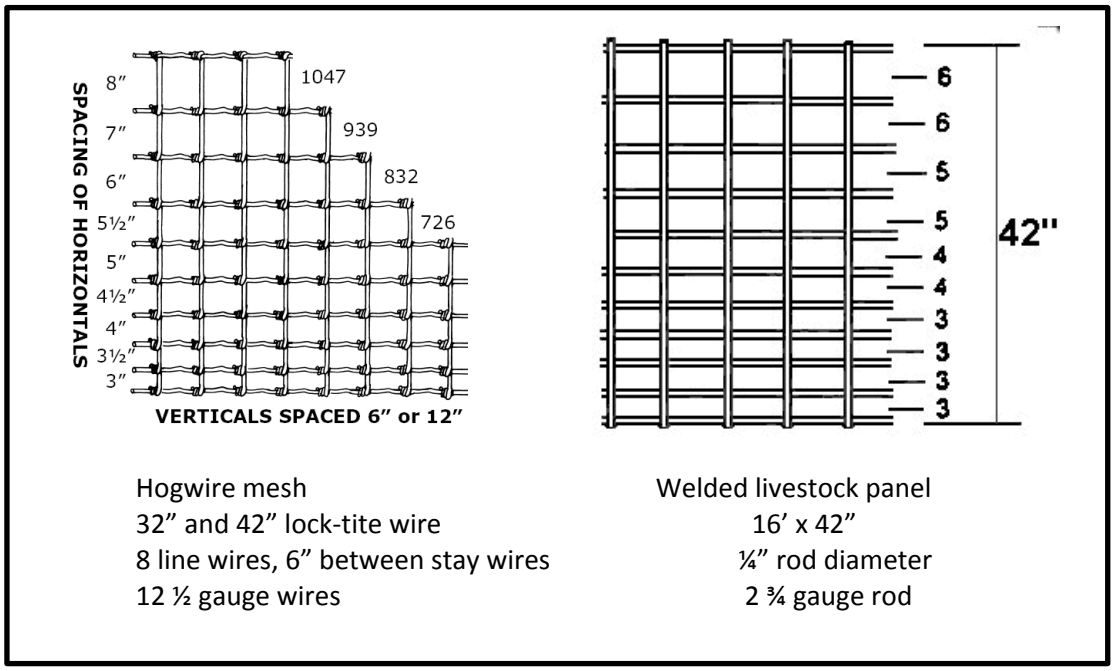


Figure 12. Details of hog-wire mesh and livestock panels

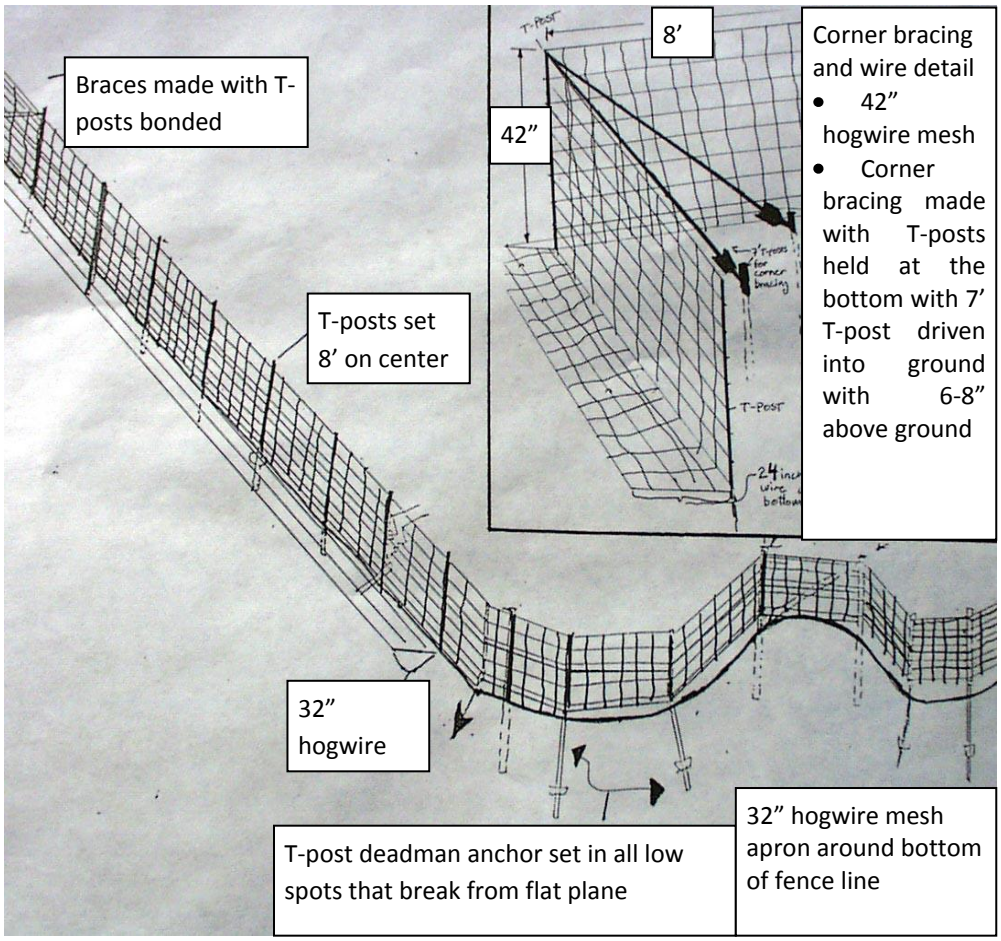


Figure 13. Schematic of fence design with post placement and mesh apron

7. Pest Control

With the exception of the Chinese Rose Beetle (*Adoretus sinicus* Burmeister), Hawai‘i does not have any of the insect pests that damage cacao orchards in other parts of the world. Chinese Rose Beetles are of concern during the period of early-tree establishment. This insect can cause considerable damage, including possible death of juvenile cacao trees during the first year or two of growth. However, older trees are not noticeably affected and generally do not require further treatment involving insecticides. Depending on the severity and extent of Chinese Rose Beetle attack, it may become necessary to apply a registered insecticide to prevent tree loss. Insecticide application will only be used if and when needed for insect control. Koa and other wind break trees will be also be monitored for pests, and treated as needed.

Up until 22 March, 2012, carbaryl 4L was the only EPA-approved (EPA Reg No. 34704-447) insecticide for control of Chinese Rose Beetle. Use of this product was allowed as a special local-need use (EPA SLN No. HI-970003) in Hawaii on non-bearing tropical fruit crops. At the present time, there is only one type of insecticide (various azadirachtin formulations) that is registered for cacao. According to Dr. Mike Kawate, a pesticide specialist at the University of Hawaii, azadirachtin products are unlikely to be effective in controlling Chinese Rose Beetle.

Although the process for renewal of the Special Local Needs (SLN) permit for carbaryl 4L was started in July 2012, it is not currently re-registered for use in Hawaii. Carbaryl is harmful to humans and toxic to aquatic invertebrates and honeybees. If carbaryl is used to control the Chinese Rose Beetle, special precautionary measures will be taken to protect handlers and to minimize environmental impacts, as described in the Environmental Assessment for this project.

As of October 2012, ‘Ōhulehule Forest Conservancy Cacao Farm consultant Mr. Daniel O’Doherty, along with University of Hawai‘i researchers Dr. Mike Kawate and Dr. H.C. Bittenbender, are working with the EPA to obtain a SLN for imidacloprid instead of Carbaryl. The application process was started by conducting the EPA-required pesticide efficacy trial for Admire Pro (BayerCropScience), which contains imidacloprid as the active ingredient. The process of testing and applying to the EPA for a new SLN permit is anticipated to be completed in early-mid 2013.

Imidacloprid is substantially more effective than Carbaryl at controlling rose beetle. Carbaryl is a contact or stomach poison for rose beetles and since it has little residual activity, must often be reapplied repeatedly. In contrast, imidacloprid is absorbed by the tree and provides systemic activity for at least 6-9 months after application as a soil drench or as broadcasted granules. The application and use of imidacloprid is more efficient and is less of a safety hazard for farm workers than Carbaryl. Because rose beetle damage becomes less severe in the second and third year of cacao establishment, application of imidacloprid will no longer be needed by the time the trees reach bearing age.

8. Nutrient management

Optimal soil conditions for cacao tree orchards are as follows:

Table 1. Cacao Farm Optimal Soil Conditions

Soil attribute/nutrient	Optimal Range
pH	5-7
Nitrogen NO3/NH4 (ppm)	5-10
Organic Carbon (%)	2-4
Phosphorus (ppm)	30-50
Potassium (ppm)	250-500
Calcium (ppm)	1750-2500
Magnesium (ppm)	350-750

Soil testing will be conducted prior to tree establishment and then on an annual basis at a minimum to ensure that proper soil conditions are maintained. Approximately one composite soil sample will be conducted per two-to-five acres of orchard. Additional samples may be needed depending on physiochemical conditions at planting sites.

Soil amendments that may be required to maintain proper soil conditions for the cacao orchard include lime, magnesium sulfate, phosphate, compost, and mulch. A disc harrow is expected to be used on all five acres of the initial cacao area. The primary purpose of disking is to loosen the soil and to incorporate agricultural limestone/dolomite and phosphorous amendment into the top six inches. Limestone reacts very slowly if surface-applied, and incorporation with a disc harrow is often recommended by soil scientists and consultants. Disking does not disturb the soil structure to the same degree as a rototiller or moldboard plow. The soil pH at the proposed site is relatively low (pH ~ 5). Liming to increase the pH to around 6.0 will allow more effective absorption of nutrients and reduce the possibility of aluminum toxicity.

Soil nutrient deficiencies and high levels of exposure to wind and sun in portions of the cacao farm pose a significant challenge to the initial establishment of cacao seedlings. These issues will be addressed in part by improvement of the soil and growing environment through land preparation, organic soil amendments and ongoing management practices. Additionally, the ʻŌhulehule Forest Conservancy may plant a trial plot of cacao seedlings using inorganic fertilizers, to compare the health and vigor of plants established with different types of fertilizers. In the trial plot, a slow-release fertilizer will be placed in the planting holes, where it may continue to provide nutrients for up to a few years after the final application. Regular application of mulch in the long-term may prove to be very important to maintain cacao health and vigor on these sites. Once the cacao plants are established (after 3-5 years), the ʻŌhulehule Forest Conservancy plans to operate an organic cacao farm.

9. Water Management

During cacao tree establishment, irrigation may be required during the dry season (*i.e.*, April-October) and during extended droughts. The use of a micro-irrigation system will allow targeted irrigation delivery to each tree and also reduce the amount of irrigation water needed. During dry periods, irrigation will

be conducted two-to-three times per week at a rate not exceeding 2,000 gallons per acre per week. Water will be drawn through an existing lateral pipe connected to the Waiāhole Valley Water System (WVWS) that runs along Waiāhole Valley Road. A water tank of approximately 20 feet in diameter may be installed to store agricultural water for the farm and nursery irrigation systems, if needed.

Once a closed canopy with light shade cover is formed and cacao trees are mature, moisture evaporation from transpirative water loss (through tree leaves) as well as soil surface evaporative loss should decrease substantially, thus reducing irrigation needs. A thick layer of leaf litter on the orchard floor is expected to reduce erosion and limit evaporation. It is expected that occasional irrigation will be needed during the dry season. The amount of irrigation water needed will be dependent on the water-retention properties of the soil and other environmental factors.

2.1.3 Long-Term Actions: Full-Scale Cacao Orchards

Once the five-acre test cacao orchard has been established, we will be able to assess our records related to fruit production and fermentation methods, allowing us to judge whether commercial cacao production in Waikāne Valley is feasible. If determined to be feasible, then the cacao orchards will be progressively expanded to the full production scale of up to 50 acres (see Figure 2). Expansion of the cacao farm beyond the initial five acres will be subject to DLNR approval of a Conservation District Use Permit (CDUP) and a Finding of No Significant Impact (FONSI) determination for the Environmental Assessment (EA) of the additional acreage.

Long-term actions (6-20 years include:

- Establish additional farm vehicle access to the other proposed cacao orchard areas on the property.
- Clear, prepare, and establish up to 50 acres of shaded cacao orchards on suitable lands (with fertile soil and relatively level to moderate slopes).
- Conduct invasive species control and native vegetation restoration in gulches of the *makai* parcel to protect remaining lowland native vegetation and to improve stream riparian ecosystems on the property. These actions are described in a Conservation District Use Application submitted to the Office of Conservation and Coastal Lands (OCCL) in September 2012 for forest restoration activities on the property.
- Conduct demonstrations and outreach to interested local farmers on organic cacao production.

It is anticipated that the same orchard establishment methods and best management practices will be used to establish the full production orchards as for the five-acre test orchard. Cacao orchard expansion may occur at a maximum rate of five acres every six months. Such a rate would allow for the establishment of a 50-acre cacao farm over a five-year period. Cacao orchards will be established primarily on lands with gentle to moderate slopes on ridge tops and plateaus. Cacao trees need well-drained soil conditions and consequently no orchards will be planted in gulches near stream beds. However, the low slopes of gulches furthest from the stream bed are suitable for cacao and may be used for expanded acreage.

The northern cacao area has been negatively impacted by recreational 4x4 vehicle use, which has denuded the ground surface and caused significant soil erosion. The land in that area will need to be smoothed using a bulldozer to remove erosion gullies as part of land preparation process prior to orchard planting. The US Army also used the northern part of the property as a training ground between 1942 and 1976. The U.S. Army Corps of Engineers recently conducted a remedial investigation and removal of munitions and explosives of concern (MECs) on the property. The investigation indicated that only minimal amounts of munitions debris were found in the mountainous parts of the property on the *mauka* parcel. However more munitions debris was found in the northern part of the *makai* parcel, where the proposed northern cacao farm area is located. Removal of MECs was conducted in a large portion of the northern cacao farm area.

Based on the work conducted by the USACE, areas where the MEC removal effort was conducted are considered clear, but not necessarily other areas around them. Consequently, special measures may need to be taken prior to conducting any earth-moving activities in those areas to ensure personnel safety: 1) the area where earth-moving activities are planned will be inspected for the presence of any suspicious items, and 2) a metal detector will be used to check for the presence of metallic items below ground surface. If any suspicious items are identified, the "3Rs of Unexploded Ordnance Safety" will be followed: "Recognize, Retreat, Report". We will call local law enforcement (911) if we suspect an item might be ordnance.

Once the orchard is established, we expect that one farm manager and two workers will be needed to manage the tree nursery, full-scale orchards, and general farm operations. Three to four additional seasonal employees will be needed to harvest and to process cacao beans during the fruiting season.

Phase 2 of the Cacao Farm (to be addressed by a future CDUA) will involve establishing an access road from the southern cacao orchard to the northern cacao orchard that will need to cross an intermittent stream. Within 50 to 100 feet of streams is the streamside management zone (SMZ), which requires special attention to minimize impacts to water quality. In addition to the BMPs described in the table above, we plan to use the following steps to avoid significant alteration of the stream channel.

We are proposing a natural low-water crossing with Armorflex cable-concrete approaches for the stream crossing. Armorflex cable concrete will provide erosion control and stability to the stream approaches while minimizing hardening of the road access. Armorflex cable concrete has been used successfully for stream crossings installed by the U.S. Army. It is also commonly used to protect stream banks and on boat ramps. No material will be placed within the stream channel. The aggrading stream bottom is not anticipated to be negatively impacted by the light road access use. The stream crossing will not be used during extended periods of heavy rain. Impacts to the stream channel will be mitigated during construction by minimizing the number of stream crossings by heavy machinery and by temporarily placing large wooden pallets in the stream channel for heavy machinery to cross on, so as to minimize channel disturbance. Consultation with the State Commission on Water Resource Management prior to road work involving the stream crossing will determine whether a Stream Channel Alteration Permit is required.

3. Description of the Affected Environment

3.1. Natural Environment

3.1.1. *Climate*

Trade wind patterns have a significant effect on Windward Oʻahu's climate patterns. Trade winds blow from the northeast most of the year and bring warm moist air from the ocean onto the land. As the air is forced upwards over the Koʻolau Mountains, a phenomenon known as orographic lift, the air cools, forms clouds and creates precipitation. As a result, the mountainous regions of Windward Oʻahu experience frequent rainfall and are often cloudy. Fog drip at higher elevations also contributes to the overall precipitation.

The highest annual average rainfall in the Koʻolaupoko district (5,000 millimeters, or approximately 197 inches) occurs near the summit of Puʻu Kaʻaumakua in the upper portions of the Waikāne *ahupuaʻa*. The average annual rainfall on the *makai* parcel of the property ranges from approximately 80 to 110 inches.

Data from the Western Regional Climate Center (WRCC) indicate that average temperatures in the vicinity of the property (temperatures recorded in Kāneʻohe *mauka*) vary minimally throughout the year with the warmest temperatures averaging 79.8° F in the summer months and the coolest temperatures averaging 68.8° F in the winter months. The average annual wind speed recorded at the Marine Corps Base in Kāneʻohe between 1996 and 2006 was 8.4 miles per hour.

3.1.2. *Geology and Soils*

The Island of Oʻahu is formed by the eroded remnants of two elongated shield volcanoes; the older Waiʻanae Volcano on the western part of the island (main shield-building stage approximately 3.8-2.95 million years ago) and the younger Koʻolau Volcano on the eastern part (shield-building stage approximately 2.5-1.7 million years ago). The approximate area of the Koʻolau caldera would have encompassed the areas where the towns of Kāneʻohe and Kailua are now located. Two rift zones trending northwest from the caldera generated lava flows that formed the bulk of the island. The eruptive period of the volcano was followed by a long period of extensive erosion, leading to the amphitheatre-shaped valleys of windward Oʻahu. The ʻŌhulehule property is located in Waikāne Valley, one of the smaller amphitheatre-shaped valleys of the windward coast, just north of the town of Kāneʻohe. The *mauka* portions of the valley have narrow ridges and very steep to precipitous slopes, which become gradually less steep in the center and *makai* portions of the valley.

In the very steep *mauka* portions of the valley, the Koʻolau Basalt is exposed. Below the *mauka* cliffs, a thin layer of weathered alluvium and rock overlays the Koʻolau Basalt in the upper reaches of the valley. In the middle and lower reaches of the valley, the layer of weathered alluvium becomes deeper and is locally overlain with younger alluvium. The rich alluvial soils of Waikāne Valley are in the Waikāne silty clay series. On the lower to moderate slopes in the *makai* parcel, these soils are considered to be very fertile for agriculture and are included in the Agricultural Lands of Importance to the State of Hawaiʻi

(ALISH). Lands classified as ALISH are those lands that (1) are capable of producing sustained high agricultural yields when treated and managed according to accepted farming methods, (2) contribute to the State's economic base and produce agricultural commodities, and/or (3) are needed to promote the expansion of agricultural activities and income for the future, even if not currently in agriculture. ALISH maps were drafted in 1977 by the State Department of Agriculture, with support from the U.S. Department of Agriculture and the University of Hawai'i College of Tropical Agriculture. Soils and areas of the property included in the ALISH are shown in Figure 3-1. Three classes of agriculturally important lands were established for the State of Hawai'i:

- **Prime Agricultural Lands**: criteria for these lands include adequate moisture supply, pH between 4.5 and 8.4, deep water table, soils that are not flooded frequently during the growing season, soils that do not have serious erosion hazard, and soils that contain less than 10% of rock fragments coarser than 3 inches.

- **Unique Agricultural Lands**: those lands are used for the production of specific high-value crops (*e.g.,* coffee, taro, rice, non-irrigated pineapple, *etc.*)

- **Other Important Agricultural Lands**: other agricultural lands that do not qualify as prime lands or unique lands. Generally, these lands may require greater application of agricultural inputs or improvements (*e.g.*, erosion control, drainage improvements) to produce good crop yields.

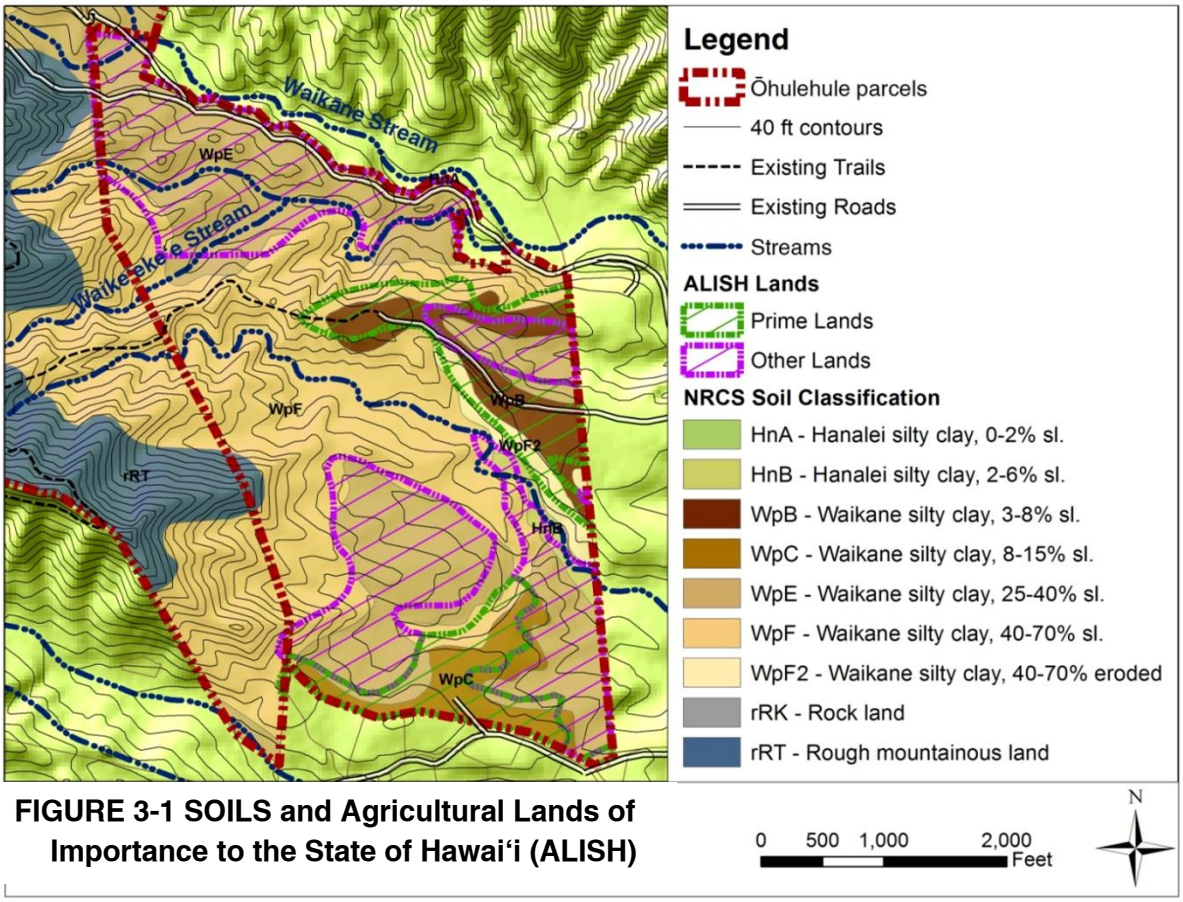


FIGURE 3-1 SOILS and Agricultural Lands of Importance to the State of Hawai'i (ALISH)

3.1.3. *Hydrology*

Dikes in the rift zone of the Koʻolau Range consist of steeply-dipping intrusive rocks that have very low permeability and impound groundwater into high-altitude confined aquifers. These high-level aquifers discharge groundwater through seeps and springs into the streams of windward Oʻahu. The Waikāne watershed is approximately 2.65 sq. miles in area and is drained by the Waikāne Stream and its tributary, the Waikeʻekeʻe Stream, into Kāneʻohe Bay. The Waikāne Stream is naturally a perennial stream throughout its course.

The USGS estimates that the average daily natural stream flow was approximately 2.3 million gallons per day (MGD) in the upper reaches of the Waikāne Stream and 1.3 MGD in the Waikeʻekeʻe Stream. However, these natural flows were significantly modified by the construction of the Waiāhole Ditch between 1913 and 1916 to transport water from the windward side to the sugar plantations of leeward Oʻahu. The ditch produced approximately 27 MGD water by collecting surface and dike-impounded groundwater from the watersheds of Kahana, Waikāne, Waiāhole, Uwao, and Waianu. Diversion of water into the ditch led to significant reductions in stream and spring flows on the windward side of the Island.

Struggle over the Waiāhole Irrigation System began when the Oʻahu Sugar Company announced that it would be closing its plantation in 1995 and thus would no longer need the ditch water. A series of water-use petitions were submitted to the Commission on Water Resources Management (CWRM) from parties with interests on the windward and leeward sides of O'ahu. Leeward petitioners wanted the water that had been allocated to Oʻahu Sugar Company to continue to be transported to the leeward side, whereas windward petitioners wanted the water to be returned to the windward streams. The Waiāhole Contested Case Hearing lasted for nearly two years and in 1997, CWRM issued its Decision and Order, requiring that a significant amount of water from the Waiāhole Ditch be returned to windward streams. CWRM's Decision and Order was appealed twice to the Hawaiʻi Supreme Court and amended twice. The most recent Decision and Order was issued in 2006, which ordered the allocation of 12 MGD water to windward streams and 12.57 MGD water to the Waiāhole Ditch.

Approximately 2.1 MGD water was returned from the Waiāhole Irrigation System to the south fork of the Waikāne Stream. As a result, the Waikāne Stream is now perennial again throughout its length, whereas the Waikeʻekeʻe Stream is still intermittent in its upper reaches.

3.1.4. *Water Quality*

Under the provisions of the Clean Water Act, the State of Hawaiʻi Department of Health (DOH) is responsible for setting the state's Water Quality Standards (WQS). The WQS define (1) the classification system for state surface waters, which assigns different protected uses to different water classes, and (2) the specific numeric and qualitative water quality criteria needed to support those protected uses. The DOH is also responsible for monitoring surface water bodies to assess whether they are meeting the criteria of the WQS. Streams that do not meet those criteria are included on the state's Section 303(d) List of Impaired Waters. After identifying water bodies with impaired water quality, the DOH is responsible for establishing and enforcing Total Maximum Daily Loads (TMDLs), which are the total amounts of pollutants that can flow into a water body from various pollutant sources. The

establishment of TMDLs is a long and complex process, so the DOH prioritizes streams for TMDL development by severity of water quality concerns. The Waikāne Stream was listed in 2006 on the State's 303(d) List of Impaired Waters with nitrate-nitrite as the pollutant of concern impacting stream water quality. However, the stream is classified as a low-priority for the development of TMDLs.

Nitrates are essential plant nutrients, but in excess amounts they can cause significant water-quality problems. Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing increases in aquatic plant growth and changes in the types of plants and animals that survive in streams. Nitrates are naturally produced in the environment through the microbial decomposition of dead plant and animal matter. However, natural processes generally do not lead to excessive concentrations of nitrates in aquatic habitats. Human activities which may increase nitrate concentrations in aquatic habitats, including those of Waikāne Valley, include runoff from fertilized agricultural lands and farm animal enclosures, as well as leaching from cesspools or failing septic systems. These potential sources of pollutants to Waikāne Stream are primarily located in the *makai* portion of the valley, near the Kamehameha Highway.

3.1.5. *Scenic Resources*

The *makai* portions of the property have significant scenic resources including views towards the ocean of Kāneʻohe Bay and Puʻu ʻŌhulehule to the north. Figure 3-2 below shows the view into Waikāne Valley from the *makai* parcel.

Figure 3-2 Puʻu ʻŌhulehule View from *makai* parcel

3.1.6. *Biological Resources*

Habitats

Major vegetation climate zones in Hawaiʻi are generally classified by elevation and rainfall. The most recent vegetation classification by Gagné and Cuddihy (1990) identifies the following general rainfall regimes:

- Dry: less than 1,200 millimeters (mm) (47.2 inches) annually
- Mesic: between 1,200 mm (47.2 inches) to 2,500 mm (98.4 inches) annually
- Wet: greater than 2,500 mm (98.4 inches)

Additionally, vegetation zones for O'ahu are also classified in three major elevation zones: lowlands located below 150 feet above mean sea level (amsl), mid-elevation lands between 150 and 1,000 feet amsl, and mountainous lands above 1,000 feet in elevation.

Mesic Forest Ecosystem

The *makai* parcel of the property has annual rainfall ranging between 80 to 110 inches, placing it largely in the mesic climate zone, and has land elevations ranging from 120 to 500 feet. As a result of the relatively mild slopes of the *makai* parcel and moderate rainfall, it was historically used for ranching, resulting in significant disturbance to the native forest vegetation. Some hala, ʻōhiʻa lehua and koa trees remain on the parcel, however, the native canopy has been largely overgrown by non-native invasive plants.

Wet Forest Ecosystem

The *mauka* parcel of the property is largely in the wet climate zone with land elevations ranging from about 300 to 2,600 ft amsl. The wet forest ecosystem occurs throughout much of the *mauka* parcel. In the minimally disturbed areas, this ecosystem is characterized by high biodiversity and a high rate of endemism. On the property, areas still dominated by native plant species are limited to the relatively steep *mauka* portions of Waikāne Valley, at elevations above 1,000 feet amsl.

Flora

Endangered Species

Records from the Hawaiʻi Biodiversity Mapping Program (HBMP) database, the U.S. Fish and Wildlife Service (USFWS) and the Bishop Museum indicated that no endangered plant species have been recorded to occur within the *makai* parcel of the property – which is in contrast with the *mauka* area of the property where 24 rare plant species have been recorded historically. This is likely due in large part to the long history of land disturbances in this part of the property, including deforestation by cattle ranching and military training. There are also no endangered plant critical habitats listed within the *makai* parcel.

A botanical survey conducted by Mr. Joel Lau in May 2012 (See Appendix A) confirmed that no endangered plant species were identified on the *makai* parcel of the property.

Non-Native Species

Parts of the *makai* parcel are dominated by strawberry guava (*Psidium cattleianum*), growing in thick, impenetrable stands. The areas not dominated by strawberry guava are more open, with various tree species growing amongst alien grasses, shrubs, and herbs. Non-native tree species aside from strawberry guava identified during the May 2012 survey included Java plum (*Syzygium cumini*), albizia (*Falcataria moluccana*), octopus tree (*Schefflera actinophylla*), shoebutton ardisia (*Ardisia elliptica*), Christmas berry (*Schinus terebinthifolius*), rose apple (*Syzygium jambos*), fiddlewood (*Citharexylum caudatum*), koa haole or haole koa (*Leucaena leucocephala*), hau (*Hibiscus tiliaceus*, either a Polynesian introduction or a native species), coconut (*Cocos nucifer*), royal palm (*Roystonea regia*), and the common guava (*Psidium guajava*).

Fauna

Endangered Species

According to the HBMP database and the USFWS, no endangered fauna has previously been recorded to occur within the *makai* parcel of the property. A survey conducted by Eric VanderWerf in April 2012 (See Appendix B) also identified no endangered species on the *makai* parcel.

Although it is possible that the Ōpeʻapeʻa or Hawaiian hoary bat (*Lasiurus cinereus semotus*) occurs in the Waikāne Valley area, it was not recorded during the April 2012 survey. There is currently very little information available on the distribution, biology, and ecology of Ōpeʻapeʻa on Oʻahu. Some research on this bat has been conducted over the past five years on the Island of Hawaiʻi, which provides some clues as to its habitats, prey, and potential threats. Research indicates that the bat roosts in native and non-native trees with no strong preference for any particular species, shows seasonal patterns in movements, and establishes distinct feeding areas (Bonaccorso, 2010). Research also indicates that the bat is widespread at all elevations sampled, from 10 to 2,000 meters amsl, and it was observed in coastal areas, above wetlands and streams, rainforests, and dry forests. The Ōpeʻapeʻa preys on Lepidoptera and Coleoptera. The decline of the Ōpeʻapeʻa may be related in large part to deforestation in the early 19th Century. Other threats to the bats include barb-wire fences and pesticide use that may reduce or alter their prey populations. To help protect the Ōpeʻapeʻa, the USFWS recommends not cutting trees greater than 15 feet in height during the bat's breeding season. Based on limited data, the roosting season is currently estimated to occur between June and September.

Non-native Fauna

There are several non-native species of concern at the property, including feral pigs and rodents. Feral pigs are of concern as they can significantly alter ecosystems by trampling, uprooting and eating native plants, and spread the seeds of invasive species. Pigs can also contribute to soil erosion as well as negatively impact cultivated plants by foraging and rooting.

Rodents can impact agricultural harvests by foraging on cultivated plants and fruits. Rats are known to eat cacao pods and thus can be a serious pest for cacao farms.

3.1.7. *Environmental Hazards*

Military-related Environmental Contaminants

The property was used by the U.S. military as training ground from 1942 to 1976. The US Military designated the area as the Waikāne Training Area (WTA). A series of UXO investigations and removal efforts have been conducted by the U.S. Army Corps of Engineers (USACE) on the property since the 2000's and are summarized below. An Engineering Evaluation/Cost Analysis (EE/CA) to evaluate munitions and explosives of concern (MEC) within the WTA was conducted in 2006. During the EE/CA, seven MEC items were recovered in the southeastern portion of the WTA and removed. One hundred and seventy-two munitions debris items were also found.

An abbreviated Site Investigation (SI) focusing on the WTA was conducted in 2008. A team of samplers collected two multi-incremental soil samples in areas where MEC was found during the EE/CA and collected two co-located surface water and sediment samples from the Waikāne Stream, downstream of locations where MEC was found. The samples were analyzed for Target Analyte List metals and explosives. Contaminants of potential concern identified in the SI were chromium, iron, vanadium, cobalt, mercury, and Research Department Explosive or "RDX", an explosive nitroamine widely used in military applications during World War II. Chromium, iron, and vanadium exceeded action levels, and additional analysis will be required to clarify whether those concentrations are background levels or related to military activities. Elevated concentrations of hexavalent chromium and mercury would be of particular concern for human and environmental health.

A Remedial Investigation/Feasibility Study (RI/FS) and removal of MECs was conducted in 2011. The purpose of the RI/FS was to determine further actions to reduce the risk of remaining UXO, discarded munitions, and constituents of concern. The study included three general investigation areas: the "Western/Mountainous Region" in the *mauka* portions of Waikāne Valley, the "Southern Impact Region" just *mauka* of the northern cacao area, and the "Southeastern Region" in the general vicinity of the northern cacao area. The investigation indicated that only minimal amounts of munitions debris were found in the Western/Mountainous Region. In the Southern Impact Region and Southeastern Region, munitions debris was found but no MECs were recovered outside of the removal areas. The highest munitions debris concentrations were found in the Southeastern Region. A qualitative MEC hazard assessment was conducted for the Southern and Southeastern Regions, which assigned a Hazard Level of 4 indicating "low potential explosive hazard conditions."

Removal of MECs was conducted in a large portion of the northern cacao farm area. The removal effort included a 100% sweep of the removal areas and recovered 50 MEC items from the Southeastern Region. Although no MECs were identified outside of the removal areas, the USACE cannot guarantee that all MECs have been removed from the property. Based on the work conducted by the USACE, areas where the MEC removal effort was conducted are considered clear.

Steep Terrain and Erosion

The morphology of the terrain on the *makai* parcel is highly variable, ranging from nearly level on ridge tops and in gulch bottoms to slopes in excess of 35% along gulch walls. Slopes in excess of 35% are generally considered unsuitable for agricultural activities. Gully erosion is visible in disturbed sloping areas and on steep jeep trails where the vegetation has been removed.

There is a significant amount of erosion on-or-about the Waikāne Valley Road and the tops of ridges in the northern part of the *makai* parcel. The erosion is related to illegal recreational off-road vehicle motoring gained by trespass.

Illegal Property Access

The property is illegally accessed on a regular basis for hunting, dumping, and recreational off-road vehicle use. Off-road vehicle use has developed significant erosion in the northern part of the *makai* parcel. Additionally, illegal dumping of refuse also occurs on the property.

3.2. Socio-Economic , Cultural and Archaeological Resources

3.2.1. *Waikāne Valley History*

Pre-Contact

It is estimated that Hawaiians first settled the windward coast of Oʻahu as early as 1,500 years ago. The abundance of fresh water in streams and springs along the coast allowed the development of extensive *loʻi kalo* (taro terraces) and *loko iʻa* (fishponds) in the watersheds of Kāneʻohe Bay. The fertile soils and extensive agricultural lands allowed the growth of a large Hawaiian population on the windward coast, which was estimated at 20,000-25,000 inhabitants at the time of Western contact.

Before Western contact, Hawaiians had established an intricate land tenure system and hierarchical structure, whereby the land could not be owned or traded, but instead was carefully managed to sustain its resources for the people of Hawaiʻi. In this land tenure system, *ahupuaʻa* were land divisions that generally extended from the mountain tops out into the sea to allow their inhabitants access to a full range of resources. Exchange between *mauka* and *makai* resources allowed most *ahupuaʻa* to be fairly self-sufficient. Groups of *ahupuaʻa* formed large *moku* or districts. The property is located within the Waikāne *ahupuaʻa* in the *moku* of Koʻolaupoko.

The name Waikāne is an abbreviation of the word Wai-a-Kāne, which means "Water of Kāne" (Pukui *et al.*, 1974:223). Kāne was one of the four principal Hawaiian gods representing the source of life. Handy and Handy (1972, p.446) describe the following story about the naming of Waikāne:

> "As Hiʻiaka's canoe skirted the windward coast of Oʻahu, she greeted many a site made famous or hallowed by the exploits of her ancestors in the area before the Pele clan moved onward to the younger island, Hawaiʻi. Passing the shores of Waikāne (the original name was Wai-a-Kāne, Water-of-Kāne), she explained to her companion,

> Wahine-omaʻo, that here Kāne first dug for water at a place called Poliuli, creating the Waiʻola-li, which was male, and the Waiʻola-la, which was female."

Handy and Handy (1972, p.442) also describe the traditional Hawaiian taro agriculture in the *ahupuaʻa* of Waikāne:

> "Waikāne was a major source of Koʻolau taro, especially in the broad area between the highway and the sea, and as much as half a mile inland there was extensive *loʻi* cultivation. The northern (and larger) section, extending *mauka* for two or more miles, used to have cultivated *loʻi* and home sites all along Waikāne Stream. The southern section of the valley, divided off by a low ridge, comprises a gulch where there were old terraces watered by Waikeʻekeʻe Stream, no longer cultivated in taro."

Post-Contact

Many changes occurred with Western contact in Hawaiʻi, including catastrophic Hawaiian population declines from disease epidemics, changes in land tenure from the traditional *ahupuaʻa* model to the Western private property model, the start of new agricultural endeavors for profit rather than subsistence, and the importation of many immigrant workers from Asia and the Pacific Islands to work on large plantations. By the 1880s, taro production on the windward side was largely replaced by sugar and rice plantations. In Waikāne Valley three rice plantations were in operation in 1880 in the *makai* part of the valley. The rice industry declined in the early part of the 20th Century, partly because of demographic and economic changes, and also because of the introduction of pests including rice birds and the rice borer insect.

Between February 1913 and December 1916, the Waiāhole Irrigation Company, a subsidiary of Oʻahu Sugar company, built the Waiāhole irrigation system. The system was designed to bring water from the wet valleys of windward Oʻahu to Oʻahu Sugar's plantation in leeward Oʻahu. Additions to the system were made from 1925 to 1933 and in 1964. The whole system is approximately 25 miles long and stretches from Kahana Valley to Kunia. The system collects primarily dike-impounded groundwater and historically produced 27 million gallons of water per day for the plantation. Flows in Kahana, Waikāne, and Waiāhole Streams were significantly reduced as a result of the Waiāhole irrigation system.

Despite the agricultural changes throughout the windward and leeward Oʻahu, Handy reported that in 1935, there was still a broad area of terraces at Waikāne, where large crops of taro were being raised to sell to poi factories (Handy 1940, p.97). There were also inland terraces with taro for milling situated between the Waikāne and Waikeʻekeʻe Streams. These inland terraces are still present on the property, although they are not cultivated and are now overgrown by invasive plants.

Starting in 1942, the U.S. Army leased 1,061 acres of land in Waikāne Valley from the McCandless heirs and Waiāhole Water Company to conduct advanced offensive warfare training and air-to-ground practice bombing. In 1953, the lease was transferred to the U.S. Marine Corps, which continued training in the valley until 1976 when the lease was terminated. The Marine Corps conducted ordnance

clearance sweeps in 1976 and 1984. The 1976 clearance effort resulted in the removal of over 24,000 pounds of practice ordnance and fragments, including 42 unexploded ordnances (UXOs). The 1984 effort resulted in the removal of 16,000 pounds of demilitarized practice ordnance and 190 UXOs. In 1989, the U.S. Marine Corps acquired title to the 187-acre ordnance impact area located immediately to the northeast of the property. In 2003, a proposal to use the parcel for blank-fire training was abandoned as a result of safety concerns from UXOs.

Meanwhile, the Koʻolaupoko District experienced a population boom starting in the 1940s. Several factors contributed to the district's rapid rate of population growth and development, including the decline of the agriculture industry and subdivision of land by large landowners to lease or sell parcels for residential or commercial use. Additionally, the completion of the Pali Tunnels in 1957 and the Wilson Tunnels in 1960 improved access to the windward side from Honolulu and further spurred the transformation of Kāneʻohe and Kailua from small rural communities into suburban population centers.

Land subdivision and development also was proposed for the Waiāhole and Waikāne Valleys in the 1970s. However, the small community of residents and farmers of Waiāhole-Waikāne organized to oppose these proposed commercial developments. When threatened with eviction by the Waiāhole Valley landowner, Mrs. Elizabeth Lloyd Marks, the Waiāhole residents organized protests, including a civil disobedience demonstration that temporarily blocked the Kamehameha Highway. In order to resolve the issue, the State acquired the Waiāhole Valley property in 1977 and organized the grounds as an agricultural state park and rural community subdivision in 1986. These lands cover approximately 600-acres in Waiāhole and Waikāne valleys. The majority of the property is currently under the management of the Hawaiʻi Housing Finance and Development Corporation (HHFDC).

The Waiāhole-Waikāne community has continued to fight against development threats to land and water in the valleys. In one of the most significant water struggles in the State, the Waiāhole-Waikāne community fought throughout the 1990s and 2000s for the return of water from the Waiāhole Irrigation System (which transports water to leeward agricultural producers) to windward streams. In 2006, CWRM issued its Decision and Order on this case, which resulted in the restoring of 12 MGD to windward streams and allocated 12.57 MGD to leeward users. The case is further discussed in Section 2.3 above.

3.2.2. *Archaeology in the Vicinity of the Cacao Farm Area*

The most recent archaeological inventory survey conducted in the project area was completed by Ms. Coral Rasmussen in 2008 in support of the UXO assessment and removal operations conducted by the U.S. Army Corps of Engineers in 2008 through 2010. The archaeological inventory survey recorded the following sites on the *makai* parcel:

- Site 50-80-06-1078: a *loʻi* complex nominated to the National Register in 1973 ("Waikāne Taro Flats"). The site is at the confluence of the north fork and south fork of Waikāne Stream and extends across the northwest corner of the *makai* parcel, the *mauka* parcel, and the neighboring U.S. Marines parcel. The site is composed of eight traditional Hawaiian terrace sets that include

stone-built terrace walls enclosing *loʻi*, *ʻauwai*, and probable habitation sites on raised ground near the *loʻi.*

- Site 50-80-06-4356: a *loʻi* complex that was originally recorded by Dunn *et al*. 1992. The site is located along the Waikeʻekeʻe Stream, approximately 250 meters upstream of the junction with Waikāne Stream. Five terrace sets were identified along the alluvial stream deposits on the bends in the stream. The complex includes traditional Hawaiian features such as terrace walls enclosing *loʻi*, *ʻauwai*, a trail, and probable habitation areas near the *loʻi*.

- Site 50-80-06-4361: a post-contact site near the Waikeʻekeʻe Stream with nine charcoal kilns, a rock alignment, and remnants of a historic trail or road. Remnants of two types of kiln are present at this site, including earth covered mound kilns and excavated kilns.

- Site 50-80-06-4352: a small *loʻi* complex located on a small meander loop of a tributary to an unnamed intermittent stream that crosses the *makai* parcel. Traditional Hawaiian *loʻi* features, including terraces, embankments, and a possible habitation were identified, as well as *ʻulu* and *noni* trees on the opposite side of the stream from the habitation site.

- Site 50-80-06-4359: two excavated charcoal kilns (first recorded by Dunn *et al.* 1992) on the south side of a gulch with flowing water.

- Site 50-80-06-4362: a charcoal kiln first recorded by Dunn *et al.* (1992).

- Site 50-80-06-6862: a set of six fighting positions or foxholes excavated into the hillside and top of a small knoll. M-60 machine gun bullets, other ammunitions, and miscellaneous fragments were present on the ground surface around the foxholes.

Prior to that survey, Dunn *et al.* (1992) conducted a survey of the entire *makai* parcel in 1972 and recorded a few additional sites outside of the 2008 survey area:

- Site 50-80-06-4360: a small *loʻi* in a gulch near the border between the *makai* parcel and the City and County of Honolulu property.

- Sites 50-80-06-4354 and 50-80-06-4355: Excavated charcoal kilns.

- Sites 50-80-06-4351, 50-80-06-4353, and 50-80-06-4358: small *loʻi* sets near an unnamed intermittent stream that crosses the *makai* parcel, near the eastern boundary of the parcel.

A field survey was conducted by Cultural Surveys Hawai'i in 2012 that confirmed the findings of the previous archaeological surveys and did not identify any historic sites within the proposed cacao farm areas. The letter report from that field survey is included as Appendix D. The survey areas and locations of historic sites on the *makai* parcel are shown on Figure 3.4 below. No historic sites were identified in previous surveys in the proposed cacao planting areas.

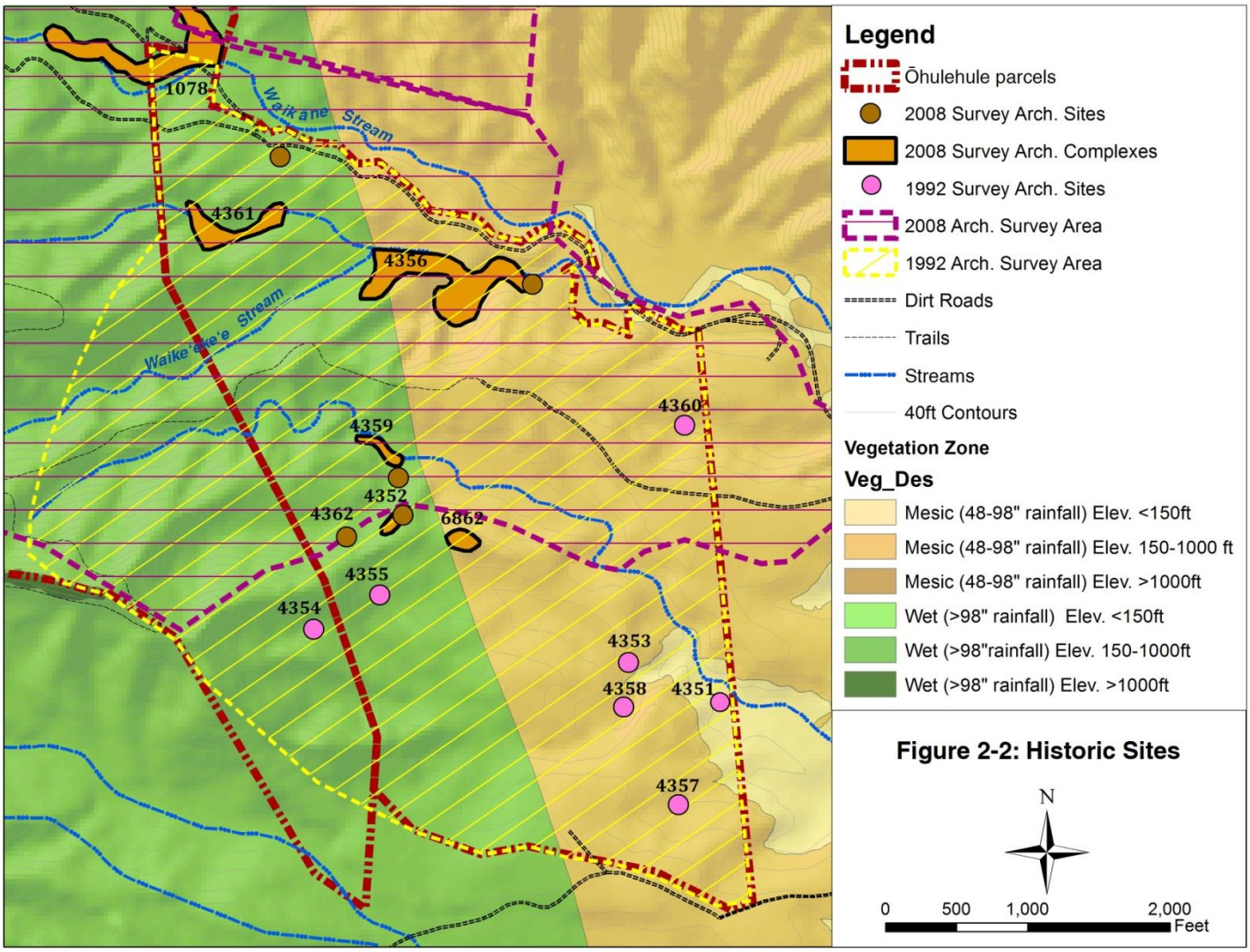


Figure 2-2: Historic Sites

3.2.3. *Cultural Practices*

Cultural practices in Waikāne Valley and the surrounding area of windward O'ahu go back many centuries through oral tradition and storied landscapes. Many of the current residents can trace familial descent for generations, and they carry with them stories of the land, resources, and people of this area. To assess the potential impact of the proposed cacao farm on cultural practices in Waikāne Valley, historical and cultural source materials were consulted, along with interviews with knowledgeable community members. Permission to include information gathered during interviews was granted by all interviewees.

A number of historic sources were reviewed and summarized by Cultural Surveys Hawai'i during their preparation of the lo'i restoration plan (See Appendix E). Source materials include *The Kumulipo,* translated by Beckwith in 1951; *Native Planters in Old Hawai'i* by Handy and Handy (1972); and *Nā Wahi Pana 'o Ko'olaupoko*, compiled by Landgraf (1994), among others. These sources document many stories, significant places and traditions connected to the *ahupua'a* of Waikāne, including references to the Hawaiian *akua* (gods) Kāne and Hi'iaka, the Hawaiian demi-god Kamapua'a as well as the *Kumulipo* (Hawaiian origins chant).

In historic times, Waikāne Valley was famed for its abundance of water and other resources utilized by traditional Hawaiians. *Kalo* and other crops provided food for a large population. Sites of religious and/or political significance include Kukuianiani Heiau, located near the coast of Waikāne, and Ka'awakoa Heiau, which at one time stood in close proximity. Additionally, several upland sites have been interpreted as agricultural shrines. Waikāne is one of three *pu'uhonua* (place of refuge) lands of Ko'olaupoko. The sport of *hōlua* sledding was practiced by the chiefs and ordinary people on a steep incline behind the present-day Catholic Church, ending on a lower plain area. *Ala hele* (trails) constructed by ancient chiefs are described in mythology of the area.

A number of community members were contacted and interviewed to assess the potential impacts of the proposed cacao farm on cultural practices in Waikane Valley. The list of prospective interviewees was assembled by consulting with Cultural Surveys Hawai'i, who had conducted some interviews for the historic taro lo'i preservation plan. Members of the Waiahole-Waikane Community Association also provided contact information for knowledgeable interviewees. Phone interviews were conducted with community leaders, cultural practitioners and long-time residents. A total of fourteen people were contacted, and three were willing and able to discuss cultural practices in the Waikāne Valley area.

Mr. Ted Saizon has lived on Waiāhole Valley Rd. near the entrance to the proposed cacao farm for twenty years. Before Waikāne Valley, his family lived in nearby Kahalu'u. His family traces its origins in Kahalu'u to the 1800's, and many of Mr. Saizon's relatives still live on the peninsula behind the fishpond. As a child he attended school in Waiāhole Valley, and remembers the valley was mostly in farming then as it is now. Now, more people live in the valley. Way back, there used to be cattle in the valley. Mr. Saizon thought the proposed cacao farm would be good because it's all farming in the area. Some people go pig hunting, hiking and bike riding in the valley. Old families sometimes go into the forest to

get bamboo for decoration and garden trellises. Some people also gather edible fern shoots from the forest. The government closed off the backside of the valley where the Kamakas used to be because it was a former military training area. Before that, the Kamakas used that land for a long time. They used to have *lo'i* way up in the valley. Mr. Saizon takes care of his five grandchildren who live with him. He is thankful that they have a place to stay for a while, but is unsure what will happen in the future (Saizon interview, 2012).

Mr. Keoki Fukumitsu is a resident of Hakipu'u, an *ahupua'a* next to Waikāne. His family is a *kuleana* landowner, receiving title to the land during the Great *Māhele*. The family migrated from Waikāne to Hakipu'u in the time of Kamehameha I. Mr. Fukumitsu has been active in the community with a focus on agriculture and Native Hawaiian subjects for many years. He was a founder of the Native Hawaiian legal corporation, and used to be very active in the area's Neighborhood Boards. He currently serves on the Governor's "Taro Purity and Security Task Force" that has been monitoring and advocating for expanded taro production. Mr. Fukumitsu shared his knowledge of the area's history and its cultural significance.

Hakipu'u and Waikāne valley were very sacred places that the king gave to the kahuna. This area is where the first voyagers from the Pacific landed, so it holds the significance of what they brought on the voyage in their canoes. *La'au lapa'au* (medicinal plants) and trees were some of the plants they brought from across the Pacific. Each site signified an individual and his trade, with trades going from mountain to ocean. For example, Ka'ai brought *ulu* to Kualoa. Mauiloa is buried between Waikāne and Hakipu'u. The history here goes back 25,000 years. In the modern day, as we put these pieces together, it becomes a more significant reality, a real history. This history represents a way of life that is being modernized and Westernized. People started using animals like buffalo and oxen to pull carts. It was sophisticated living, even in grass shacks, pounding *poi*. Then cars arrived. Now we're trying to integrate tradition with modern life (Fukumitsu interview, 2012).

Mr. Fukumitsu has done extensive research on the history of the area, and has documents from the Great *Māhele*, population counts, Land Commission awards and court awards from the approximate time period of 1850-1920. He is interested in preserving the *ahupua'a*, with particular emphasis on native crops. Cacao is believed to be compatible with native crops, and is environmentally sound and has good economic potential. Taro is culturally and educationally important, but labor-intensive. There is economic possibility there, but it needs to be an agricultural operation, a business. In the olden days taro was a dietary staple and an industrial crop with significance throughout Hawai'i and the Pacific. We need to prove to future generations that taro can be grown again (Fukumitsu interview, 2012).

Based on her archeological investigation, Ms. Coral Rasmussen (2008:iii) concluded the documented cultural resources in the valley represent ". . . part of a landscape of traditional Hawaiian taro production and later historic period charcoal manufacturing that likely occurred alongside the taro production." These planting sites were located along the alluvial flats near streams, and probable habitation sites were present on higher ground near these fields. Rasmussen also noted that metal tools found in association with some cultivated fields indicate these were being farmed into the early 20th

century, an observation that is consistent with oral- historical information from local families who report such activities into the 1920s (Cultural Surveys Hawai'i, 2012).

Many people are interested in perpetuating the cultural and agricultural traditions of the Waikāne and Waiāhole area in the modern context. Mrs. Pat Royos was born in Waiāhole Valley in 1945, was raised there and continues to live in the valley today. She has served as president of the Waiāhole-Waikāne Community Association (WWCA) and is currently an active member. Her parents came to Waiāhole Valley in 1932, after her father lost his leg while working at the quarry in Waimānalo. Their family farmed banana and papaya on a seven-acre lot. There were many taro *lo'i* in those days. Mrs. Royos shared her perspective on the area's history, and the importance of activities like farming, canoe building and preservation of important natural and cultural sites.

One significant historic site is the Waikāne pier, which has a legacy of more than 100 years. Ships used to pick up crops grown in Waiāhole and Waikāne valleys, such as coffee, sugarcane, rice, and pineapple. There was a train track that carried food from up in the valley down to the pier. Mrs. Royos believes that restoration of the collapsing pier could foster *mauka-makai* connections within the *ahupua'a*. Canoes carved out of albizia trees from the valley could serve as an educational tool for children and could be launched from the pier.

Agriculture plays a prominent role in Waikāne's history, and Mrs. Royos felt it important to maintain a residential and agricultural community that is different from "outside" (Royos interview, 2012). The number of cultivated taro patches in the valley declined significantly in the 1960's. Now very few farmers in the valley still grow taro, although many people are interested. If more taro and other crops are grown, that may help the community get back more of the water that is currently being diverted to Leeward O'ahu. Another challenge is that all the old-timers who knew how to farm are fading away, and the next generation is more interested in office jobs. There is a need for "serious farming" in Waiāhole and Waikāne (Royos interview 2012).

Mrs. Royos and the WWCA support plans for the proposed cacao farm, because they would rather see farming than development. They believe Mr. Zweng is different from the previous landowner. He is involved in the community, and they see him every weekend. He is going through the correct process, showing the community his proposal, and they trust him. Seeing what he's doing so far, they support the project. Mr. Fukumitsu agreed that the 'Ohulehule Forest Conservancy's plans to plant cover crops, use mulch and avoid land clearing during the rainy season would help to mitigate the potential impacts of soil runoff on the aquatic environment.

Access to land, loans and markets will also be critical to developing viable agricultural operations in the Waikāne area. An open market has been proposed for Waiāhole-Waikāne Park, to encourage more farming since farmers would have a place to sell their products. Mrs. Royos feels that people living in the area would care for the park and that it would be a beautiful place for the community. The cleaning of public spaces and restoration of the natural environment is seen as a means of bringing members of the community together and teaching young people. People want to clean the area near the *poi* factory,

and to see beautiful scenery with plenty of *lo'i*. "Anything can happen with willpower, then people want to get involved" (Royos interview, 2012).

Mr. Fukumitsu used to volunteer cultivating taro 30 years ago on the Kamaka family *kuleana* parcel up in Waikane valley. They also used to clean the land, propagate native species, and also hike on trails to hunt and gather mountain apples. Those lands were condemned by the Federal government to serve as military training grounds until 9/11. The government hasn't made an attempt to clean up that part of the valley, only the lower areas (Fukumitsu interview, 2012).

Regarding the proposed cacao farm, Mr. Fukumitsu commented that removal of vegetation may cause runoff that would impact water quality in the streams, shore areas and ocean. Sediment running off the land can smother *limu, o'opu,* and other native aquatic species as well as coral reefs. There needs to be a good vegetated buffer zone between the cleared land and the stream, which can be accomplished by planting from the bottom up. This practice was followed in traditional taro planting. Mr. Fukumitsu did not think that the proposed cacao farm would impact any cultural practices in Waikāne Valley (Fukumitsu interview, 2012).

The coastal ecosystem has a great deal of cultural and environmental significance. The *ho'iwai* (river mouth area) is important because many fish and crustaceans conceive there. Species like *hi'iwai* and *opae* lay eggs in the sand. Ocean species like mullet, *moi* and *awa* come to the *muliwai*, where their hormones are activated by sweet (brackish) water and they reproduce (Fukumitsu interview, 2012). Community members are interested in protecting and restoring the aquatic environment by making an area for fish to lay eggs. They would need netting and more fresh water from the streams to create the right habitat for *aholehole* (mullet), crabs and *limu* (seaweed, algae).

The ʻŌhulehule Forest Conservancy is planning to restore two areas where taro was historically grown on the property. The Waikāne Taro Flats, located primarily in the *mauka* parcel, with some terraces in the northwestern corner of the *makai* parcel, was placed on the National Register of Historic Places in 1973. The site consists of seven terrace sets; associated agricultural features such as *ʻauwai*; possible habitation features; and religious features including an agricultural shrine and a birthing stone. The Waikeʻekeʻe Loʻi is located in the northern portion of the *makai* parcel, and consists of five terrace sets and other agricultural features; a number of charcoal kilns and a boulder with historic petroglyphs.

A restoration plan prepared by Cultural Surveys Hawaiʻi, in consultation with SHPD/DLNR, describes the methods and procedures that will be used to restore and reuse the *loʻi* and also protect certain features of those sites which have been identified as having traditional cultural significance (See Appendix D). Although neither of the areas lie within the boundaries of the proposed cacao farm, the restoration of historic *lo'i* so that traditional agriculture may be practiced is a positive impact of the activities proposed by the ʻŌhulehule Forest Conservancy.

3.2.4. *Socio-Economic Environment*

Most of Waikāne Valley remains relatively undeveloped, with a number of tenants leasing agricultural land from the HHFCD. The agricultural park neighboring the ʻŌhulehule Forest Conservancy property is intended to provide long-term affordable rental housing for tenants in Waiāhole and Waikāne valleys who were threatened with eviction during the 1970s, to promote diversified agriculture, and to preserve the rural lifestyle of the valleys. Construction and development activities have been concentrated in the southwestern portions of the *ahupuaʻa*, near Kūhiō Highway.

3.3. Existing Infrastructure

3.3.1. *Potable Water*

The nearest Board of Water Supply main in the Waiāhole-Waikāne area is located along Kamehameha Highway. This water main services lots located in the vicinity of the highway. Water service to residential and agricultural lots in the Waiāhole Valley is supplied mainly by the Waiāhole Valley Water System (WVWS) operated by Doonwood Engineering on behalf of the Hawaii Housing Finance & Development Corporation (HHFDC).

The source, storage, and transmission system for the WVWS was constructed in 1989 and includes a well station with two deep wells, a 1.0 million gallon steel reservoir, and a booster pump station. The two wells have a combined Water Use Permit of 0.075 MGD from the CWRM, although they can supply up to 1.15 MGD of good-quality water. As of 2006, the system served 46 agricultural lots, 65 residential lots, and the Waiāhole Elementary School. The line occurring along the north branch of Waiāhole Valley Road, adjacent to the property, is an 8-inch-diameter PVC pipe.

An application for five tie-ins to the WVWS from the property was submitted by the previous owner (Mr. Tom Enomoto) in the early 2000's. The tie-ins would have permitted the subdivision of 15 acres of land into five 3-acre lots, each with a residential and agricultural water line. Installation plans indicated that the lateral lines would have consisted of 1-inch-diameter pipes for residential water connection and 2-inch-diameter pipes for agricultural water connection. Instead, Mr. Enomoto indicated that only one 6-inch lateral line (the maximum size allowed by HHFDC) was installed. The lateral line was capped and has never been used. A separate tie-in provides water for the residential and agricultural uses of Mr. Saison's family who are currently living on the property.

The basic charge for water use from the WVWS is currently $3.00 monthly per meter in addition to a domestic rate of $0.90 per thousand gallons, and/or an agricultural rate equal to the domestic rate for the first 15,000 gallons and $0.22 for each additional thousand gallons.

The HHFDC anticipates making upgrades to the system over the next five years, pending budget approval by the Governor. Currently, the 1.0 million-gallon steel reservoir that supplies water to the Waiāhole-Waikāne areas is leaking. The HHFDC is proposing to replace that tank with a new concrete tank that would be located at the top of the north fork of the Waiāhole Valley Road in order for the water supply for the entire valley to be delivered by gravity, thus eliminating the use of costly pumps.

The HHFDC also anticipates that after needed upgrades are made to the system, the water-use cost will be incrementally adjusted to match eventually that of the Honolulu Board of Water Supply (BWS). The WVWS may also eventually be transferred to the BWS once the necessary upgrades are completed. The current basic charge for water supplied by the BWS is $6.40 per month per meter, and a domestic rate of $3.06 per thousand gallons, or an agricultural rate equal to the domestic rate for the first 13,000 gallons and $1.31 for each additional thousand gallons.

3.3.2. *Non-potable Agricultural Water*

Waiāhole Irrigation System

The Waiāhole Irrigation System crosses the *mauka* portion of the property. The Waiāhole Irrigation System collects impounded dike groundwater from Kahana, Waikāne, and Waiāhole Valleys and transports this water to agricultural water users in leeward O'ahu. The Waiāhole Irrigation System is currently permitted by CWRM to collect and transport 15 MGD of groundwater. Existing water permits related to the Waiāhole Ditch total 12.57 MGD, leaving 2.43 MGD unpermitted. The unpermitted water currently goes back into the windward streams.

There are currently several pending permit applications for this unpermitted water. However, those applications have been placed on hold for several months. The new applications are contentious because windward residents are advocating against allowing any new permits to transfer water to leeward O'ahu.

McCandless Pipe System

Another existing private groundwater system in the vicinity of the property is the McCandless Pipe System, which diverts water from the Waianu Stream, a tributary of the Waiāhole Stream. Even though the McCandless system diverts water from the Waianu Stream, water in the system is considered ground water because it was originally established as a water reserve released from the Waiāhole Irrigation System for Waiāhole users. The McCandless Pipe System can provide up to 0.5 MGD of non-potable water to some of the farmers in Waiāhole Valley. Currently, some of the farmers are using the McCandless water for irrigation. However, because the system is not metered, there is no public information on the current number of users and the amount of water they consume. The McCandless water system, which runs along Waiāhole Valley Road adjacent to the property, is maintained by a group of residents in Waiāhole-Waikāne. Members of the Waiāhole-Waikāne community that use water from the McCandless system cooperate to conduct maintenance and do repairs on the system.

3.3.3. *Sewer Service*

There is no municipal sewer service to the rural communities north of Kahaluʻu in Koʻolaupoko. Consequently, homes in Waiheʻe to Waikāne use septic systems or cesspools. Residents in the area of the Kahaluʻu Neighborhood Board have voiced concern that leaking cesspools may impact the surface water resources of the area.

3.3.4. *Roads*

The property is accessible via two main access roads. The paved two-lane Waiāhole Valley Road borders the property to the southeast and provides the main access point to the property. The northern part of the property is accessible via the unpaved Waikāne Valley Road, which traverses across the property all the way to Waikāne Camp where an intake of the Waiāhole Irrigation System is located.

The Waikāne Valley Road is a public road from the Kamehameha Highway until it reaches the property of the City and County of Honolulu (TMK 4-8-006:008), at which point a locked gate is present across the road. This private road is legally utilized by local residents and landowners who have either an access agreement with the City or an easement recorded in their property deeds. The road is also legally utilized by the Agribusiness Development Corporation for the purpose of maintaining the Waiāhole Irrigation System. Illegal trespassing onto the subject property and the City lands by hunters and recreational off-road vehicles represents a significant concern.

3.4. Existing Land Use

3.4.1. *Land Use on the Property*

The *makai* parcel of the property is largely overgrown with trees and shrubs. Land uses on that parcel include the following activities:

- In the northeastern corner of the property, the Roberts family and relatives use the Waikāne Valley Road to access their *kuleana* parcel (TMK 4-8-006:009).
- Drivers of 4x4 vehicles access the northeastern portion of the property for off-roading recreational use (unpermitted).
- In the southern portion of the property, along Waiāhole Valley Road, Mr. Ted Saison and his grandchildren currently live in a house on the property and conduct agricultural activities on approximately 3 acres, including raising chickens and growing *ti* and banana plants. Although unpermitted, these activities were occurring prior to purchase of the property and thus have been allowed to continue.
- An additional small house is also present at the property entrance on Waiāhole Valley Road. This house is vacant.

The vast majority of the *mauka* parcel is forested and uses of the land are limited to the following activities:

- Access by the State Department of Agriculture, Agribusiness Development Corporation (ADC) for maintenance of the Waiāhole Irrigation System. The ADC has an access easement on the property for this maintenance.
- Access by pig hunters and recreational hikers (trespassing).

3.4.2. *Surrounding Landowners and Land Uses*

Land uses in the vicinity of the property are dominated by small farms and rural neighborhoods in the *makai* portions of valleys, and by large expanses of forested lands in *mauka* areas. The bulk of lands surrounding the property are owned and managed by various federal, state, and local government agencies, with the exception of one large private landowner. Surrounding landowners are described below:

- To the north of the property, the *ahupuaʻa* of Kahana is owned and managed by the State Department of Land and Natural Resources as a State Park.
- To the west of the property, across the crest of the Koʻolau Mountains is the Oʻahu Forest National Wildlife Refuge managed by the USFWS in the Waipiʻo *ahupuaʻa*. The U.S. Army East Range is just north of the wildlife refuge, in the Waiʻanae Uka *ahupuaʻa*.
- To the south of the property, about half of the Waiāhole *ahupuaʻa* is owned and managed as the Waiāhole Agriculture Park by the Hawaiʻi Housing Finance and Development Corporation (HHFDC). The other half of the *ahupuaʻa* is managed by the State Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) as a Forest Reserve.
- To the east of the property in Waikāne Valley, the City and County of Honolulu owns most of the *makai* portion of the *ahupuaʻa*. The City previously intended to develop a nature park on the large vacant parcel adjacent to the property. However as a result of budget constraints, community concerns, and a changing administration, this plan is no longer being pursued. The Department of Parks and Recreation currently manages the vacant parcel.
- The U.S. Marine Corps owns the parcel located adjacent to the property, just north of the *makai* parcel. The U.S. Marine Corps acquired title to the land in 1989 due to concerns associated with unexploded ordnances from decades of use as a missile-training-and-target area. The U.S. Marine Corps has been conducting ordnance survey and removal efforts, which may lead to the return of portions of the property to its previous owners, the Kamaka family, or to the public.

  To the northeast of the property, the largest part of the *ahupuaʻa* of Hakipuʻu and Kaʻaʻawa is privately owned by Kualoa Ranch, Inc ("Kualoa Ranch"). The Kualoa Ranch operates a cattle ranch as well as a number of visitor attractions.

3.5. Relation to Federal, State and Local Land Use Policies and Regulations

3.5.1. *General Plan*

The General Plan for the City and County of Honolulu, a requirement of the City Charter, is a broad statement of objectives and policies to guide the City's future. The General Plan is a guide for all levels of government, private enterprise, neighborhood and citizen groups, organizations, and individual citizens in eleven areas of concern: population, economic activity, the natural environment, housing, transportation and utilities, energy, physical development and urban design, public safety, health and

education, culture and recreation, and government operations and fiscal management. The General Plan is used as policy guidance in developing plans, programs, and legislation.

The proposed cacao farm on the *makai* parcel of the property supports the following objectives of the General Plan:

1) (Economic activity) To maintain the viability of agriculture on Oʻahu.
2) (Natural Environment) To preserve and enhance the natural monuments and scenic views of Oʻahu for the benefit of both residents and visitors.

3.5.2. *Sustainable Communities Plan*

The Koʻolaupoko Sustainable Communities Plan (SCP) is one of eight community-oriented plans required by the City Charter to implement objectives and policies set forth in the General Plan. Each of the eight plans guides development in one of eight districts on the island of Oʻahu. The Koʻolaupoko SCP is currently in the process of being updated. The original Koʻolaupoko SCP was developed in 1998-2000.

The Koʻolaupoko SCP identifies ten key elements of the vision for Koʻolaupoko. The proposed cacao farm on the *makai* parcel of the property supports four of those elements:

1) Adapt the concept of *ahupuaʻa* as a basis for land use and natural resources management.
2) Preserve and promote open space throughout the region.
3) Preserve and promote agricultural uses.
4) Preserve and enhance scenic, recreational, and cultural features that define Koʻolaupoko's sense of place.

Land uses identified in the Kahaluʻu to Kualoa area in the 2000 Koʻolaupoko SCP are dominated by open space/preservation in *mauka* areas, and agriculture, parks, and low-density residential in the *makai* areas. The 2000 SCP identifies the *mauka* parcel of the property as open space/preservation area and the *makai* parcel as agricultural area.

3.5.3. *Zoning and State Land Use*

The City and County Land Use Ordinance (LUO) establishes land-use zoning and development regulations in accordance with the policies of the Oʻahu General Plan and Development Plans/Sustainable Communities Plans. The entire property is zoned as P-1: Restricted Preservation District. The P-1 District covers all lands that are designated by the State as "Conservation District". Within the P-1 District, all land uses, structures, and development standards are governed by the Conservation District Rules of the State's Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL).

The entire *makai* parcel and the greater part of the *mauka* parcel are within the Conservation District's Resource Subzone. The purpose of this subzone is to ensure, with proper management, the sustainable use of the natural resources within this subzone. A number of uses can be permitted within this

subzone, including agriculture, one single-family residence per lot, aquaculture, commercial forestry, botanical gardens, *etc*. A Conservation District Use Permit is required for most major projects within the Conservation District.

3.5.4. *Other Regulations Affecting Proposed Activities*

There are several other regulatory requirements that may affect the proposed activities in the project area. These requirements are summarized in Table 3-1 below.

Table 3-1: Other Regulations Affecting Proposed Activities

Law or Guidance document	Govt Level	Requirements and Prohibited Uses
Endangered Species Act (ESA)	Federal	Regulates activities that may impact Federally-listed threatened and endangered plant and animal species, as well as their habitats. The law prohibits any action that causes a "taking" of any threatened or endangered species. A "taking" is defined as harassing, harming, pursuing, hunting, wounding, killing, trapping, capturing, or collecting.
Grubbing, grading & stockpiling (ROH Chapter 14-13 thru 16)	City & County	The City and County of Honolulu requires a permit for any grubbing, grading, and stockpiling (except small exempt quantities). Alternatively, land being managed in accordance with a Conservation Plan acceptable to the applicable Soil and Water Conservation District directors is exempt from this requirement. Actions that will require a Conservation Plan or grading and grubbing permit include: - Construction of access roads, - Land preparation for cacao farm, - Grading and grubbing for farm facilities and residence.
Historic Preservation (HRS Chapter 6E)	State	Regulates activities that may impact historic properties. Requires a survey to identify whether historic properties may be impacted by a proposed action and the preparation of a preservation plan or a mitigation plan if a historic property is going to be affected.
State Water Code (HRS Chapter 174C)	State	Regulates the use of surface water and groundwater in the State. Potential activities that would be subject to the requirements of the State Water Code include: - Groundwater well for crop irrigation - Spring or stream diversion for crop irrigation

4. Summary of Major Impacts and Mitigation Measures

In considering the significance of potential environmental effects, the applicant has considered the sum of effects on the quality of the environment and evaluated the overall effects of the proposed action. The applicant has considered the expected consequences and both short- and long-term effects of the proposed action. As a result of these considerations, the applicant anticipates that approval of the proposed action will have no significant effect on the environment since:

1. The proposed action does not involve the degradation of soil and water quality as the proposed improvements do not compromise the character of the property and surrounding area, but will improve the resources of the land by controlling aggressive invasive species and improving soil moisture retention through establishment of a koa-cacao agroforestry system. Best management practices for land clearing, cacao farm establishment and road/facilities construction will reduce the possibility of erosion and sedimentation, and seepage into the streams.
2. The proposed action is consistent with the character and size of other parcels in the area, does not substantially impact upon the scenic vistas and view planes of surrounding properties, and will enhance the scenic and open space resources of the project area. Safe and controlled public access to the property will provide recreational and educational opportunities to the community.
3. Botanical and faunal surveys of the property did not identify any rare, threatened, or endangered plant or animal species or habitats within the proposed cacao farm area. Native or endangered species that may exist in the vicinity of the project area will be protected by surveying vegetated areas prior to removal of invasive vegetation. Native vegetation will be protected and enhanced through the proposed action.
4. The proposed action would occur in areas where the U.S. Army Corps of Engineers (USACE) has already mitigated the environmental hazard of munitions and explosives of concern (MECs). The proposed areas of the cacao farm are confined to gentle and moderate slopes to minimize erosion potential.
5. The proposed action will occur on limited areas where no historic or archaeological sites have been identified, to prevent disturbance of historic and cultural sites. Planned restoration of historic taro *lo'i* in the vicinity of the project area is a positive impact of the overall activities proposed by the 'Ōhulehule Forest Conservancy.
6. The economic and social welfare of the community will be positively affected from the creation of farming jobs and increase in agricultural activity in Waikāne Valley. The cacao farm activities are not anticipated to impact cultural practices or customary Native Hawaiian rights as walking access into the valley will not be prohibited. Although ungulate fencing could limit access, gates will allow access through the fences at locations where they intersect trails. The proposed action is consistent with the expressed desire of community members in the Waikāne area to maintain and increase agricultural production in the area.
7. The proposed action will not cause substantial secondary impacts, nor adversely affect population changes on public facilities. Access is provided off of Waiāhole Valley Road, a County-owned and maintained roadway. There are no additional burdens on public facilities anticipated from the proposed action.

8. The proposed action will not have a significant detrimental affect air or water quality or ambient noise levels.
9. The property will remain consistent in character and size with other properties in the area, and will neither conflict with or intensify existing land uses, nor burden the existing area resources and available public services, and therefore does not have a cumulative effect upon the environment or involve a commitment for larger action.

4.1. Soil and Water Quality

4.1.1. *Beneficial Impacts*

The proposed koa and cacao agroforestry system is well-suited to the dominant soil type found in the *makai* parcel of the ʻŌhulehule Forest Conservancy property. On the lower to moderate slopes in the *makai* parcel, the rich alluvial soils are considered to be very fertile for agriculture and are included in the Agricultural Lands of Importance to the State of Hawaiʻi (ALISH). Most of the proposed cacao farm areas are located on "Prime Agricultural Lands", which have adequate moisture supply, pH between 4.5 and 8.4, deep water table, low risk of flood and erosion, and soils that contain less than 10% of rock fragments coarser than 3 inches. Although erosion of exposed soil by wind and water is a concern involved in any agricultural operation, tree crops such as cacao that develop a closed canopy and extensive root system cause minimal soil erosion when compared to more intensively cultivated herbaceous crops that often require regular plowing of planting fields.

For the initial establishment of wind block, shade and cacao trees, irrigation will be required during the dry season (*i.e.,* April-October) and during extended droughts. The use of a micro-irrigation system will allow targeted irrigation delivery to each tree and also reduce the amount of irrigation water needed. During dry periods, irrigation will be conducted two-to-three times per week at a rate not exceeding 2,000 gallons per acre per week. The Waiāhole Valley Water System (WVWS) has sufficient capacity to supply the minimal irrigation needs of the proposed cacao farm, without causing significant impacts to the area's water resources.

Once the agroforestry area is established, including windbreak, cover crops, shade trees and cacao trees, the vegetative cover will reduce soil erosion from wind and rain. As trees mature, they develop an extensive lateral root system that stabilizes the surface layer of soil. Improved rain infiltration will increase groundwater recharge rates. Soil fertility is expected to improve through soil amendments, mulching and establishment of cover crops. Retention of leaf litter and return of fruit husks to the field will recycle substantial nutrients to the fields. In Waikāne Valley's wet climate, this type of agroforestry system cultivation may only require limited supplemental irrigation and agricultural inputs for cacao cultivation.

4.1.2. *Potential Adverse Impacts and Mitigation Measures*

Potential impacts on soil and water quality are primarily limited to early establishment of the site and orchards. Potential sources of water contamination by soil deposition include erosion from construction of roads, buildings and land clearing. Sources of chemical contamination are the application of herbicides, pesticides and fertilizer. Herbicides (triclopyr) and pesticides (imidacloprid) have been selected because of their rapid breakdown and minimal risk for penetration into the water table. Herbicides will only be applied to assist in removal of invasive vegetation for new plantings. Pesticides will only be used if needed during the first three years of growth to control the Chinese rose beetle (*Adoretus sinicus*). Once the cacao orchard has matured, organic certification may be acquired; it is anticipated that no herbicides or pesticides will be used, and only organic fertilizers will be applied when needed.

Best management practices will be followed to avoid soil runoff, which has the potential to contribute to impaired water quality in Waikāne and Waike'eke'e Streams. The cacao farm fields are located no closer than 250 feet from any stream on the property, and all proposed facilities are at least 1,000 feet from streams. Vegetated buffer areas, sediment basins and silt fences between land disturbance areas and streams are anticipated to filter sediment and improve soil water absorption. Therefore, it is unlikely that the cacao farm would have significant adverse impacts on the water quality of Waikāne and Waike'eke'e Streams.

Land clearing will be conducted outside of the wettest months from December through March, and during clement weather as much as possible. The trunks of larger trees that cannot be mulched will be cut into logs and laid across hill slopes on the edges of the cacao farm for slope stabilization and erosion control. Ground cover cloths, cover crops and mulching will improve soil quality and moisture retention while the agroforestry plants are being established. A disc harrow is expected to be used to loosen the soil and to incorporate agricultural limestone/dolomite and phosphorous amendment into the top 6 inches. Disking does not disturb the soil structure to the same degree as a rototiller or moldboard plow.

Pest Control

If pest control of the Chinese Rose Beetle (*Adoretus sinicus* Burmeister) is needed for cacao seedlings, insecticides will be applied in a manner that minimizes potential adverse impacts to human and ecosystem health. As noted under "Pest Control" in Section 2.2.2 above, application and use of Imidacloprid is more efficient and is less of a safety hazard for farm workers than Carbaryl. Imidacloprid is absorbed by the tree and provides systemic activity for at least 6-9 months after application as a soil drench or as broadcasted granules. Because rose beetle damage becomes less severe in the second and third year of cacao establishment, application of Imidacloprid will no longer be needed by the time the trees reach bearing age. The process of testing and applying to the EPA for a new SLN permit for imidacloprid is anticipated to be completed in early-mid 2013.

In the event that imidacloprid is not approved for use, Carbaryl 4L may be applied as needed at a rate of one quart per acre in water solution using conventional hydraulic-type or airblast sprayers. The insecticide will only be applied when insects or their feeding damage appear. Application may be repeated at seven-to-ten day intervals as necessary. Carbaryl is harmful to humans if swallowed, absorbed through the skin, or inhaled. Insecticide handlers will be required to wear protective clothing and a NIOSH-approved respirator during mixing and application.

Carbaryl is toxic to aquatic invertebrates and honeybees. The product will not be directly applied to water or to areas where surface water is present. Additionally, insecticide application will be conducted during clement weather and will be minimized to the extent possible during the rainy season. The amount of product mixed will be calculated according to the number and size of trees that require treatment. The minimum amount of product needed will be prepared to minimize disposal of extra insecticide. Application will only be done where needed and will be carefully controlled to minimize drift and runoff. To the extent possible, product application will be minimized during tree blooming season and will be conducted during evening hours when bees are less active. Additionally, beekeepers within one mile of treatment areas will be notified at least 48 hours before product is applied to allow them to take additional steps to protect their bees as needed. These steps may include temporarily confining honeybees to their hives or moving the hives beyond bee-flight range from the treated area. Precautionary measures may be discontinued after spray residues have dried.

Farm Facilities

Cacao farm facilities will be designed, constructed, and operated to minimize adverse impacts to soil and water quality in the surrounding environment. The Site-Specific Construction Best Management Practice Plan ("SSBMPP") will be followed during construction activities. The SSBMPP will identify appropriate BMPs for sediment control and contractor activities, and provide information on BMP installation and monitoring. BMPs related to building construction may include silt fences, compost socks, proper location of potential sediment sources, dust control, proper stockpile management, and/or other BMPs as needed.

The cacao fermentation process may produce a few gallons of sweatings per day at full production. Sweatings contain sugars, alcohol, and acetic acid. Although not toxic, the sweatings are mildly corrosive and are likely to attract insects. The collection system will be connected to a reservoir that will be regularly emptied into the property's septic system. Prior to construction of the septic system, we will submit the appropriate permit to the State Department of Health.

The shade house facility will follow requirements identified in the 2010 "Phytosanitation Standards and Guidelines". The native plants and cacao seedlings in the shade house will be watered using drip systems with timers. Integrated pest management (IPM) for the shade house may include a combination of the following: systemic pesticides, neem oil, soap spray, mitecides, and/or horticultural oil. Foliar and slow-release fertilizers will be used minimally according to directions on the labels to minimize potential impacts. Even when fertilization and irrigation factors are optimized, the plant nursery may generate a small amount of runoff containing traces of pesticides and fertilizers. Any runoff will be diverted into a nearby "bioretention swale", a vegetated depression that allows water to percolate into

the soil. The swale will be planted with common native plants that help to remove chemicals from the shade house runoff through phytoremediation.

4.2. Scenic Resources

4.2.1. *Beneficial Impacts*

The *makai* portions of the property have significant scenic resources including views towards the ocean of Kāneʻohe Bay and Puʻu ʻŌhulehule to the north. Parts of the *makai* parcel are dominated by strawberry guava (*Psidium cattleianum*), growing in thick, impenetrable stands. The areas not dominated by strawberry guava or other alien trees such as albizia (*Falcataria molucanna*) tend to be more open, with various invasive tree species growing amongst alien grasses, shrubs, and herbs. The ʻŌhulehule Forest Conservancy plans to provide limited public access to the property, so that Waiāhole-Waikāne residents as well as people from the surrounding community can enjoy recreational and scenic resources.

4.2.2. *Potential Adverse Impacts and Mitigation Measures*

The cacao facilities will be sited to minimize their visual impact from Waiāhole Valley Road and other areas of the property. Views of the ocean and mountains may be partially obstructed by windbreaks, shade trees, and cacao trees, but the proposed land use fits within the rural agricultural character of Waikāne Valley.

4.3. Biological Resources

4.3.1. *Beneficial Impacts*

The proposed action will improve habitat for native and endangered plants and animals by replacing an invasive-dominated landscape with an agroforestry system that includes native plants and non-natives with a low invasive potential. Consistent with the *makai* parcel's designation within the Conservation District's Resource Subzone, the ʻŌhulehule Forest Conservancy plans for sustainable use of the natural resources within this subzone.

The existing environment is dominated by a number of invasive tree and shrub species that create a monotypic forest stands, leach soil nutrients, and choke out native species. Feral pigs can significantly alter ecosystems by damaging native plants and spreading the seeds of invasive species. Pigs can also contribute to soil erosion as well as negatively impact cultivated plants by foraging and rooting. The potential fencing of the agroforestry area and removal of pigs may provide ecosystem benefits to the area by improving habitat for native species and reducing soil erosion.

Koa trees have the potential to provide many benefits to a cacao farm, including nitrogen fixation, light shade, and wind protection. Koa trees with genetic resistance to koa wilt at low elevations, as well as koa trees produced from seed from Waikāne koa trees, will be used as the dominant in-field shade

trees. Additional shade trees may not be native Hawaiian species, but will be carefully selected to include non-invasive characteristics. Cacao trees (*Theobroma cacao*) will be the primary agricultural crop grown in the agroforestry area. When properly managed, cacao crops are associated with low levels of environmental impact compared to other crops. Additionally, cacao trees have demonstrated a very low invasive potential.

4.3.1. *Potential Adverse Impacts and Mitigation Measures*

No rare, threatened and endangered species were recorded on the *makai* parcel historically or during surveys conducted in 2012 (see Appendices C and D). Therefore, the ʻŌhulehule Forest Conservancy does not anticipate any adverse impacts to these species in the proposed agroforestry area. Although it is possible that the Ōpeʻapeʻa or Hawaiian hoary bat (*Lasiurus cinereus semotus*) occurs in the Waikāne Valley area, it was not recorded during the April 2012 survey. Threats to the bats include barbed-wire fences and pesticide use that may reduce or alter their prey populations. To help protect the Ōpeʻapeʻa, the ʻŌhulehule Forest Conservancy management plan follows USFWS and DOFAW recommendations not to cut trees greater than 15 feet in height during the bat's breeding season from June 1 to September 30. A site reconnaissance will be conducted before the start of land clearing activities, to identify the presence of any native trees and plants to preserve during land clearing, preparation, and planting.

4.4. Environmental Hazards

4.4.1. *Beneficial Impacts*

Avoidance of slopes greater than 35% for agricultural activities will prevent excessive erosion. The ʻŌhulehule Forest Conservancy may help to avoid and mitigate the impacts of illegal off-roading and refuse dumping on the property, by maintaining a presence on the property. Trees established as part of the agroforestry system may reduce wind velocities on neighboring properties.

4.4.2. *Potential Adverse Impacts and Mitigation Measures*

Removal of munitions and explosives of concern (MECs) was conducted over a large portion of the northern cacao farm area. The removal effort included a 100% sweep of the removal areas and recovered 50 MEC items from the Southeastern Region. Although no MECs were identified outside of the removal areas, the USACE cannot guarantee that all MECs have been removed from the property. Based on the work conducted by the USACE, areas where the MEC removal effort was conducted are considered clear.

The potential existence of MECs on the property may pose "low potential explosive hazard conditions" to people and animals that enter the cacao farm area. Signage will inform people of this potential risk and the ʻŌhulehule Forest Conservancy will maintain contact with the USACE for updates on the status of military-related hazards on the property.

4.5. Archaeology

4.5.1. *Beneficial Impacts*

The proposed action will occur on limited portions of the *makai* parcel where no historic or archaeological sites have been identified. The intentional siting of the cacao farm away from historic sites will avoid disturbance of the sites. A restoration plan prepared by Cultural Surveys Hawai‘i, in consultation with SHPD/DLNR, describes the methods and procedures that will be used to restore and reuse historic taro *lo‘i* and also protect certain features of those sites which have been identified as having traditional cultural significance. Although neither of the areas lies within the boundaries of the proposed cacao farm, the restoration of historic *lo’i* so that traditional agriculture may be practiced is a positive impact of the overall activities proposed by the ‘Ōhulehule Forest Conservancy.

4.5.1. *Potential Adverse Impacts and Mitigation Measures*

A field survey was conducted by Cultural Surveys Hawaii in 2012 that confirmed the findings of the previous archaeological surveys and did not identify and historic sites within the proposed cacao farm areas. Therefore, the ‘Ōhulehule Forest Conservancy does not anticipate any adverse impacts to historic archaeological sites within the *makai* parcel.

4.6. Cultural and Socio-Economic Environment

4.6.1. *Beneficial Impacts*

A commercial-scale cacao operation in Waikāne Valley has the potential to stimulate the local economy over a period of decades by creating long-term employment opportunities and involvement of local businesses during the establishment and maintenance of the proposed farm. During early establishment of the farm site and orchards, it will be necessary to obtain contracts for the construction of roads and buildings, cultivation of seedlings in a nursery, and for clearing and preparation of the land for planting.

The agroforestry operation may provide employment for one farm manager and two workers to manage the tree nursery, full-scale plots, and general farm operations. Three to four additional seasonal employees will be needed to harvest and to process cacao beans during the fruiting season. If the viability of cacao production in Waikāne Valley is demonstrated, the ‘Ōhulehule Forest Conservancy hopes to encourage other local farmers to produce high-quality, organically-grown cacao so as to create the critical mass needed for a regional appellation, which may then command premium prices for Waiāhole-Waikāne cacao.

The cacao farm activities are not anticipated to impact cultural practices or customary Native Hawaiian rights as walking access into the valley will not be prohibited. In addition, the ‘Ōhulehule Forest Conservancy will seek to partner with local community members interested in restoring the historic taro *lo`i* of upper Waikāne Valley. This will provide opportunities for local community members to reconnect

with traditional cultural practices of the valley. Prior to beginning any lo`i restoration activities, a Preservation Plan will be submitted to the State Historic Preservation Division for approval to ensure that proposed activities do not impact the historic nature of these cultural sites.

4.6.2. *Potential Adverse Impacts and Mitigation Measures*

No adverse impacts to cultural practices or to the socio-economic environment of the surrounding area are expected as a result of the proposed cacao agroforestry activities and facilities. Access to natural resources such as bamboo and fern shoots will be permitted, and potential impacts to the aquatic and coastal ecosystems will be mitigated through Best Management Practices to minimize soil erosion and surface runoff. Hiking and other recreational activities on limited areas of the property will also be permitted, allowing members of the public to access the scenic and natural resources of Waikāne Valley. Although ungulate fencing could limit access, gates will allow access through the fences at locations where they intersect trails.

Three interviews with community members were conducted in order to gather more information and recommendations about the proposed Cacao Farm project. Mr. Keoki Fukumitsu, a cultural practitioner, Mrs. Pat Royos, long-time resident and former WWVCA president, and Mr. Ted Saizon, a long-time neighbor helped the applicant to identify cultural practices in Waikāne Valley (see "Cultural Practices", section 3.2.3 above and Appendix E) and assess the potential impact of the proposed action. They supported the ʻŌhulehule Forest Conservancy's overall vision for the property. Mr. Fukumitsu expressed some concern that the ground-disturbing activities proposed for the early stages of site preparation for the farm might have a negative impact on water quality. He agreed that Best Management Practices should be used during land clearing, road repairs and facilities construction to avoid runoff. In the opinion of the community members interviewed, the proposed actions would not have any adverse impacts on cultural practices in the valley.

4.7. Cumulative impacts

The cumulative impact of the proposed project over time and in the context of the surrounding area is expected to be primarily positive. In addition to the cacao-koa farm, the ʻŌhulehule Forest Conservancy is proposing restoration of native forest and ʻElepaio habitat in the *mauka* portion of the valley, and restoration of the historic taro *lo'i* on Waikāne Stream. These actions are consistent with past and present land uses, as well as the desire of community members to perpetuate agriculture and the rural lifestyle of Waikāne Valley. Best Management Practices will be implemented during road repairs, construction work, and operation of the forest restoration and cacao agroforestry projects to avoid adverse impacts to soil, air and water quality in Waikāne Valley. By protecting important watershed area and allowing limited public access to the property, the Ōhulehule Forest Conservancy is maintaining and improving the environmental quality of the land and allowing for continued cultural practices in the area.

5. Alternatives Considered

5.1. No Action

If no action is taken to establish an agroforestry system on the *makai* parcel of the ʻŌhulehule Forest Conservancy property, the land cover and resources will likely remain in their existing state. The *makai* parcel is currently dominated by invasive vegetation and is visited by trespassers who illegally dump refuse and contribute to soil erosion through off-roading activities.

5.2. Alternative Crops

The purpose of starting with a five-acre agroforestry test plot is to determine if cacao is a feasible crop for the ʻŌhulehule Forest Conservancy to cultivate at a commercial scale. If it is determined that cacao does not have good potential for the planned full-scale farm operation, other suitable crops such as avocado and citrus may be cultivated instead. The ʻŌhulehule Forest Conservancy will continue to consult with knowledgeable local farmers, resource managers and relevant agencies as plans for the farm evolve according to results of the initial test plot.

Citrus crops would have similar environmental benefits for the ʻŌhulehule Forest Conservancy property as would be expected from a cacao farm, and few potential adverse impacts which could be mitigated through sound management practices. Examples of citrus varieties that have been successfully grown and marketed in Hawai'i include: Meyer lemon *(Citrus meyeri),* Tahitian lime *(Citrus latifolia),* Valencia orange (*Citrus x sinensis)*, and Fremont tangerine *(Citrus reticulata)*. In many cases, these plants are grown organically farms with elevation and precipitation levels similar to those found on the subject property in Waikāne Valley. Like cacao, citrus trees are sensitive to wind and therefore would require wind blocks. The same wind block species used in the cacao farm, such as bana grass, *ti* and hibiscus, would be appropriate to shelter citrus seedlings.

Unlike cacao, citrus plants require full sunlight to thrive. The lack of shade trees throughout the orchard (as in the proposed koa-cacao agroforestry system) may cause a higher rate of evaporation from the soil. Citruses in general are better adapted to dry climates than wet, and can tolerate infrequent watering during drought periods. The citrus grove would be planted within the proposed cacao areas along the contours to minimize runoff, and the presence of trees would improve aquifer recharge rates. Soil preparation methods such as disking the top six inches of soil, planting of cover crops, mulching and retention of leaf litter to retain moisture and prevent erosion would apply to citrus, just as described for the cacao farm. Insects that may affect citrus include scale, aphids, whitefly, Chinese rose beetle, citrus swallowtail caterpillar, citrus blackfly, and citrus leafminer.

Avocado (*Persea americana) is* another viable alternative crop, with local varieties such as Sharwil, Green Gold, and Murashige recommended by CTAHR for commercial planting. Avocado trees require well-drained soil and thrive with the annual precipitation level of roughly 50 inches found on the *makai* parcel of the ʻŌhulehule Forest Conservancy property. Similar soil preparation and amendments would

be required for avocado, and the environmental benefits of soil and moisture retention would be expected. Avocado trees are commonly propagated by grafting budding desirable cultivars onto seedling or grafted rootstocks, and bear fruit within 3-5 years. In additon to the Chinese rose beetle, scales and aphids mentioned above for citrus, avocado trees may be attacked by fruit flies (*Ceratitis capitata* and *Bactrocera dorsalis*), Mealybug (*Dysmicoccus neobrevipes),* and Red-banded thrips (*Selenothrips rubrocinctus*). Regardless of which crop is ultimately cultivated on the farm, the ʻŌhulehule Forest Conservancy would work with CTAHR to develop an Integrated Pest Management (IPM) system to control pests while striving for a minimal impact on the surrounding environment.

Slow release fertilizer may be used in the planting holes to help establish seedlings, and subsequent fertilizer application will be minimal according to soil and leaf tissue analyses that help identify nutrient deficiencies. Application of fertilizer may cause a limited amount of runoff into surface water bodies, which can lead to elevated nitrate levels and eutrophication. However, the fields are located a sufficient distance away from water bodies, and with vegetative buffer between the fields and stream. These factors are expected to minimize any adverse impacts to the aquatic environment. As with the cacao farm, it is expected that the citrus or avocado farm could become organic within five years.

Both crops may serve as viable alternatives to the cacao farm, if commercial production of cacao does not seem feasible for the ʻŌhulehule Forest Conservancy after the initial five-acre phase of cacao agroforestry system is established and observed. While cacao is the first choice of crop, citrus or avocado would also provide similar environmental benefits and few potential adverse impacts to the existing land use. Furthermore, a successful agricultural venture would be compatible with the surrounding land use in Waikāne and Waiāhole valleys, and would provide jobs in Windward O'ahu. We anticipate that the proposed activities would not have any significant adverse impacts on soil or water quality, scenic resources, wildlife habitat, ecosystems, archaeological sites, cultural practices, or on the surrounding community.

APPENDICES

Appendix A.
Written Support from Kahalu'u Neighborhood Board and Waiāhole-Waikāne Community Association

Appendix B.
Waikāne Valley Botanical Survey (Lau, 2012)

Appendix C.
Waikāne Valley Faunal Surveys – Final Report (VanderWerf, 2012)

Appendix D.
Archaeological Field Survey Letter Report (Cultural Surveys Hawai'i, 2012)

Appendix E.
Cultural Impact Interview Summaries (Townscape, Inc., 2012)

Appendix A: Written Support from Kahalu'u Neighborhood Board and Waiāhole-Waikāne Community Association

KAHALU'U NEIGHBORHOOD BOARD NO. 29
(Heeia Kea, Ahuimanu, Kahalu'u, Waihee, Kaalaea, Waiahole, Waikane, Hakipuu, Kualoa
HONOLULU HALE, ROOM 406 ↑530 SOUTH KING STREET ↑HONOLULU, HAWAII, 96813
L808) 768-3710 ↑FAX (808) 768-3711↑E-MAIL nco@honolulu.gov↑INTERNET: http://www1.honolulu.gov/nco

"LET US NOT EVER HAVE AN UNHAPPY MINORITY; RATHER, LET US BUILD A COMMUNITY CONSENSUS."

RESOLUTION
REGARDING OHULEHULE FOREST CONSERVANCY

At its Wednesday, June 13, 2012 regular meeting, the Kahalu'u Neighborhood Board No. 29 unanimously adopted the following resolution:

The Kahalu'u Neighborhood Board supports in concept the five principal activities of the 'Ōhulehule Forest Conservancy, namely, (1) forest restoration/preservation, (2) preservation of 'Elepaio nesting sites, (3) operation of an agroforestry cacao farm, (4) restoration of taro growing and the protection of cultural and historical sites, and (5) construction of a single-family residence to be used by the Zweng family. This support is based on the information presented at the Kahalu'u Neighborhood Board's June 13, 2012 meeting and is subject to revision or even possibly complete withdrawl should new information regarding the above five proposed activities come forth that are inconsistent with the purpose and mission of the Kahalu'u Neighborhood Board.

David Henkin
Chair, Kahalu'u Neighborhood Board No. 29

Waiahole-Waikane Community Association

June 12 2016

Kahaluu Neighborhood Board.
47 2800 Waihee Rd
Kaneohe Hi 96744

Dear Members of the Kahaluu Neighborhood Board,

The WWCA Steering Committee supports in concept the five principal activities of the 'Ohulehule Forest Conservancy, namely,(1) forest restoration/preservation, (2) preservation of 'Elepaio nesting sites, (3) operation of a agroforestry cacao farm, (4) restoration of taro growing and protection of cultural and archeological sites, and (5) construction of a single-family residence for the Zweng family.
This support is based on 'Ohulehule Forest Conservancy presented information on June 5 2012 to the WWCA Steering Committee and is subject to revision or even possibly complete withdrawal should new information regarding the above five proposed activities come forth that are inconsistent with the purpose and mission of the WWCA.

Respectfully Yours

Byron Ho
President of the WWCA

Appendix B: Waikāne Valley Botanical Survey (Lau, 2012)

Waikāne Valley Botanical Survey
Oʻahu, Hawaiʻi

Prepared for:
ʻŌhulehule Forest Conservancy, LLC
Kailua, Hawaiʻi 96734

By:
Joel Lau

July 2012

INTRODUCTION/DESCRIPTION OF THE AREA

This report presents the findings of a botanical survey of mountainous lands in Waikāne Valley, O`ahu, Hawai`i that are proposed for native forest management and restoration by the `Ōhulehule Forest Conservancy, and of other lands in the valley bottom proposed for the cultivation of cacao (*Theobroma cacao*). The primary objectives of the field studies were to:

1. Provide a description of the vegetation;
2. Compile a list of the vascular plant taxa seen on the survey.
3. Search for plant taxa listed as endangered or threatened by the U. S. Fish and Wildlife Service, plant taxa that are currently proposed for listing, or are candidates for listing.
4. Search for plant taxa that have no federal status, but are nevertheless of conservation concern.
5. Identify threats to the native biota of the area, such as the major invasive weed threats and incipient weeds.

Property owned by the `Ōhulehule Forest Conservancy is made up of two land parcels that lie within the ahupuaʻa of Waikāne in the Koʻolaupoko district (Figure 1, Appendix A). Both parcels sit on the mauka (mountain) side of the ahupuaʻa with Puʻuʻōhulehule and Pu`ukoiele to the north of the property and the Koolau summit to the west of the property (Figure 1, Appendix A). Within these parcels, two proposed project areas are designated for native plant restoration along with four smaller areas allotted for cacao farming (Figure 2, Appendix A).

Two separate areas are proposed to be managed for the perpetuation of native Hawaiian ecosystems and the native plants and animals they contain, and for the restoration of native ecosystems in the portions of the areas that are no longer dominated by native plants. The northern restoration area is the larger of the two areas and includes 166 acres. It extends from the bottom of Waikāne Valley up to the crest of the ridge that divides Waikāne Valley from Kahana Valley to the north (Figure 2, Appendix A). Its elevations range from about 300 feet in the valley bottom to 1,683 feet at Pu`ukoiele, which is a peak on the ridge dividing Waikāne and Kahana Valleys. The southern restoration area includes 110 acres. It is located in the head of Waikāne Valley, and extends from 520 to 1,620 feet in elevation (Figure 2, Appendix A). Both areas include much steeply sloped terrain. Four separate areas constitute the cacao farming areas, which are located in the lower elevations of Waikāne Valley, and include a total of 49 acres. These areas consist of gently sloped land in between more steeply sloped gulches.

SURVEY METHODS

Prior to the field survey, a search was made for any records of rare and endangered plants found in the survey areas, in the neighboring areas, and in the general area. Information from the Hawai`i Biodiversity and Mapping Program and the Bishop Museum was reviewed.

The survey was conducted in April to May 2012. A total of seven non-consecutive days were spent surveying the northern restoration area (3 days) the southern restoration area (3 days) and the cacao farming areas (1 day).

The survey was conducted on foot, utilizing few existing trails as well as going into areas where there were no trails. Off trail routes often followed ridge tops, gulch bottoms, or streambeds. The full range of vegetation and habitat types within the survey areas were sampled.

In order to maximize the chances of finding rare and endangered plants, the survey was concentrated in the areas judged to have the most potential for these plants. These high potential areas were often those with a high diversity of native plant taxa in the upper elevations of the survey areas. Also judged to have a high potential for rare and endangered plant taxa were the habitats in the gulch bottoms. Plant taxa were mostly identified in the field. For the plants that could not be positively identified in the field, collections were made for later determination.

The plant taxa included in the species list were the observed native plants, the non-native plants that are known to be naturalized, and any non-native plants that were observed to be spreading. Not included were the various planted ornamental plants present in the survey areas that were persisting after being planted, but not were not observed to be spreading. Also, there are currently inhabited residences as well as currently cultivated crops in the southern cacao farming areas. The various plants planted around those residences and the various crop species still under cultivation in the proposed cacao farming area were also not included in the species list. Included in the species list are a few plant taxa that were observed only outside of the survey areas but were thought to be worthy of mention; these taxa are indicated in the species list as being observed only outside of the survey area boundaries.

DESCRIPTION OF THE VEGETATION

Restoration Areas

Both of the restoration areas contain native dominated and non-native dominated areas (Figure 5, Appendix A). The northern restoration area has a greater percentage of native dominated vegetation than the southern restoration area however; there are areas in the upper elevation portions of the southern restoration area where the vegetation is almost completely native. In general, in both of the restoration areas, the lower elevations tend to be more alien dominated, and the gulch bottoms are mostly alien dominated. The native vegetation of both of the forest restoration areas ranges from mesic to wet. Portions of the native-dominated vegetation of the restoration areas, especially in the northern restoration area, are dominated by uluhe (*Dicranopteris linearis*). Such areas are blanketed with a layer of the fern forming an impenetrable mat 1 or 2 meters thick, with scattered native trees sticking out of the mat. Uluhe dominated areas range from the lower gulch slopes to the ridge crests. In other areas the common forms of tree `ōhi`a lehua (*Metrosideros polymorpha* var. *glaberrima*, var. *incana*, and var. *polymorpha*) are co-dominant with uluhe. There are some areas, especially near the ridge tops, where uluhe is lacking and `ōhi`a lehua is the only dominant. In native vegetation areas not dominated or co-dominated by uluhe the native tree canopy is denser, and there is a greater diversity of native shrub and groundcover species. In the lower elevations of the northern restoration area, there are areas where hala (Pandanus tectorius) is abundant enough to be considered a co-dominant or a dominant species.

In the northern restoration area, there is a fair amount of koa (*Acacia koa*) in the lower elevations, but it is not a dominant species. In the southern restoration area there are also some trees of it in the lower elevations. The common to occasional native trees of the native forests on the gulch slopes and on the ridges of the two forest restoration areas seen on this survey were lama (*Diospyros sandwicensis*), the most common species of kōpiko, *Psychotria mariniana*, `ahakea (*Bobea elatior*), mehame (*Antidesma platyphyllum* var. *platyphyllum*), and `ōhi`a hā (*Syzygium sandwicense*). Occasional to uncommon native trees seen on the survey were the native holly, kāwa`u (*Ilex anomala*), manono (*Kadua affinis*), `āla`a (*Planchonella sandwicensis*), maua (*Xylosma hawaiiense*), kōlea (*Myrsine lessertiana*), hō`awa (*Pittosporum glabrum*), olopua (*Nestegis sandwicensis*), `ohe mauka (*Polyscias oahuensis*), the less common species of *Metrosideros*, lehua `āhihi (*Metrosideros tremuloides*) and *M. macropus*, an uncommon kōpiko, *Psychotria kaduana*, kalia (*Elaeocarpus bifidus*), olomea (*Perrottetia sandwicensis*), hao (*Rauvolfia sandwicensis*) (seen only just outside of the southern restoration area), and māmaki (*Pipturus albidus*).

Common to occasional shrubs seen in the restoration areas included naupaka kuahiwi (*Scaevola gaudichaudiana*), ha`iwale (*Cyrtandra calpidicarpa, C. hawaiensis, C. laxiflora, and C. propinqua*), `ākia (*Wikstroemia oahuensis* var. *oahuensis*), and the occasional to uncommon shrubs included `ōhelo (*Vaccinium calycinum*, *V. dentatum*, and *V. calycinum* x *V. dentatum* hybrids), pilo (*Coprosma longifolia*), kanawao (*Broussaisia arguta*), pūkiawe (*Leptecophylla tameiameiae*), and ko`oko`olau (*Bidens macrocarpa*).

The native tree fern hāpu`u (*Cibotium chamissoi*) was fairly common at all elevations of the restoration areas, and hāpu`u `i`i (*Cibotium menziesii*) was occasional in the upper elevations of the two areas. Common to occasional native vines seen in the restoration areas were maile (*Alyxia stellata*) and `ie`ie (*Freycinetia arborea*). An uncommon native vine was hoi kuahiwi (*Smilax melastomifolia*).

Native groundcover and small understory plants included `uki`uki (*Dianella sandwicensis*), the sedges *Gahnia beecheyi*, `uki (*Machaerina angustifolia*),`ahaniu (*Machaerina mariscoides* subsp. *meyenii*), *Carex wahuensis* subsp. *wahuensis*, and *Rhynchospora sclerioides*. Native terrestrial ferns included the common to occasional pala`ā (*Sphenomeris chinensis*), sword fern (*Nephrolepis exaltata* subsp. *hawaiiensis*), and the occasional to uncommon palapalai (*Microlepia strigosa* var. *strigosa*), *Asplenium contiguum* var. *contiguum*, `alae (*Asplenium caudatum*), and pāmoho (*Doodia kunthiana*).

Common to occasional native epiphytic (growing on trees) ferns and fern allies seen in the restoration areas were hoe a Māui (*Elaphoglossum crassifolium*), the whiskferns or moa (*Psilotum complanatum* and *P. nudum*), wahine noho mauna (*Adenophorus tamariscinus* var. *tamariscinus*), kolokolo (*Adenophorus tenellus*), adder's tongue or puapua moa (*Ophioglossum pendulum*), palai hinahina (*Hymenophyllum lanceolatum*), `ōhi`a kū (*Hymenophyllum recurvum*), and pākahakaha (*Lepisorus thunbergianus*). Occasional to uncommon native epiphytic ferns and fern allies included `ohe`ohe (*Haplopteris elongata*), wāwae `iole (*Huperzia phyllantha*), bird's-nest fern (*Asplenium nidus*), `opeha (*Elaphoglossum aemulum*), and palai lau li`i (*Hymenophyllum obtusum*).

Certain native plant taxa were restricted or were most common in the gulch bottoms of the two restoration areas. Included among these were the trees pāpala kēpau (*Pisonia umbellifera*), koki`o ke`oke`o (*Hibiscus arnottianus* subsp. *punaluuensis*), loulu (*Pritchardia martii*) and pāpala (*Charpentiera tomentosa* var. *maakuaensis*). Shrubs found mainly in the gulch bottoms were `ākōlea (*Boehmeria grandis*), olonā (*Touchardia latifolia*), the various species of ha`iwale (*Cyrtandra calpidicarpa*, *C. hawaiensis*, *C. laxiflora*, and *C. propinqua*), and the hybrid combination *C. laxiflora* x *C. propinqua*. Native ferns found mainly in the gulch bottoms were *Callistopteris baldwinii*, *Crepidomanes draytonianum*, *Crepidomanes minutum*, *Vandenboschia cyrtotheca*, and *Vandenboschia davallioides*.

Polynesian introduced plants seen on the survey of the restoration areas included the tree kukui (*Aleurites moluccana*), which was a dominant in some gulch bottoms, and ti (*Cordyline fruticosa*), which was common in some areas. A single stand of the Polynesian introduced bamboo (*Schizostachyum glaucifolium*) was seen in the southern restoration area. Another Polynesian introduced tree, kamani (*Calophyllum inophyllum*), was seen in the southern restoration area, but these were evidently planted sometime in the early 1900's. A single plant of the culturally important Polynesian plant kava (*Piper methysticum*), was seen alongside a stream in the northern restoration area. A few plants of the taro relative `ape (*Alocasia macrorrhizos*) were seen in the gulch bottoms of the southern restoration area.

Hau (*Hibiscus tiliaceus*) is a tree whose branches form a tangled, almost impenetrable mass. The species is thought to be either a native plant or a Polynesian introduced plant. It was seen in both restoration

areas, with a large area of the main gulch bottom in the northern restoration area dominated by the species.

Common Invasive Weeds in the Restoration Areas

Albizia (*Falcataria moluccana*), which grows into a large, tall tree, is a major non-native canopy dominant in the gulch bottoms in both restoration areas, and it can be found additionally on the gulch slopes up to the ridge tops. The tree koka (*Bischofia javanica*) is very common particularly in the SRA, dominating some of the gulch bottoms and extending up to the ridge tops. The tree white moho (*Heliocarpus popayanensis*) is common in both restoration areas extending from the gulch bottoms to the ridge tops. Bingabing (*Macaranga mappa*) is a tree that was seen only in the southern restoration area, where it is a dominant tree in some gulch bottoms and lower gulch slopes. Large mature trees of octopus tree (*Schefflera actinophylla*) are not yet very common in the restoration areas, but numerous seedlings and saplings, often epiphytic, can be found throughout the restoration areas as the seeds are apparently being spread by fruit eating birds. Shoebutton ardisia (*Ardisia elliptica*) is a small tree that is common in some areas of both of the restoration areas. Its seeds are also apparently being dispersed by fruit eating birds, and young plants of this species can be found throughout the restoration areas. There are areas in both restoration areas where strawberry guava (*Psidium cattleianum*) has become a dominant understory species. It is not spreading as rapidly as the weed species whose seeds are being spread by fruit eating birds. Koster's curse (*Clidemia hirta* var. *hirta*) is a very common to dominant understory shrub in both restoration areas. The species may have already spread into its entire potential habitat, and is possibly no longer increasing in numbers.

Cacao Farming Areas

Much of the acreage of the areas proposed for the cultivation of cacao are lands that were formerly utilized as pasture lands, but have not been used as such for at least two or three decades. There are still currently occupied residences on the large southern cacao farming area, and portions of that area are still being utilized for the cultivation of various crops.

The parts of the cacao farming areas that have not been utilized for agricultural purposes in recent years are dominated by non-native plant species. There are small areas of native dominated vegetation in the general area of the cacao farming areas, but these areas are generally on the steeper gulch slopes outside of the cacao farming area boundaries. Parts of the cacao farming areas are dominated by strawberry guava (*Psidium cattleianum*), growing in thick, impenetrable stands. The areas not dominated by strawberry guava are more open, with various tree species growing amongst alien grasses, shrubs, and herbs. Non-native tree species aside from strawberry guava seen on this survey included Java plum (*Syzygium cumini*), albizia (*Falcataria moluccana*), octopus tree (*Schefflera actinophylla*), shoebutton ardisia (*Ardisia elliptica*), Christmas berry (*Schinus terebinthifolius*), rose apple (*Syzygium jambos*), fiddlewood (*Citharexylum caudatum*), koa haole or haole koa (*Leucaena leucocephala*), hau (*Hibiscus tiliaceus*, either a Polynesian introduction or a native species), coconut (*Cocos nucifer*), royal palm (*Roystonea regia*), and the common guava (*Psidium guajava*). The dominant grass in the cacao farming areas is broomsedge or yellow bluestem (*Andropogon virginicus*). Shrubs and shrub sized woody plants seen were Koster's curse (*Clidemia hirta* var. *hirta*), saplings of strawberry guava, young plants of shoebutton ardisia, and ti (*Cordyline fruticosa*). Non-native ferns encountered on this survey included sword fern (*Nephrolepis brownii*), *Blechnum appendiculatum*, laua`e (*Phymatosorus scolopendria*), silver fern (*Pityrogramma calomelanos*), and *Cyclosorus parasiticus*. Terrestrial non-native orchids seen were the bamboo orchid (*Arundina graminifolia*) and the Philippine ground orchid (*Spathoglottis plicata*).

The most common remnant native plants seen in the cacao farming areas were the trees `ōhi`a lehua (*Metrosideros polymorpha*) and hala (*Pandanus tectorius*), the shrub `ākia (*Wikstroemia oahuensis* var. *oahuensis*), and the ferns uluhe (*Dicranopteris linearis*) and pala`ā (*Sphenomeris chinensis*). Uncommon remnant native plant taxa included the tree koa (*Acacia koa*), the fern moa (*Psilotum nudum*), and the sedges *Cyperus polystachyos* and *Fimbristylis dichotoma*.

DISCUSSION AND RECOMMENDATIONS

No rare plant taxa or taxa federally listed as endangered or threatened were found on this survey. However, there is still some potential for undiscovered rare plant occurrences to found, and it is recommended that further searching for rare plant taxa be conducted.

Although no rare plants are currently known from the restoration areas, the areas are suitable for the reintroduction of rare plant taxa historically known from the general area or known from similar habitats in neighboring areas.

The following are some plant taxa that would benefit from being outplanted in the Waikāne Valley restoration areas. The first group of taxa are those of high conservation concern that are especially relevant to Waikāne Valley because of their restricted historical ranges that include Waikāne Valley. The second group of plant taxa includes those of high conservation concern that are relevant to conservation efforts throughout the Ko`olau Mountains. The third group includes taxa that are of lower conservation concern, that would be appropriate for outplanting in Waikane.

Group 1: Taxa of high conservation concern that are especially relevant to Waikāne

Cyanea truncata (Rock) Rock (hāhā; federally listed as endangered) – *Cyanea truncata* is a shrub that is unbranched or branched from the base. It is endemic to the windward Ko`olau Mountains. No plants of the species were known to be extant when a single plant was discovered in 1998 in the Hau`ula area. That plant died about two years after it was discovered, however, seeds were collected from it before it died. Offspring from that plant are still in cultivation and in outplantings. A new wild population of three plants was discovered in 2004 in Kahana on the seaward extension of the ridge system between Kahana and Waikāne Valleys. Two of those plants are still alive, and the genetic material of the population has been secured (Susan Ching, personal communication, Feb. 1, 2012). *Cyanea truncata* has been recorded from gulches against the main spine of the Ko`olau Mountains as well as in two of the gulches on the seaward extension of the ridge between Kahana and Waikāne Valleys, so the gulch bottoms of both of the restoration areas in Waikāne should be suitable for the outplantings of this species.

Cyrtandra kaulantha H. St. John & Storey (ha`iwale; proposed for listing as federally endangered) – *Cyrtandra kaulantha* is a shrub that is narrowly endemic to the windward central Ko`olau Mountains from Waikāne Valley to Waiāhole Valley. There are only seven wild plants known to remain in a single gulch along the Waiāhole Ditch Trail between the valleys of Waikāne and Waiāhole (Susan Ching, personal communication, June 28, 2012). A vegetative *Cyrtandra* plant seen by the principal investigator in April 2011 in Waike`eke`e Gulch just to the south of the southern restoration area appeared be a plant of *C. kaulantha* based on its vegetative characteristics. The plant is outside of the southern restoration area but on the property of the `Ōhulehule Forest Conservancy. *Cyrtandra kaulantha* has proven easy to propagate from leaf cuttings (Susan Ching, personal communication, Feb. 1, 2012). Because so few wild plants are known to remain, this individual in a different drainage from the other known plants of *C. kaulantha* potentially represents an important addition to the conserved genetic material of the species.

Leaf material from this individual should be collected for propagation so that the resulting plants can be positively identified when they come into flower in cultivation and so that their genetic material can be conserved should they prove to be *C. kaulantha*. The species has been found only in the very wet gulches right up against the main spine of the Ko`olau Mountains, and as such, only the southern restoration area appears to contain suitable habitat for this species.

Delissea subcordata Gaudich. subsp. *subcordata* (hāhā; federally listed as endangered) - *Delissea subcordata* subsp. *subcordata* is a branched or unbranched shrub. *Delissea subcordata* subsp. *subcordata* is now considered to include only certain historically collected specimens from the southern and central Ko`olau Mountains. All of the plants of *Delissea* known to be extant in the Wai`anae Mountains are now assigned to the species *D. waianaeensis*. No plants of *D. subcordata* subsp. *subcordata* are currently known to be extant. However, should the taxon be rediscovered, Waikāne Valley would be a good place for outplantings of the taxon since several of the historically collected specimens of this taxon were collected in the valley, most recently in 1934.

Lysimachia filifolia C. N. Forbes & Lydgate (no common name; federally listed as endangered) – *Lysimachia filifolia* is endemic to the islands of Kaua`i and O`ahu. However, the plants on Kaua`i may prove to constitute a separate taxon from the O`ahu plants since the plants on Kaua`i grow to be much larger than the O`ahu plants (Susan Ching, personal communication, June 28, 2012). On O`ahu it has been found only in Waiāhole Valley and in one other gulch between Waiāhole and Waikane Valleys. The O`ahu plants occur only on the faces of nearly vertical dry or dripping waterfalls. At least one of the waterfalls seen on this survey in the southern restoration area seemed possibly suitable for outplantings of this species. Additional survey of the southern restoration area may result in the finding of other apparently suitable waterfalls.

Pritchardia lowreyana Rock (loulu; no federal status)
Pritchardia lowreyana is a native fan palm endemic to Moloka`i and the Ko`olau Mountains of O`ahu. The only currently known wild *P. lowreyana* plants in Ko`olau Mountains are located only 0.7 kilometers (0.45 miles) from the boundary of the northern restoration area, where there is a grove of six mature plants and additional immature plants. In order to minimize the risk of hybridization, the species should not be planted close to natural or out-planted populations of other species of *Pritchardia*. Since *P. martii* occurs naturally in the SRA, but no naturally occurring *Pritchardia* plants are known from the NRA, the NRA could be reserved for outplantings of *P. lowreyana*, while the SRA could be reserved for outplantings of *P. martii*. Outplantings of *P. lowreyana* could also be tried outside of the restoration areas in the lower elevations of Waikāne Valley, as the natural range of the species may have included lower elevations in the valley bottoms. The species may have originally occurred in the lowlands primarily where groundwater was available to the plants, such as in gulch bottoms, along streams, and around springs.

A note concerning *Cyrtandra crenata* H. St. John & Storey (ha`iwale; federally listed as endangered) – The only recorded location for *Cyrtandra crenata* is along the windward leg of the Schofield-Waikāne Trail. However, *Cyrtandra crenata* is now recognized to be a hybrid between *C. hawaiensis* and *C. subumbellata* (Warren L. Wagner, personal communication, May 18, 2010).

Group 2: Taxa of high conservation concern that are relevant to Waikāne as well as to conservation efforts throughout the Ko`olau Mountains

Acacia koaia Hillebr. (koai`e; no federal status) and intermediates between *A. koa* A. Gray and *A. koaia* (no federal status) – *Acacia koaia* is a rare plant endemic to Kaua`i, O`ahu, Moloka`i, Lāna`i, Maui, and the island of Hawai`i. It is usually a small tree. *Acacia koa* is similar to *A. koaia*, but it is usually a much larger tree. Naturally occurring *A. koaia* is known from only a single location on O`ahu, namely in

Wailupe Valley in the southern Ko`olau Mountains. All of the plants at that location look identical, and they appear to have been clonally reproduced by root suckering ultimately from a single original plant. The genetic material of that apparent clone has not yet been safeguarded in cultivation or in outplantings. Intermediates between *A. koa* and *A. koaia* have been found in several areas of the Ko`olau Mountains. One of the areas where they have been found is in Kahana Valley just to the north of Waikāne Valley. Outplantings of *A. koaia* and/or the *A. koa-koaia* intermediates could be tried in lowest elevations of the southern restoration area or in areas seaward of the restoration areas.

Cyanea crispa (Gaudich.) Lammers, Givnish & Sytsma (hāhā; federally listed as endangered) – *Cyanea crispa* is a shrub with somewhat fleshy stems that is unbranched or branched from the base. It is endemic to the Ko`olau Mountains. There are still widely scattered populations of the species known to remain in various parts of the mountain range. Plants of this species still survive in the gulches on the seaward extension of the ridge system between Kahana and Waikāne Valleys. The gulch bottoms in the mid- and high elevation portions of the southern restoration area may constitute the most suitable habitat within the two restoration areas in Waikāne for this species.

Cyperus odoratus L. (kili`o`opu, pu`uka`a, mau`u pu`uka`a, pu`uko`a, pūko`a; no federal status) – The Hawaiian plants of *C. odoratus* are considered by Koyama (1990) to represent an endemic Hawaiian taxon, *Torulinium odoratum* subsp. *auriculatum*. *Cyperus odoratus* is an annual or short-lived perennial sedge. It is native to the Hawaiian Islands as well as to many other regions of the world. There is a wide diversity in the morphology of the Hawaiian specimens. Mature Hawaiian plants can be as short as 15 centimeters tall or grow to be over 1.5 meters tall. The non-Hawaiian plants are extremely variable as well, and taxonomic study of *C. odoratus* complex world-wide could possibly result in the recognition of taxa endemic to Hawai`i. No wild populations of *C. odoratus* are known to be extant in Hawai`i. However, there are plants of Hawaiian origin in cultivation, all of which originated from seeds collected by the principal investigator in 1998 from a few plants found growing at a seep along the Maunawili Trail on the windward side of the southern Ko`olau Mountains. Although the 1998 finding of *C. odoratus* constitutes the only record of the species in Hawai`i since 1939, it seems likely to the principal investigator that the species still persists in the wild in multiple locations throughout the Hawaiian Islands, and efforts should be made to find any surviving plants. This species could be planted in either of the restoration areas in its favored habitats, namely at springs and seeps, and along streams.

Cyrtandra kalichii Wawra (ha`iwale; no federal status) – *Cyrtandra kalichii* is a shrub endemic to the Ko`olau Mountains and the Ka`ala area in the northern Wai`anae Mountains. It is one of the rarer of the *Cyrtandra* species occurring on O`ahu. There is at least one individual growing along the Kahana section of the Waiāhole Ditch Trail. There also used to be a plant of this species in a gulch on the Kahana side of the seaward portion of the ridge system between Kahana and Waikāne Valleys, but that plant died a few years ago. However, that area should be searched for additional currently unknown plants. The gulch bottoms and lower gulch slopes of both restoration areas seem to constitute good habitat for this species.

Embelia pacifica Hillebr. (kilioe; no federal status) – *Embelia pacifica* is a long-lived perennial vine endemic to Kaua`i, O`ahu, Moloka`i, Lāna`i, Maui, and Hawai`i. There is only a single currently known plant of this species in the Ko`olau Mountains. The plant was found by the principal investigator in May 2011 in Kaluanui in the windward northern Ko`olau Mountains. It was growing in wet forest, which is unusual for the species on O`ahu. All of the plants of *E. pacifica* known in the Wai`anae Mountains occur in mesic forests. All parts of the two restoration areas seem to constitute appropriate habitat for this species depending on the stock that is outplanted. The Kaluanui stock seems to be appropriate for the wetter portions of the restoration areas, while stock from the Wai`anae Mountains may be more appropriate for the lower, drier portions of the restoration areas.

Eurya sandwicensis A. Gray (ānini, wānini; no federal status) – *Eurya sandwicensis* is a shrub or a small tree endemic to Kaua`i, O`ahu, Moloka`i, Maui, and the island of Hawai`i. There are only about seven plants of *E. sandwicensis* currently known on O`ahu. All except one of these are in the Ko`olau Mountains. A plant of this species was seen by the principal investigator in 1980 on the seaward extension of the Kahana-Waikāne ridge system, on the ridge between Kahana Valley and Makaua Gulch. That area should be searched for the plant seen in 1980 and any other individuals of the species that may survive in the area. The ridge tops and upper ridge slopes in the upper elevation portions of both restoration areas seem to be suitable for outplantings of this species.

Exocarpos gaudichaudii A. DC. (heau; no federal status) – *Exocarpos gaudichaudii* is a shrub or a small tree endemic to O`ahu, Moloka`i, Lāna`i, Maui, and the island of Hawai`i. The species is rare throughout its range. There are fewer than 10 currently known plants of this species in the Ko`olau Mountains. There are three currently known plants of this species on the windward side of the Ko`olau Mountains. All three are in the Hau`ula area in the northern part of the mountain range. The upper ridge slopes and ridge crests of the northern restoration area seem to best match the conditions where the plants in the Hau`ula area are growing.

Gardenia mannii H. St. John & Kuykendall (nā`ū, nānū; federally listed as endangered) – *Gardenia mannii* is a tree endemic to both mountain ranges of O`ahu. Fewer individuals of this species are known to survive in the Wai`anae Mountains than in the Ko`olau Mountains, where the species can still be found in various areas throughout the mountain range. However, the number of individuals in the Ko`olau Mountains has declined significantly over the last two or three decades. The species has been recorded at more than one location on the ridge system between Kahana and Ka`a`awa Valleys within the last two decades, and its persistence there should be confirmed. Outplantings of this species could be tried in the upper elevations of both of the restoration areas in Waikāne Valley.

Hibiscus kokio Hillebr. ex Wawra subsp. *kokio* (koki`o `ula`ula; no federal status) - *Hibiscus kokio* subsp. *kokio* is a tree endemic to Kaua`i, O`ahu, Moloka`i, Maui, and the island of Hawai`i. There may be fewer than 20 plants of this native tree species currently known on O`ahu, most of which are in two populations in the Ko`olau Mountains. There is habitat that is seemingly appropriate for this species in the lower elevations of both of the restoration areas.

Joinvillea ascendens Gaudich. ex Brongn. & Gris subsp. *ascendens* (`ohe; proposed for listing as federally endangered) – *Joinvillea ascendens* subsp. *ascendens* is a large, grass-like, clumping perennial plant. The subspecies is endemic to Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i. The most appropriate material to use in outplantings in the two restoration areas in Waikāne Valley may be material originating from plants of the species in the Wai`anae Mountains rather than in the Ko`olau Mountains, since all of the plants known to be extant in the Ko`olau Mountains grow in extremely wet habitats on or near the main dividing ridge of the mountain range, habitats that are much wetter than the wettest parts of the two restoration areas. All of the known plants in the Wai`anae Mountains are in mesic habitats that seem to be fairly similar to habitats in the mesic, lower elevation portions of the two restoration areas.

Lindsaea repens (Bory) Thwaites var. *macraeana* (Hook. & Arn.) C. Chr. (no common name; no federal status) – *Lindsaea repens* var. *macraeana* is a rare wet forest fern with a creeping rhizome that is either terrestrial or epiphytic. The taxon is endemic to most of the main Hawaiian Islands. One of the locations where it has been seen in recent years is in Kahana Valley, along the trail that connects the Schofield-Waikāne Trail to the Kahana Valley portion of the Waiāhole Ditch Trail. The higher, wetter parts of the southern restoration area appear to be the most appropriate habitat for this species.

Neraudia melastomifolia Gaudich. (ma`aloa, ma`oloa, `oloa; no federal status) – There has been only one observation of this native shrub species in the Ko`olau Mountains in the last two decades. The

observation was of a single plant on the windward side of the mountain range opposite the land section of Waimano on the leeward side of the mountain range. If no other plants are discovered in the Ko`olau Mountains in the coming years, plants originating from the Wai`anae Mountains may have to be used in any outplanting trials in Waikāne. Various areas of both restoration areas seem to be suitable for this species, depending on the stock utilized.

Nothocestrum longifolium A. Gray (`aiea; no federal status) – At most, only about 6-8 plants of this native tree species are currently known in the Ko`olau Mountains. The species was known to occur on the seaward extension of the ridge system between Kahana and Waikāne Valleys, namely in Makaua Gulch, into at least the 1990's or maybe past the year 2000, but those plants appear to have died. The area should be searched for any additional unknown plants that might still survive. Various areas of both restoration areas seem to be suitable for this species, depending on the stock utilized.

Pteralyxia macrocarpa (Hillebr.) K. Schum (kaulu; proposed for listing as federally endangered) – *Pteralyxia macrocarpa* is a native tree species endemic to O`ahu. It is more common in the Wai`anae Mountains than in the Ko`olau Mountains. Fewer than 30 mature individuals of the species are known to survive in the Ko`olau Mountains. Included among these individuals are several that are known from the seaward extension of the ridge system between Kahana and Waikāne Valleys, in the drainages of Makaua and Kahana. Outplantings of this species could be tried in the lower elevations of both of the restoration areas.

Strongylodon ruber Vogel (nuku `i`iwi, kā `i`iwi; no federal status) – *Strongylodon ruber* is a long-lived woody vine endemic to Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i. A single plant of this species in Pālolo Valley is the only wild plant known to be extant in the Ko`olau Mountains. Habitat that is seemingly appropriate for this species exists in both of the restoration areas. If no more plants of the species are discovered in the Ko`olau Mountains in the coming years, augmentation of outplantings of the Pālolo Valley stock with stock from outside the Ko`olau Mountains should be considered. Plants originating from wet forest areas on the neighbor islands may be more appropriate for outplanting in the restoration areas in Waikāne Valley than plants originating from the Wai`anae Mountains, which occur in habitats that may be drier than any of the habitats within the two restoration areas.

Group 3: Taxa that are appropriate for outplanting in Waikane that are of lower conservation concern

Asplenium insiticium Brack. (no common name; no federal status) – *Asplenium insiticium* is a fern native to all of the major Hawaiian Islands, and is also native to Fiji and New Caledonia. The species was not seen on this survey within the boundaries of the restoration areas, but it occurs along the Waiāhole Ditch Trail to the south of Waikāne Valley. The form of *A. insiticium* occurring along the Waiāhole Ditch Trail appears to favor the gulch bottoms and it appears to grow primarily epiphytically on the trunks or main limbs of trees.

Diospyros hillebrandii (Seem.) Fosberg (lama; no federal status) – This tree species is endemic to O`ahu and Kaua`i. No plants of this species were seen on this survey. It is occasional in Hakipu`u Valley, which adjoins the northeastern side of Waikāne Valley. The lower elevations of both of the restoration areas seem to contain suitable habitat for the species.

Dodonaea viscosa Jacq. (*D. sandwicensis* Sherff type) (`a`ali`i; no federal status) – The *D. sandwicensis* type of `a`ali`i is a shrub or a small tree. It was not found on this survey, but two individuals of it are known to be present in the northern restoration area. It seems that the existing population of this type of `a`ali`i within the restoration area may need to be augmented if it is to persist. Propagules for augmentation of the population could be obtained further seaward on the ridge system between Kahana

and Waikāne Valleys, where this type of `a`ali`i is more common than within the northern restoration area.

Hibiscus arnottianus A. Gray subsp. *punaluuensis* (Skottsb.) D. M. Bates (koki`o ke`oke`o, no federal status) – This white flowered native hibiscus grows into a medium sized tree. It is endemic to parts of the Ko`olau Mountains. The taxon was seen on this survey only in the northern restoration area. Suitable habitat for it appears to be available in the gulch bottoms of the southern restoration area as well, in addition to areas in the northern restoration area where it is currently absent.

Ochrosia compta K. Schum. (hōlei; no federal status) – This native tree species is endemic to the islands of O`ahu and Moloka`i. No plants were seen on this survey, but the species is known to occur on the seaward portion of the ridge system between Kahana and Waikāne Valleys. Seemingly suitable habitat for the species is found in the lower elevation portions of both of the restoration areas.

Peperomia membranacea Hook. & Arn. (`ala`ala wai nui; no federal status) – *Peperomia membranacea* is a native herb endemic to Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i. It grows terrestrially or epiphytically. It is common in many parts of the Ko`olau Mountains, but it was not seen on this survey within the boundaries of the restoration areas. It is known to occur along the Waiāhole Ditch Trail to the south of Waikāne Valley. There is appropriate habitat for this species in both of the restoration areas, primarily in the gulch bottoms and on the lower gulch slopes.

Peperomia oahuensis C. DC. (`ala`ala wai nui; no federal status) – This herb species is endemic to O`ahu and Kaua`i. It usually grows epiphytically on the trunks and main limbs of trees. The species is currently known to occur along the Kahana Valley section of the Waiāhole Ditch Trail. The gulch bottoms of both of the restoration areas seem to constitute appropriate habitat for this species. In the Ko`olau Mountains the species occurs primarily on the trunks and branches of the native white flowered hibiscus, *Hibiscus arnottianus* subsp. *punaluuensis*, which was seen on this survey in one of the gulch bottoms of northern restoration area. Establishing that taxon of hibiscus in the southern restoration area, and outplanting it in the parts of the northern restoration area where it is currently absent would improve the chances for the successful establishment of populations of *P. oahuensis* in the restoration areas.

Rauvolfia sandwicensis A. DC. (hao; no federal status) – *Rauvolfia sandwicensis* is a tree endemic to Kaua`i, O`ahu, Moloka`i, Lāna`i, Maui, and Hawai`i. No plants of this species were seen within the boundaries of the two restoration areas on this survey. However, three individuals were seen just outside the boundaries of the southern restoration area. The lower, drier portions of both of the restoration areas appear to constitute suitable habitat for this species.

Santalum freycinetianum Gaudich. (sandalwood, `iliahi; no federal status) – The native tree species *S. freycinetianum* is now considered to be endemic to the island of O`ahu. The species is more common on the leeward side of the Ko`olau Mountains than on the windward side. The known plants of the species on the windward side of the Ko`olau Mountains closest to Waikāne are in the Hau`ula area in the northern part of the mountain range. The lower elevations of both of the restoration areas seem to constitute suitable habitat for the species.

Urera glabra (Hook. & Arn.) Wedd. (ōpuhe; no federal status) – *Urera glabra* is a small tree endemic to Kaua`i, O`ahu, Moloka`i, Lana`i, Maui, and the island of Hawai`i. In the Ko`olau Mountains it is locally common, but in many areas it is uncommon to absent. No plants of this species was seen on this survey. However, both restoration areas seem to contain appropriate habitat for this species, particularly in the lower elevation gulch bottoms. Extant populations of the species can be found in various locations along the windward side of the Ko`olau Mountains.

Weed Recommendations

An invasive alien plant species, the Australian tree fern (*Sphaeropteris cooperi*) was seen along the Schofield-Waikāne Trail outside of the restoration areas. This incipient occurrence should be eradicated to prevent its spread to other parts of the valley. Other invasive species that may be considered to be incipient that should be considered for eradication are African tulip tree (*Spathodea campanulata*), kahili ginger (*Hedychium gardnerianum*), Moreton Bay fig (*Ficus macrophylla*), and desert fig (*Ficus platypoda*).

There are some non-native plant species in or around the restoration areas that are not known to be extremely invasive, that are still localized, but are spreading outwards. Since they still are localized it may be best to eradicate them early on, before they become bigger problems. Plants in this category include golden pothos (*Epipremnum pinnatum*), the heliconias *Heliconia caribaea* and *H. metallica*, ivory cane palm (*Pinanga coronata*), and cat's claw (*Caesalpinia decapetala*. This species was not seen on this survey, but it is known to occur in the Waike`eke`e Drainage just to the south of the southern restoration area.).

Tropical kudzu (*Pueraria phaseoloides*) was only recently documented as being naturalized in Hawai`i, so its potential to become a serious weed threat in Hawai`i is unknown. It was collected in 2009 along the main dirt road into Waikāne Valley not far from the where the road branches off from the paved road (Alex Lau, personal communication, May 17, 2012). A sterile plant of what appears to be tropical kudzu was found during this survey in one of the cacao farming areas. Alternatively, the sterile plant could be a plant of kudzu (*Pueraria montana* var. *lobata*), which in Hawai`i seems to persist from cultivation, but has not become truly naturalized (Alex Lau, personal communication, May 17, 2012). The identity of the plant should be confirmed when the plant is flowering and fruiting, or if it is just a single plant, it might be best to simply destroy it instead of waiting for a confirmation of its specific identity.

Hau (*Hibiscus tiliaceus*) is a plant that forms thick patches in the gulch bottoms that smother native plant species. It is currently unknown whether the species is a Polynesian introduction or a plant native to Hawai`i. However, whether it is native or not, the species should be treated as a plant that is not compatible with the goal of maintaining and increasing the native plant diversity of the restoration areas, and the existing patches of it within the restoration areas should be gradually eliminated.

Appendix C: Waikāne Valley Faunal Surveys – Final Report (VanderWerf, 2012)

Waikane Valley Faunal Surveys – Final Report

Part 2, Cacao Farm Areas

20 April 2012

Prepared for: Mr. Paul Zweng, Ohulehule Forest Conservancy

Prepared by: Dr. Eric VanderWerf, Pacific Rim Conservation, 3038 Oahu Avenue, Honolulu, HI 96822, 808-377-7114, cell 808-292-2884

Northern cacao farm area, looking northward toward the peak of Ohulehule

Background

Pacific Rim Conservation (PRC) was contracted by the Ohulehule Forest Conservancy to conduct faunal surveys to identify birds, mammals, and other animals present in the vicinity of two proposed project areas in Waikane Valley. The proposed project consists of two components 1) forest restoration and Oahu Elepaio (*Chasiempis ibidis*) protection on approximately 270 acres in the mauka part of the valley, and 2) a cacao farm on approximately 40 acres in the makai part of the valley (Figure 1). Species of particular interest included the Oahu Elepaio, the Hawaiian hoary bat (*Lasiurus cinereus semotus*), and the tree snail *Achatinella decipiens*, all of which are listed as endangered under the U.S. Endangered Species Act and by the State of Hawaii. This report consists of two parts, one for the forest restoration areas and the other for the cacao farm areas.

Methods

Surveys for the Oahu Elepaio and other bird species were conducted in the cacao farm areas on 20 March 2012. Surveys consisted of walking through the proposed project areas and looking and listening for birds. Playbacks of recorded Oahu Elepaio songs were broadcast at approximately 100-meter intervals in an attempt to elicit a response. Elepaio defend territories year-round and song playbacks are an efficient method of locating elepaio and determining the extent of their territory (VanderWerf 2004). Elepaio often respond more strongly to local song dialects (VanderWerf 2007), so recordings used during playbacks were from Waikane Valley. After each playback observers listened and watched for elepaio for several minutes. Most elepaio respond to recorded songs within one minute (VanderWerf 2007), but some approach quietly and must be searched for visually.

Surveys for the Hawaiian hoary bat were conducted using an SM2BAT+ bat detector (Wildlife Acoustics Inc., Concord, MA), which records their ultrasonic echolocation calls. The bat detector was deployed from 20 to 26 March, or 6 nights, and was programmed to record from sunset to sunrise each day. It was located on top of a small ridge in the middle of the 5.1 acre section of southern cacao area, near an un-named Stream (Figure 2), and was mounted on a tree 2.0 meters above the ground (Figure 3). The nearby stream provided an open flight corridor that bats might use while foraging.

Results

A total of 17 bird species was observed in the cacao farm areas of Waikane Valley (Table 1). Only one native bird species was observed, a single Kolea or Pacific Golden Plover (*Pluvialis fulva*) that was foraging on a grassy lawn. The other 16 bird species observed were non-native (Table 1). No Oahu Elepaio or other native forest birds were observed.

No Hawaiian hoary bat calls were recorded by the bat detector on any of the six nights surveyed. The bat detector made a total of 246 recordings that spanned all nights it was deployed, demonstrating that it was functioning properly, but all of recordings were of noise, such as wind or squeaking branches, and not bat calls.

Discussion and Recommendations

The absence of Oahu Elepaio in the proposed cacao farm areas is not surprising. The habitat in the cacao farm areas is generally not suitable for Oahu Elepaio because it consists primarily of open ground, agricultural plantings, and low shrubby vegetation, which elepaio

generally avoid (VanderWerf et al. 2001). There is some forest on the edges and along nearby streams, but it is dominated by alien tree species not favored by elepaio, such as *Albizia* and *Ardesia*. The proposed cacao farm areas are outside the critical habitat for the Oahu Elepaio and are fairly distant (>1.5 kilometers) from the nearest known Oahu Elepaio territories (Figure 2) and currently are of no value to the Oahu Elepaio. Modification of the existing vegetation in the proposed cacao farm areas thus would have no impact on the Oahu Elepaio or its habitat.

Little is known about the distribution or abundance of the Hawaiian hoary bat on Oahu. The Hawaiian hoary bat roosts in trees at night, usually by itself, but it may use a variety of tree species. Modification of the existing vegetation in the proposed cacao farm areas would not be expected have any impact on the Hawaiian hoary bat because it is not known to occur in the area.

Table 1. List of bird species observed in the cacao farm area of Waikane Valley. Status codes: A = Alien, I = Indigenous to Hawaii (native but also found elsewhere), Species native to Hawaii are in bold type.

Common Name	Scientific Name	Status
Pacific Golden Plover	***Pluvialis fulva***	**I**
Spotted Dove	*Streptopelia chinensis*	A
Zebra Dove	*Geopelia striata*	A
White-rumped Shama	*Copsychus malabaricus*	A
Melodious Laughing-thrush	*Garrulax canorus*	A
Japanese White-eye	*Zosterops japonicus*	A
Japanese Bush-warbler	*Cettia diphone*	A
Red-vented Bulbul	*Pycnonotus cafer*	A
Red-whiskered Bulbul	*Pycnonotus jocosus*	A
Red-billed Leiothrix	*Leiothrix lutea*	A
Common Myna	*Acridotheres tristis*	A
Red-crested Cardinal	*Paroaria coronata*	A
Northern Cardinal	*Cardinalis cardinalis*	A
House Finch	*Carpodacus mexicanus*	A
Common Waxbill	*Estrilda astrild*	A
Java Sparrow	*Padda oryzivora*	A
Nutmeg Mannikin	*Lonchura punctulata*	A

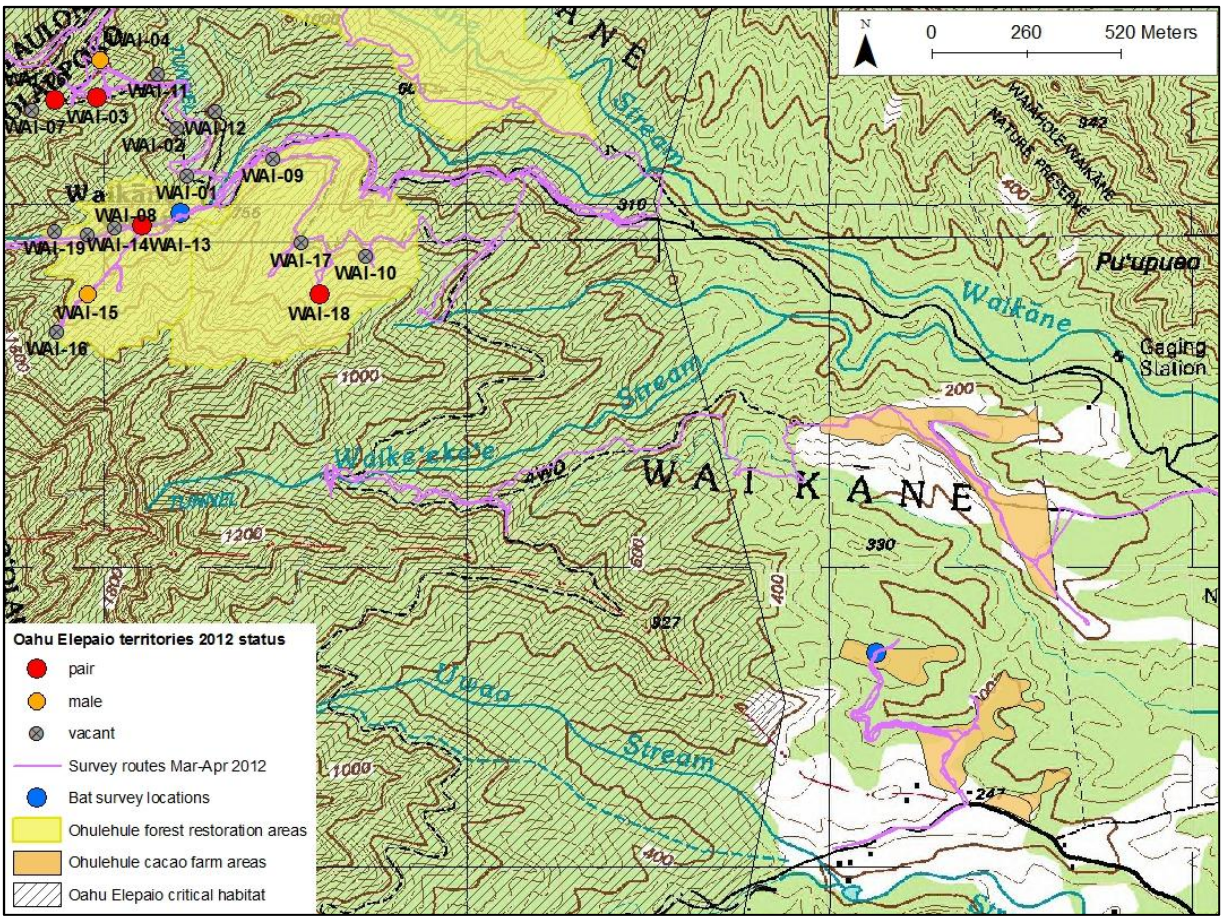


Figure 1. Location of survey routes and bat survey locations in the proposed cacao farm areas in Waikane Valley in relation to known Oahu Elepaio territories.

Figure 2. Bat detector mounted on a tree in the 5.1 acre section of the southern cacao farm area.

Appendix D: Archaeological Field Survey Letter Report
(Cultural Surveys Hawai'i, 2012)

CULTURAL SURVEYS HAWAI'I
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Lāwai, Kaua'i

June 27, 2012

Dr. Pua Aiu
State Historic Preservation Division
Department of Land and Natural Resources
State of Hawai‘i
Kakuhihewa Building
601 Kamokila Blvd. Suite 555
Kapolei, HI 96707

Request for historic preservation review (HRS Chapter 6E-42 and HAR 13-284) for the Ōhulehule Forest Conservancy Proposed Cacao Farm Project, Waikāne Ahupua‘a, Ko‘olaupoko District, O‘ahu Island [TMK: (1) 4-8-006: 001 por.]

Dr. Pua Aiu:

At the request of Townscape, Inc., Cultural Surveys Hawai‘i, Inc. (CSH) is requesting a historic preservation review of the proposed Ōhulehule Forest Conservancy Proposed Cacao Farm Project. Based on a review of previous archaeological investigations and a recently conducted pedestrian inspection of the entire project area CSH feels that an effect determination of “no historic properties affected” is warranted for the proposed project, and thus seeks SHPD’s concurrence. A description of the proposed project as well as a summary of previous archaeology and the recently conducted fieldwork is provided below.

The proposed project comprises approximately 49 acres of land located at Waikāne, on the windward side of O‘ahu. The entire acreage is divided into four discrete areas (hereafter referred to as NPA, SPA 1, SPA 2 and SPA 3). The northernmost portion (NPA) is accessible on Waikāne Valley Road; and the three southern portions (SPA 1, SPA 2 and SPA 3) are accessible on Waiahole Valley Road (Figure 1, Figure 2 and Figure 3). All areas of the proposed project are accessible on paved roads; however, within the project areas, road conditions are poor and require 4-wheel drive to traverse. The proposed project includes plans to develop these areas by preparing the land for planting multiple shaded orchards with organic cacao varieties, constructing buildings related to cacao processing, creating a base yard for storing and staging farm equipment, and a single residence for the caretaker/proprietor of the farm.

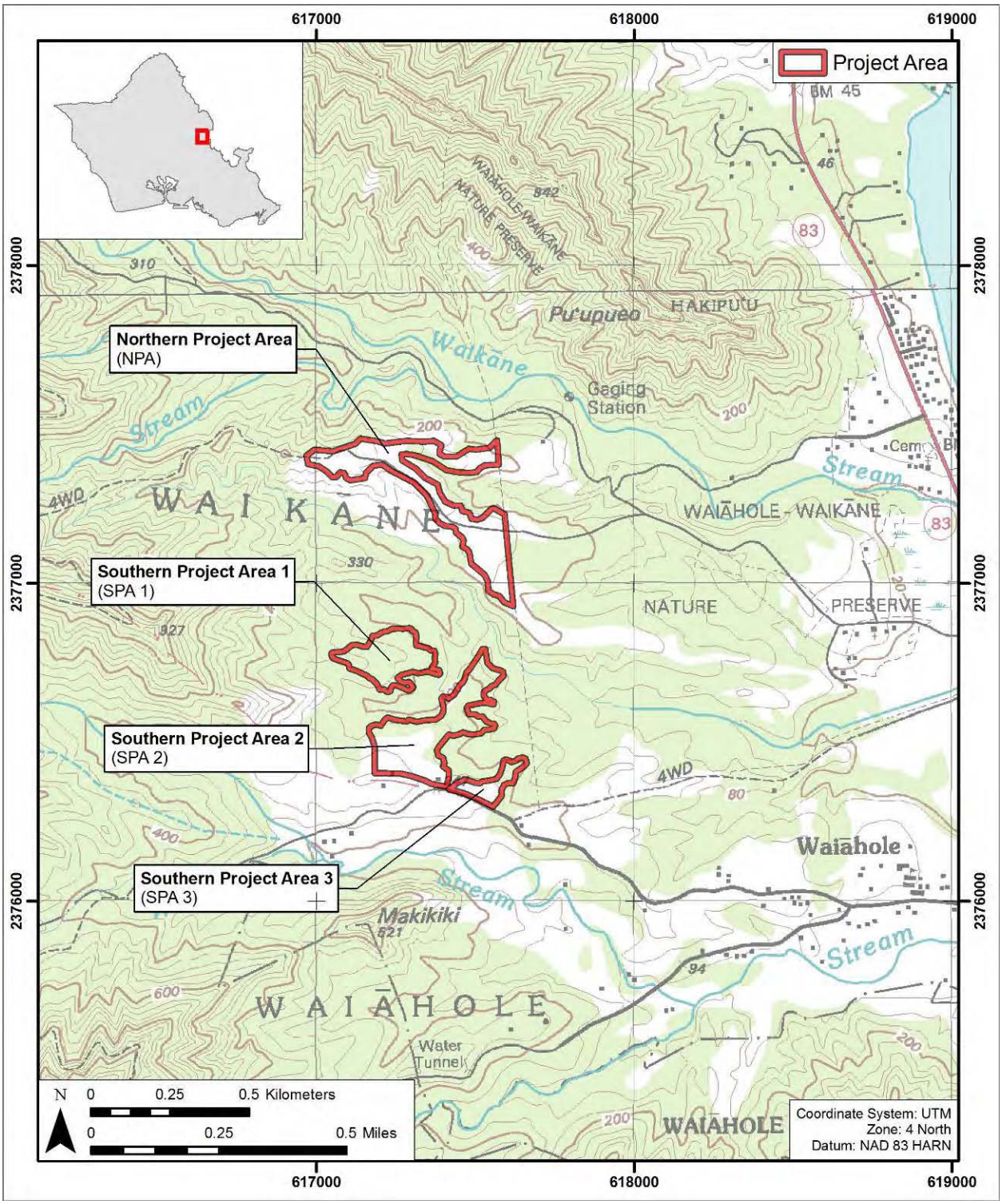

Figure 1. USGS topographic map, Kanehoe Quadrangle (1998), showing extent of the project area

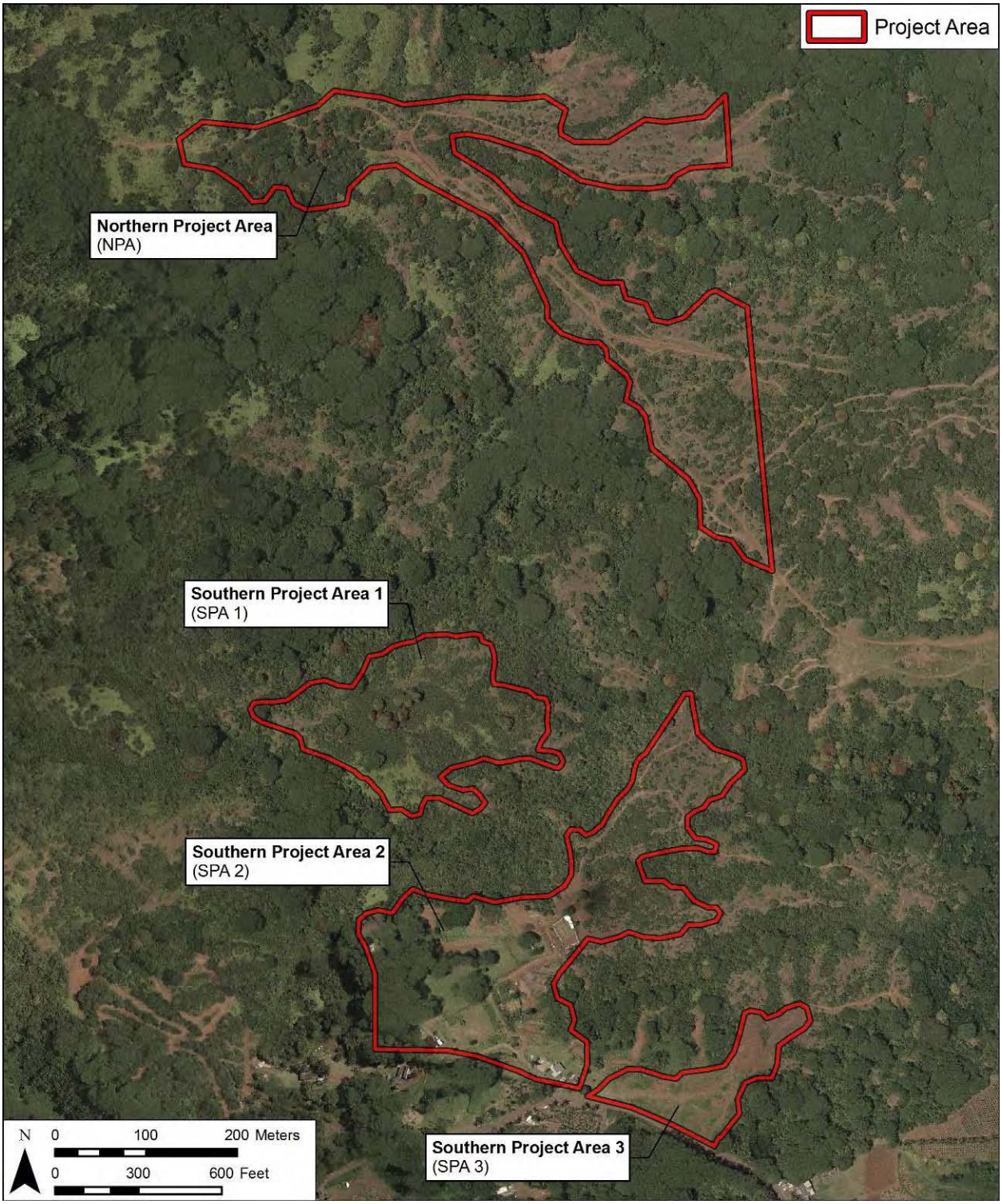

Figure 2. Aerial photograph showing extent of the project area (USGS orthoimagery 2005)

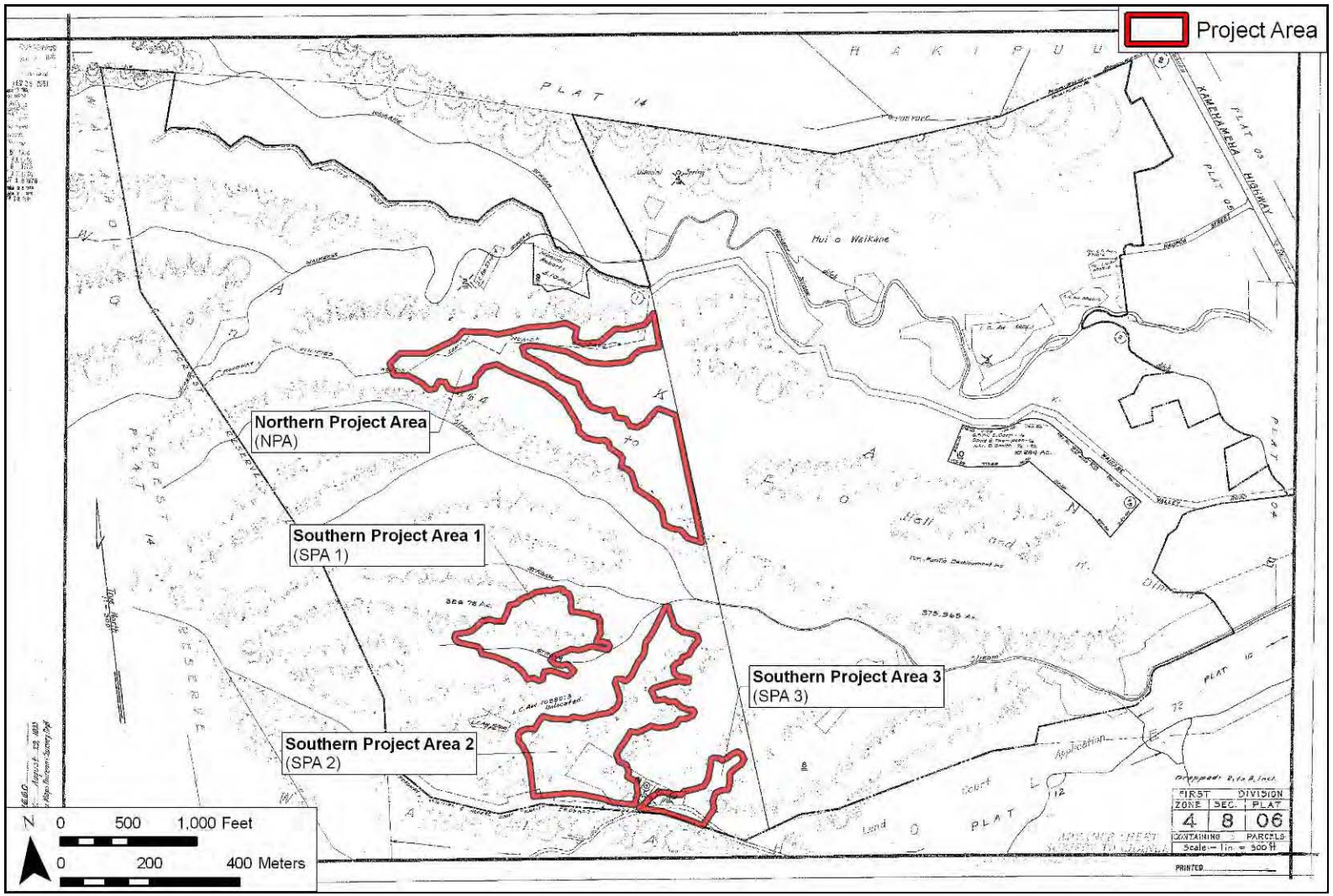

Figure 3. TMK Map of the project area

Previous Archaeological Research

Previous archaeological investigations in and around the project area are summarized in Table 1 and depicted on Figure 4 and Figure 5.

In 1988, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological reconnaissance survey with limited subsurface testing in support of the Waikāne Golf Course Project (Shapiro et al. 1988). The approximately 300-acre survey area abuts the *makai* (eastern) edge of the current project area (see Figure 4). Shapiro et al. (1988) identified 29 sites (consisting of 60 component features), including the previously-identified Kukuianiani Heiau site. The sites included agricultural, boundary, tool manufacture, habitation, transportation, and religious sites for cemeteries, burials, shrines, and *heiau*. All of the religious sites were identified well outside the current project area; most are clustered within 300 m of Kamehameha Highway.

In 1992, PHRI conducted an archaeological inventory survey with subsurface testing in support of two proposed golf course projects (Dunn et al. 1992). The approximately 407-acre survey area, which comprises the entire project area, is depicted in Figure 4. Dunn et al. (1992) identified 13 sites (consisting of 100 component features). It is noteworthy that all identified sites were found within perennial or ephemeral stream drainages, and not within the current project area, which is situated entirely atop ridges that have been impacted by agriculture and military activities. Most of the features were interpreted as pre-Contact agricultural features; nine were related to historic charcoal production; three were related to temporary habitation; and one was interpreted as ceremonial. SIHP #50-80-10-4356 appears to have been a major pre-Contact/post-Contact agricultural complex with 46 identified features. Eight C-14 dates were reported; the oldest was calibrated to A.D. 1400–1640.

The abovementioned Dunn et al. (1992) study was reviewed and accepted by the SHPD/DLNR on February 5, 1993 (Log. No. 7438; Doc. No. 9302TD08: see Appendix A).

In 2008, International Archaeological Research Institute, Inc., (IARII) conducted an archaeological survey and monitoring at the former Waikane Training Area in anticipation of ordnance assessment and removal operations (Rasmussen 2008). The IARII study area encompassed the northern portion of the current project area (see Figure 4). 10 historic properties were documented and included archaeological sites associated with pre-Contact traditional Hawaiian taro cultivation and post-Contact charcoal manufacturing. Probable habitation areas were observed on higher ground near *lo‘i* (irrigated terraces), suggesting the farmers lived near their fields. The *lo‘i* and associated features were observed along alluvial flats adjacent to streams. Metal tools found within some of the fields indicate the fields were being farmed into the 19th and early 20th century. No historic properties were observed within the current project area.

Table 1. Previous archaeological studies done within the existing project area and vicinity

Reference	Type of Investigation	General Findings
Shapiro et al. 1988	Archaeological Reconnaissance Survey and Limited Subsurface Testing	Identified 29 sites, features included terraces, mounds, ditches, walls, alignments, sunken fields, burials, coral scatters, midden and lithic scatters
Dunn et al 1992	Archaeological Inventory Survey	Identified 13 sites consisting of 100 component features including mounds, terraces, alignments, excavated depressions, enclosures, ditches, rubble concentrations and an underground chamber
Rasmussen 2008	Archaeological Survey and Monitoring	10 historic properties were documented and included archaeological sites associated with pre-Contact traditional Hawaiian taro cultivation and post-Contact charcoal manufacturing

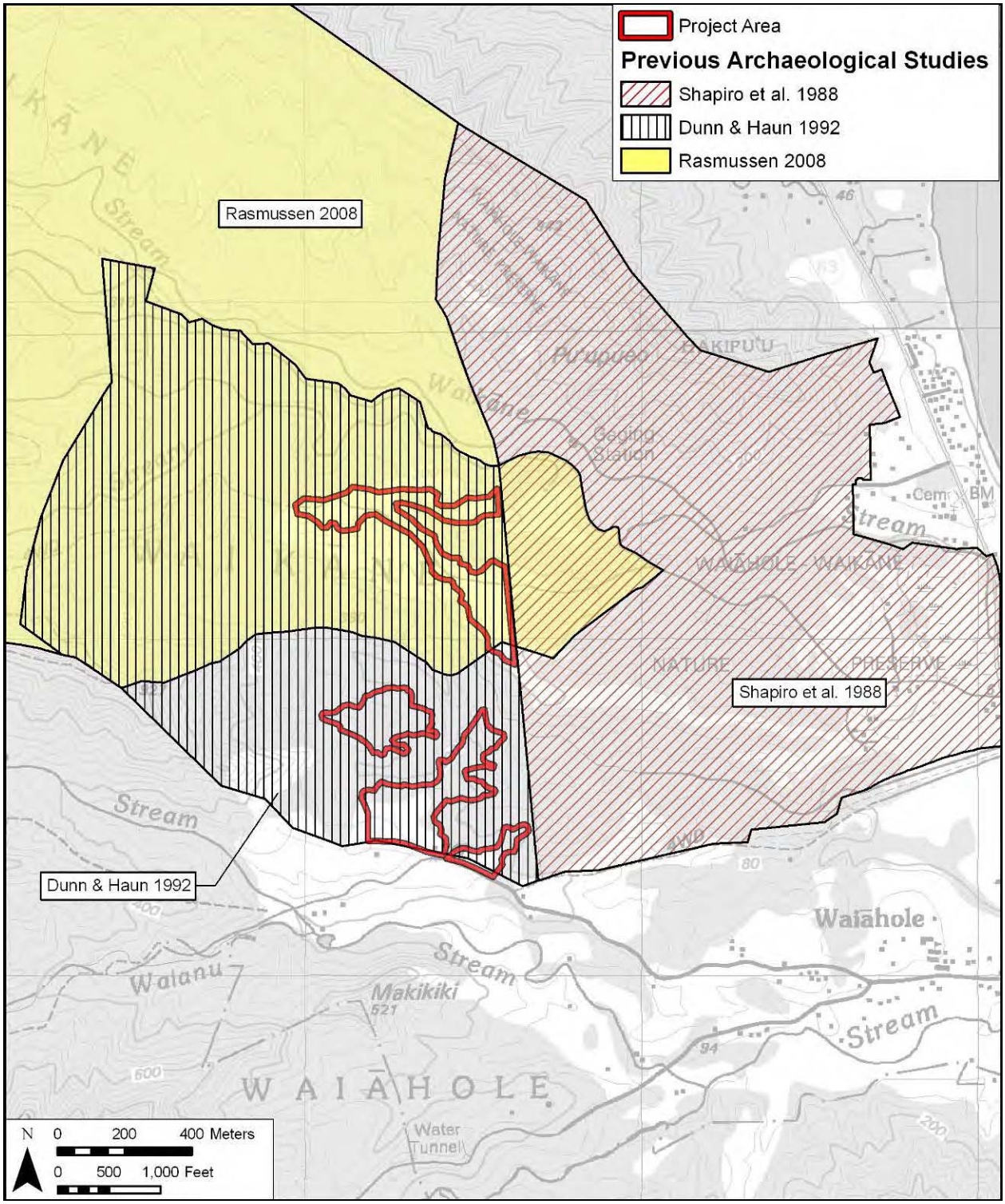

Figure 4. USGS map with overlay of previous archaeological studies in immediate vicinity of the project area

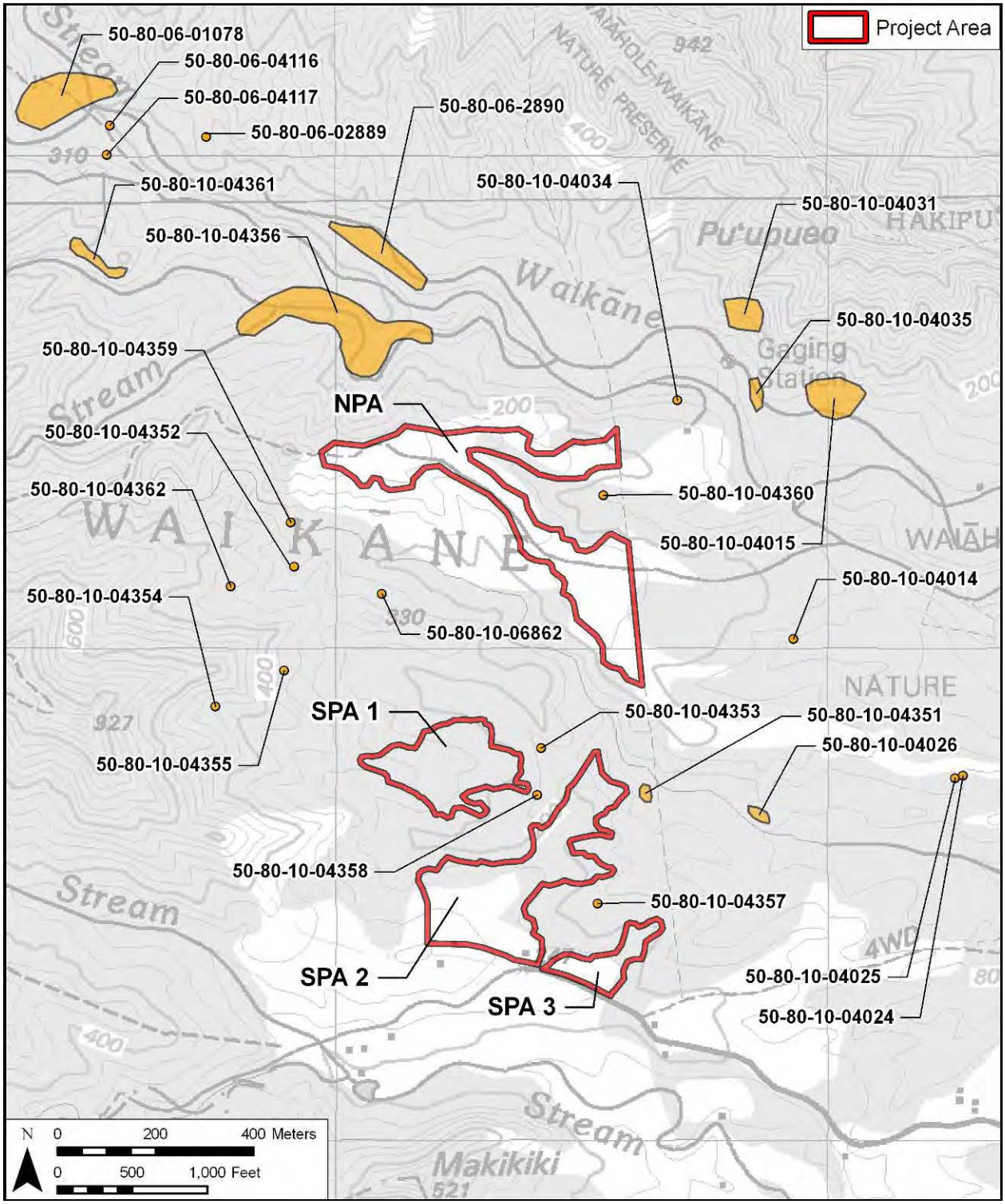

Figure 5. USGS topographic map overlay with historic properties relative to the current project area

Results of Fieldwork

The project area is characterized by low ridge tops with level to gently sloping topography bounded by steep slopes and gulches. The project area is divided into four areas: the Northern Project Area (NPA), which is 20.91 acres; Southern Project Area 1 (SPA 1), 8.86 acres; Southern Project Area 2 (SPA 2), 16.22 acres; and Southern Project Area 3 (SPA 3), 3.2 acres (see Figure 1 and Figure 2).

The pedestrian inspection consisted of a 100% ground survey of the project area. A graphic depiction of CSH's survey coverage is provided in Figure 6 and Figure 7. The ground survey of the project area was accomplished through systematic sweeps where applicable. The interval between archaeologists was typically between 5 m to 10 m.

In general, surface visibility was fair to poor due to dense vegetation that obscured the ground surface. The areas surveyed are lightly to densely vegetated; vegetation includes *uluhe* fern (*Dicranopteris linearis*), *kukui* (*Aleurites moluccana*), *ʻōhiʻa* (*Metrosideros collina*), *hau* (*Hibiscus tiliaceus*), *naupaka-kuahiwi* (*Scaevola gaudichaudiana*), *koa* (*Acacia koa*), *hala* (*Pandanus odoratissimus*), *ʻākia* (*Wikstroemia* sp.), *pukiawe* (*Styphelia tameiameiae*), Christmas berry (*Schinus terebinthifolius*), Java plum (*Eugenia cuminii*), octopus tree (*Brassaia actinophylla*), *lilikoʻi* (*Passiflora* sp.), false staghorn fern (*Dicranopteris linearis*), strawberry guava (*Psidium cattleianum*), mango (*Mangifera indica*), and various grasses.

The entire project area consists of small ridges and tablelands that have been impacted by prior land alterations related to agricultural, military and illegal dumping. Abandoned cars and other large items were dumped within the project area.

The Southern Project Area 1 (SPA 1) was approximately 9 acres. The vegetation at SPA 1 was sparse to very thick. The sparse, clear areas exhibited evidence of prior disturbance related to clearing and cutting access roads. No historic properties were observed during survey of SPA 1.

The Southern Project Area 2 (SPA 2) was approximately 16 acres. This portion of the project area was the most developed. Observed land modifications included residential structures and mass grading associated with road construction, agriculture and chicken farming (Figure 8, Figure 9, and Figure 10). No historic properties were observed during survey of SPA 2.

The Southern Project Area 3 (SPA 3) was approximately 3 acres, and consisted of an open field with a manicured lawn and an adjacent abandoned dirt road (Figure 11 and Figure 12). No historic properties were observed during survey of SPA 3.

The Northern Project Area (NPA) was approximately 21 acres. Extensive clearing and modification had taken place in the NPA due to cutting for roadways and past land use as a military training area (Figure 13). In contrast to SPA 1, 2 and 3, the NPA exhibited substantial disturbance due to military training activities and more recent ordnance detection and disposal efforts. The NPA exhibited numerous pit excavations related to these detection and disposal events, some measuring as deep as 60 cmbs (centimeters below surface) and over a meter in diameter. "Much of the project area has been affected by alluvial and colluvial erosion" (Dunn et al 1992: 7). No historic properties were observed during survey of the NPA.

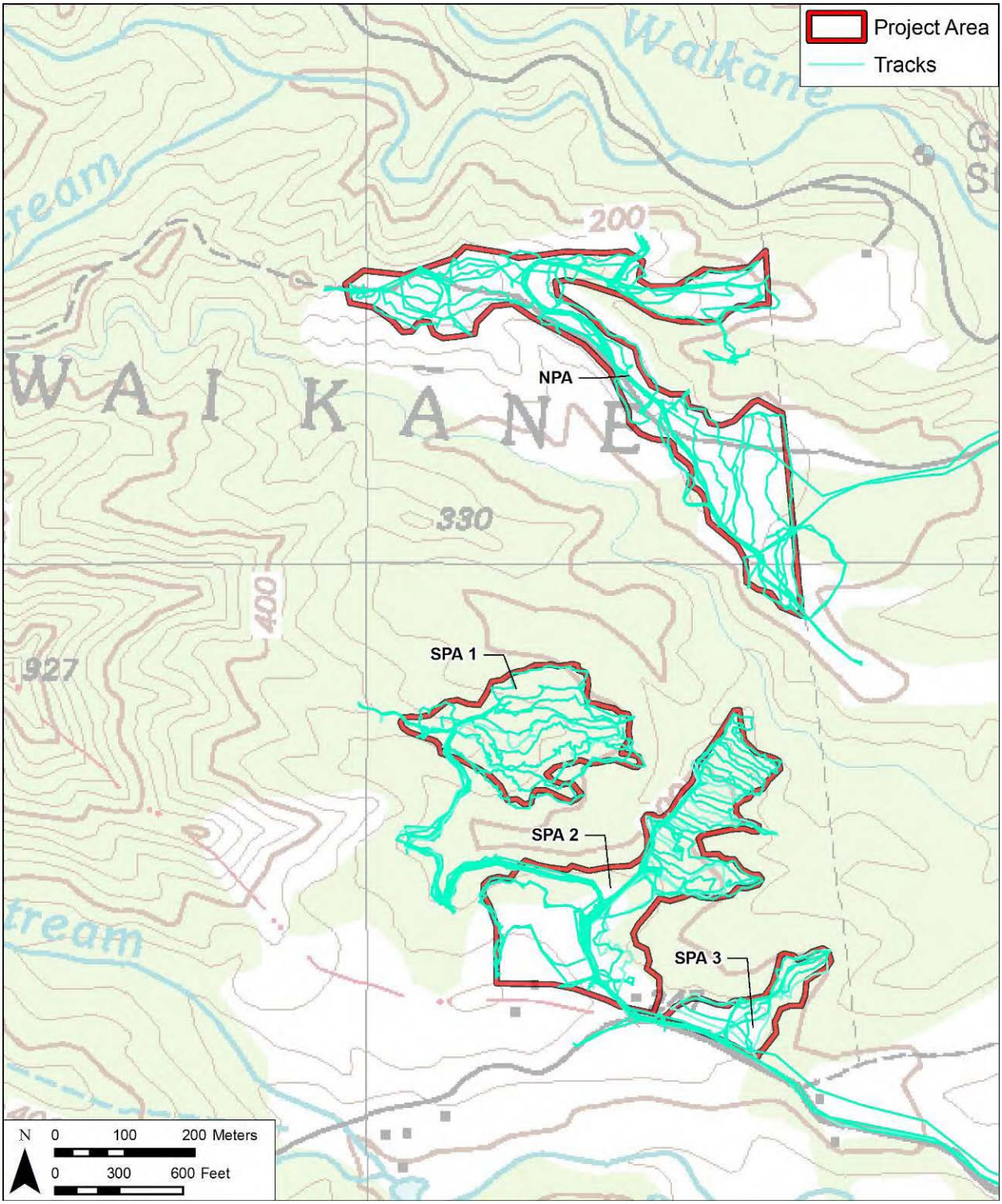

Figure 6. USGS map showing GPS tracks recorded during survey

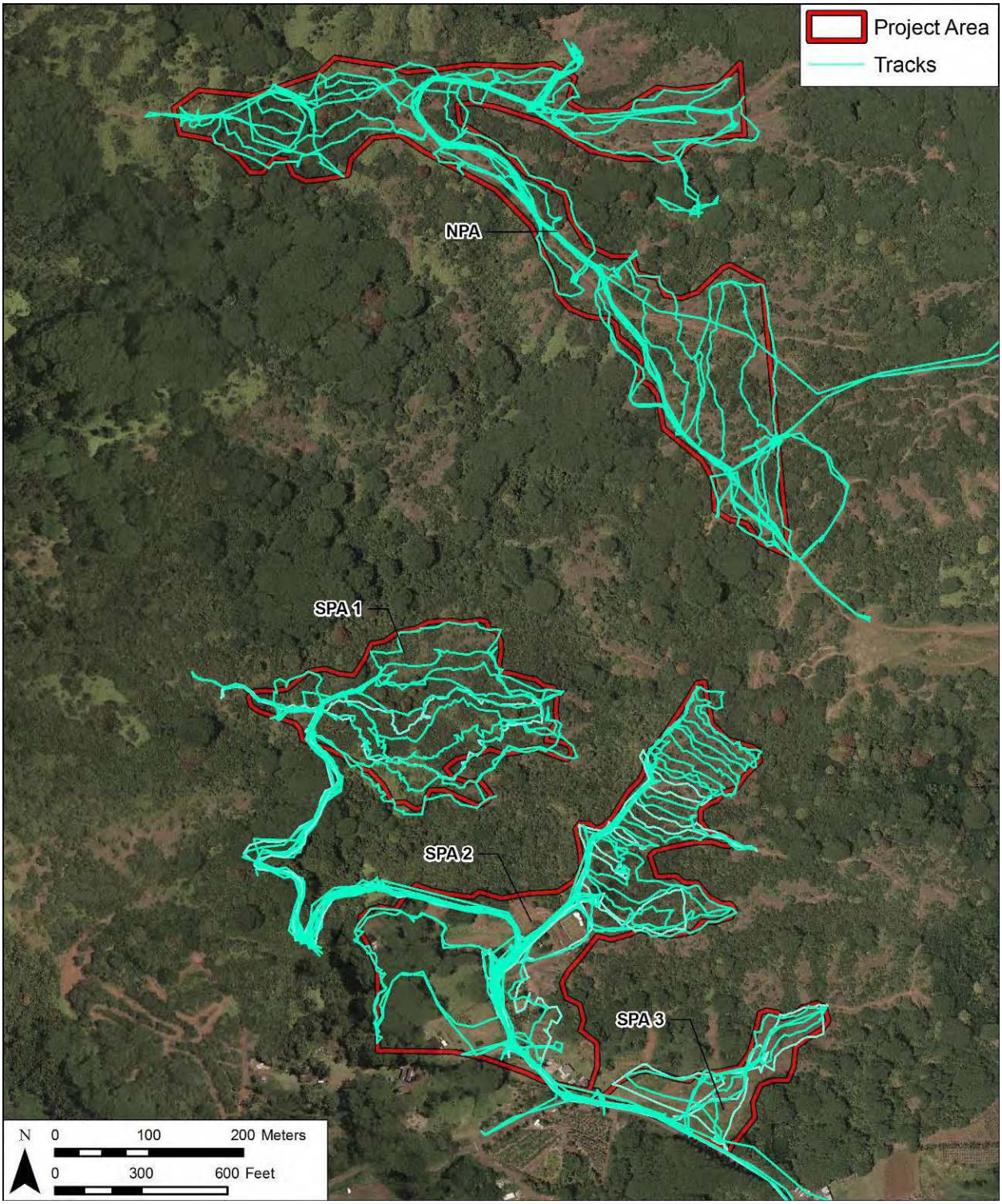

Figure 7. Aerial photograph showing GPS tracks recorded during survey

Figure 8. General view of SPA 2 with house overlooking chicken farm, view to the west

Figure 9. Small house adjacent to Waiahole Valley Road within SPA 2, view to the north

Figure 10. Cultivated lands within SPA 2, view to the south

Figure 11. Open field with manicured lawn at SPA 3, view to the north-west

Figure 12. General view of SPA 3, view to the north-east

Figure 13. Erosion impacted roadway in the NPA, view to the west

In conclusion, no historic properties were observed during a 100% pedestrian survey of the entire project area. The extensive land modifications observed within this entire project area would have destroyed and completely removed any surface historic properties that may have been present. Additionally agricultural (i.e., grading and plowing) and military (i.e., training and ordinance clearance) activities noted within the project area likely have destroyed and completely removed and subsurface cultural deposits that may have been present.

Conclusion

No historic properties were identified within the project area during previous archaeological investigations (Dunn et al. 1992 and Rasmussen 2008) and during a recent pedestrian inspection by CSH. The Dunn et al. (1992) study which encompassed the entire current project area was reviewed and accepted by SHPD/DLNR on February 5, 1993 (Log. No. 7438; Doc. No. 9302TD08: Appendix A). Additionally, the recent survey of the project area by CSH indicated that the project area has been subjected to extensive land modifications associated with agricultural and military activities. These observed disturbances have likely destroyed and/or completely removed any surface and/or subsurface historic properties that may have been present within the project area. Based on these findings CSH seeks SHPD concurrence that an effect determination of "no historic properties affected" is warranted for the proposed project, and that no additional archaeological investigation and/or mitigation is necessary for the project to proceed. We appreciate your attention to this matter and look forward to receiving your response.

Sincerely,

Hallett H. Hammatt
President
Cultural Surveys Hawaii, Inc.
P. O. Box 1114
Kailua, Hawaii 96734
Tel. (808) 262-9972
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References Cited

Dunn, Amy E, Alan E. Haun, and Susan Goodfellow

1992 *Archaeological Inventory Survey, Proposed SMF/HDI Golf Courses, Land of Waikāne, Koʻolaupoko District, Island of Oahu (TMK 4-8-06:por. 1; 4-8-14:por. 5).* PHRI, Inc., Hilo, Hawaiʻi.

Shapiro, William A., James D. Mayberry, and Alan E. Haun

1988 *Archaeological Reconnaissance Survey and Limited Subsurface Testing, Waikāne Golf Course Project Area, Land of Waikāne, Koʻolaupoko District, Island of Oʻahu, TMK: 4-8-04:4, 5; 4-8-06:8; 4-8-06:8*. PHRI, Inc., Hilo, Hawaiʻi.

Rasmussen, Coral M.

2008 *Archaeological Survey and Monitoring During the Engineering Evaluation/Cost Analysis form the Former Waikane Training Area, Island of O'ahu, Hawaiʻi, TMK 4-8-006:001, 4-9-006:008, 4-8-006:009, 4-8-014:005*. International Archaeological Research Institute, Inc., Honolulu, HI.

Appendix A: 1993 SHPD Acceptance Letter for Dunn et al 1992 AIS

JOHN WAIHEE
GOVERNOR OF HAWAII

FEB - 5 RECD PO

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Date: 90-861
Project

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 8TH FLOOR
HONOLULU, HAWAII 96813

February 5, 1993

LOG NO: 7438
DOC NO: 9302TD08

Paul H. Rosendahl, Ph.D.
Paul H. Rosendahl, Ph.D., Inc.
305 Mohouli Street
Hilo, Hawaii 96720

Dear Dr. Rosendahl:

SUBJECT: **Final Report, Archaeological Inventory Survey of Proposed SMF/HDI Golf Courses Waikane, Ko'olaupoko, O'ahu TMK: 4-8-6: por. 1; 4-8-14: por. 5**

The revisions respond adequately to the comments in our January 4th letter to you. The inventory survey report for this project is now acceptable.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

TD:amk

c: E. Henry OCEA

2/10/93
PMO

Appendix E: Cultural Impact Interview Summaries (Townscape, Inc., 2012)

Appendix E: Cultural Impact Interview Summaries

1. Keoki Fukumitsu Interview Summary

Interviewee: **Mr. Keoki Fukumitsu** (Community leader, Hakipu'u/Waikāne *kama'aina*)

Interviewed by: Lauren Armstrong (Townscape, Inc.) by phone

Date: December 6, 2012

Mr. Keoki Fukumitsu is a resident of Hakipu'u, an *ahupua'a* next to Waikāne. His family is a *kuleana* landowner, receiving title to the land during the Great *Māhele*. The family migrated from Waikāne to Hakipu'u in the time of Kamehameha I. Mr. Fukumitsu has been active in the community with a focus on agriculture and Native Hawaiian subjects for many years. He was a founder of the Native Hawaiian legal corporation, and used to be very active in the area's Neighborhood Boards. He currently serves on the Governor's "Taro Purity and Security Task Force" that has been monitoring taro lands, harvests and where taro is going for the past three years. The Task Force introduces bills to the legislature that call for more support of taro growing through loans, land, etc. He has been busy with the Task Force, which is currently preparing for the opening of the next legislative session.

Regarding the proposed cacao farm, Mr. Fukumitsu commented that removal of vegetation may cause runoff that would impact water quality in the streams, shore areas and ocean. Sediment running off the land can smother *limu, o'opu,* and other native aquatic species as well as coral reefs. The *ho'iwai* (river mouth area) is important because many species conceive there. Species like *hi'iwai* and *opae* lay eggs in the sand. Ocean species like mullet, *moi* and *awa* come to the *muliwai*, where their hormones are activated by sweet (brackish) water and they reproduce. Land clearing can also result in the loss of topsoil. There needs to be a good vegetated buffer zone between the cleared land and the stream, which can be accomplished by planting from the bottom up. This practice was followed in traditional taro planting. He agreed that the 'Ōhulehule Forest Conservancy's plans to plant cover crops, use mulch and avoid land clearing during the rainy season would help to mitigate the impacts of soil runoff.

Mr. Fukumitsu has done extensive research on the history of the area, and has documents from the Great *Māhele*, population counts, Land Commission awards and court awards from the approximate time period of 1850-1920. He is interested in preserving the *ahupua'a*, with particular emphasis on native crops. He believes that cacao is compatible with native crops, since

it is environmentally sound and has good economic potential. Taro is culturally and educationally important, but labor-intensive. There is economic possibility there, but it needs to be an

agricultural operation, a business. In the olden days taro was a dietary staple and an industrial crop with significance throughout Hawai'i and the Pacific. We need to prove to future generations that taro can be grown again.

Other good crops that could be grown in Waikāne are *ulu*, tapioca, banana and *'uala*. These crops provide good, healthy sustenance. *Awa*, which is drunk as a religious and spiritual practice, has good potential pharmaceutically and its consumption is popular. Native and non-native plants could be grown together, as part of an educational and cultural program.

Mr. Fukumitsu used to volunteer cultivating taro 25-30 years ago on the Kamaka family *kuleana* parcel up in the valley. They would clean the land, propagate native species, and also hike on trails to hunt and gather mountain apples. Those lands were condemned by the Federal government to serve as military training grounds until 9/11. The government hasn't made an attempt to clean up that part of the valley, only the lower areas.

Hakipu'u and Waikāne valley were very sacred places that the king gave to the kahuna. This area is where the first voyagers from the Pacific landed, so it holds the significance of what they brought on the voyage in their canoes. *La'au lapa'au* (medicinal plants) and trees were some of the plants they brought from across the Pacific. Each site signified an individual and his trade, with trades going from mountain to ocean. For example, Ka'ai brought *ulu* to Kualoa. Mauiloa is buried between Waikāne and Hakipu'u. The history here goes back 25,000 years. In the modern day, as we put these pieces together, it becomes a more significant reality, a real history. History represents a way of life that is being modernized and Westernized. They started using animals like buffalo and oxen to pull carts. It was sophisticated living, even in grass shacks, pounding *poi*. Then came cars. Now we're trying to integrate tradition with modern life.

Mr. Fukumitsu wants to plant taro in a *makai* part of Waikāne, and has been working with the City and WWCA to move forward. He could use support to make it happen and sustain it. He is also interested in being part of Mr. Zweng's project, and welcomes future contact from the 'Ōhulehule Forest Conservancy. He helped create the *lo'i* at University of Hawai'i and a number of other places. He identified Mr. Francis Sinenci as a good contact regarding the process and permits required for building a traditional *hale*. Also, Cultural Surveys Hawaii did a nice report on Hakipu'u.

Mr. Fukumitsu consented to allow Townscape Inc. to include the contents of this interview in the 'Ōhulehule Forest Conservancy planning documents, including the Cacao Farm Environmental Assessment.

2. Pat Royos Interview Summary

Interviewee: **Mrs. Pat Royos** (Waikāne Valley resident and member of Waiāhole-Waikāne Community Association)

Interviewed by: Lauren Armstrong (Townscape, Inc.) by phone

Date: December 6, 2012

Mrs. Pat Royos was born in Waiāhole Valley in 1945, was raised there and continues to live in the valley today. She has served as president of the Waiāhole-Waikāne Community Association (WWCA) and is currently an active member. Her parents came to Waiāhole Valley in 1932, after her father lost his leg while working at the quarry in Waimānalo. Their family farmed banana and papaya on a seven-acre lot. There were many taro *lo'i* in those days.

Mrs. Royos is very interested in preserving the Waikāne pier because it has a legacy and historic significance of more than 100 years. Ships used to pick up crops grown in Waiāhole and Waikāne valleys, such as coffee, sugarcane, rice, and pineapple. There was a train track that carried food from up in the valley down to the pier. She would like the valley to go back to that, but we need serious farmers who want to farm. Nowadays young people are more interested in working indoors on computers.

The number of cultivated taro patches began to decline in the 1960's. Now there are people like the Reppuns and a lady named Dolores on Homestead Road who still grow taro. Dolores and her husband used to grow 12 acres of taro, but since her husband passed away, she and a worker from Bishop are growing less. There are many people who want to grow taro, but it's hard to get in because the City and State own most of the land. The State wants to get rid of this place, because they're all about development and have lost interest in agriculture. The agricultural park could have been successful, but all the old-timers who knew how to farm are fading away.

Under the long-term lease, people's land goes back to the State if no one wants to take care of it. The HHFDC requires lessees to generate a good income from farming, not from what they do outside. Before, people didn't know it would come to this. They thought they could do what they wanted with the land. Now the State tells them what to grow, and doesn't allow them to raise animals. Farmers must grow things like vegetables, flowers and taro—the focus is on production. If we want more taro, we need more water. That's the only way to bring the water back, because the *lo'i* need water. It used to be 50-50 leeward and windward, now looking at our stagnant

streams, it seems that 75% is going to the leeward side. It's not fair. Since sugar plantations are done, they should return the water to us. Once you give them something, they won't give it back. Now they want the water for development.

Other crops aside from taro would also help get the water back. We need serious farming, otherwise the land goes back to the State. Mrs. Royos and the WWCA support Mr. Zweng's plans to start a cacao farm, because they would rather see farming than development. The last guy who

owned that property (Mr. Enomoto) wanted to develop it, and put in an eight-inch water line. The HHFDC wanted it, but someone in the valley found out and the community protested. She believes Mr. Zweng is different from the previous landowner. He is involved in the community, and they see him every weekend. He is going through the process, showed them (the WWCA) the proposal, and they trust him. Seeing what he's doing, they support it.

Mrs. Royos would like to see farming come back. The community won't let HHFCD sell the land, and will keep fighting. The BWS is not wanted in the valley, since the existing contractor has done fine. BWS wants our water, not to take care of people. This residential community is different from outside. It's agriculture and residential, with different water pricing for farmers. The people who live here and work the land stick together.

She is glad her son-in-law (Elijah Kane, a house builder) is getting involved in cultural practices in the valley, since the next generation needs to be involved. They want to save Waikāne pier for its historic value and the *mauka-makai* connections it could foster. The pier is collapsing, but the DLNR doesn't have money to rebuild or restore it. Also, many people in the community would like to have an open market in the Waiāhole-Waikāne Park that is currently cleaned by the WWVCA. This would encourage more farming since farmers would have a place to sell on Wednesdays and Fridays. Restrooms and parking facilities are needed to have an open market. The City has money to do this, and Donovan Dela Cruz tried really hard to make it happen. The steering committee decided not to due to concerns about homeless people living in the park. Mrs. Royos thinks that people living nearby could take care of the park so that doesn't happen, and thinks it could be a beautiful park.

Another cultural project she and others would like to make happen in Waikāne is to make a canoe for the kids. They could use albizia trees from the valley, just like the olden days. The kids could learn how to make the canoe, and this would be a linkage to the pier. The kids could paddle canoe. Also, Mrs. Royos' son-in-law wants to save the fish by making them an area to lay eggs. They would need netting and more freshwater from the streams to create the right habitat for *aholehole* fish (mullet), crabs and *limu*. They also want to clean the area near the *poi* factory, and to see beautiful scenery with plenty of *lo'i*. Anything can happen with willpower, then people want to get involved. Some people are interested in farming taro with buffalo. Mr. Keoki Fukumitsu of Hakipu'u/ Waikāne is interested in growing taro in Waikāne.

Mrs. Royos consented to allow Townscape Inc. to include all contents of this interview in the 'Ōhulehule Forest Conservancy planning documents, including the Cacao Farm Environmental Assessment.

3. Ted Saizon Interview Summary

Interviewee: **Mr. Ted Saizon** (Waikāne Valley resident)

Interviewed by: Lauren Armstrong (Townscape, Inc.) by phone

Date: December 12, 2012

Mr. Ted Saizon has lived on Waiāhole Valley Rd. near the entrance to the proposed cacao farm for 20 years. Before Waikāne Valley his family lived in nearby Kahalu'u. His family has been in Kahalu'u since the 1800's, and many of Mr. Saizon's relatives still live on the peninsula behind the fishpond. He attended school in Waiāhole Valley, and remembers the valley was mostly in farming then as it is now. Now, more people live in the valley. Way back, there used to be cattle in the valley.

The proposed cacao farm would be good because it's all farming in the area. Mr. Zweng is involved in the community, and lets people know about his plans. He loves nature, and goes hiking all over the property. Not many people hike up in the valley. Most of it is protected watershed area. Some people go pig hunting and bike riding. Old families sometimes go into the forest to get bamboo for decoration and garden trellises. Some people also gather edible fern shoots from the forest.

There is a Tongan family up Waiāhole Valley Road that runs a farming and cultural learning center. Aside from that, the valley is peaceful. The government closed off the backside of the valley where the Kamakas used to be because it was a former military training area. Before that, the Kamakas used that land for a long time. They used to have *lo'i* way up in the valley. Most of the Kamaka family now lives near Kam Highway.

Mr. Saizon takes care of his five grandchildren who live with him. He is thankful that they have a place to stay for a while, but is unsure what will happen in the future.