

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

November 13, 2015

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

Land Board Members:

**SUBJECT: AMEND PRIOR BOARD ACTION OF AUGUST 28, 2015, ITEM C-3; APPROVAL OF A REVISED FOREST STEWARDSHIP MANAGEMENT PLAN AND INCREASED COST SHARE SUPPORT FOR THE KOKUA KALIHI VALLEY FOREST STEWARDSHIP AGREEMENT, TMK 1-4-014:026; 1-4-014:001; AND 1-4-016:003, KALIHI, KONA, O‘AHU; APPROVAL OF DECLARATION OF EXEMPTION FROM CHAPTER 343, HRS, ENVIRONMENTAL COMPLIANCE REQUIREMENTS FOR THE PROJECT.**

**THIS AMENDMENT IS REGARDING THE AMOUNT OF INCREASED COST SHARE SUPPORT FOR THE IMPLEMENTATION OF THE MANAGEMENT PLAN.**

**BACKGROUND:**

At its meeting of August 28, 2015, under agenda item C-3, the Board approved the subject matter regarding a revised Forest Stewardship management plan and request for increased cost share support for the Kokua Kalihi Valley Forest Stewardship Agreement. A copy of the approved submittal is attached as Exhibit A.

**DISCUSSION:**

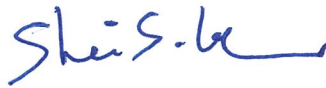
In the revised management plan and board submittal mentioned above, the total cost-share support was incorrectly noted as \$361,904, representing an increased amount of \$6,384 to the Agreement. The approved increased amount did not correctly account for previously received support under the Agreement due to a discrepancy between the State and landowner records. Following additional review by the Division of the Kokua Kalihi Valley Forest Stewardship Agreement and corresponding forest stewardship management plan, the correct total cost-share support is \$367,776, representing an increased amount of \$12,256 as detailed in Exhibit B.

RECOMMENDATIONS:

That the Board:

1. Amend its prior Board action of August 28, 2015 under agenda item C-3, by changing the amount of total cost-share support approved to \$367,776 for the implementation of the Kokua Kalihi Valley Forest Stewardship management plan.
2. All terms and conditions listed in its August 28, 2015 approval to remain the same.

Respectfully submitted,



SHERI S. MANN, Acting Administrator  
Division of Forestry and Wildlife

Attachments: Exhibit A and B

APPROVED FOR SUBMITTAL:



SUZANNE D. CASE, Chairperson  
Board of Land and Natural Resources

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

August 28, 2015

Approved by the Board of  
Land and Natural Resources  
at its meeting held on

AUG 28 2015

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

Land Board Members:

**SUBJECT: REQUEST APPROVAL OF A REVISED FOREST STEWARDSHIP  
MANAGEMENT PLAN AND INCREASED COST SHARE SUPPORT FOR THE  
KOKUA KALIHI VALLEY FOREST STEWARDSHIP AGREEMENT, TMK 1-  
4-014:026; 1-4-014:001; AND 1-4-016:003, KALIHI, KONA, O'AHU.**

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

**BACKGROUND:**

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

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

To participate in FSP, interested landowners and managers develop a long-term Forest Stewardship management plan through the Division of Forestry and Wildlife (Division) and the

Forest Stewardship Advisory Committee (FSAC). Upon approval of a project's Forest Stewardship management plan, the FSAC recommends cost-share support for the implementation of the project over a 10-year period. The request for cost-share support is submitted to the Board of Land and Natural Resources (Board) for consideration and approval. Following authorization by the BLNR, the landowner is required to enter into a Forest Stewardship Agreement that commits them to implementing their approved management plan over the next 10-years and authorizes cost-share reimbursement support for their project.

At its meeting on February 8, 2008, under agenda item C-1, the Board approved the Forest Stewardship Agreement for Kokua Kalihi Valley (KKV) to participate in the Forest Stewardship Program and authorized total cost-share support in the amount of \$355,520.00 over a 10 year period (Exhibit A). The Kokua Kalihi Valley Forest Stewardship project proposed to restore and manage 20 acres of native forest systems on approximately 100 acres corresponding to TMK 1-4-014:026; 1-4-014:001; and 1-4-016:003. All Forest Stewardship projects are asked to review and evaluate their management actions at least once during the implementation of their management plan to assess their success and adjust their practices, as appropriate, to ensure that they meet their project goals. Additionally, Forest Stewardship projects may request cost-share adjustments if costs associated with management activities have increased or decreased during the term of their agreement.

#### DISCUSSION:

The initial goals of the KKV Forest Stewardship project were to cultivate and regenerate a koa mesic forest with a mixed native understory on 20 acres of the 100 acre Kalihi Valley Nature Park for the purposes and benefits associated with native species restoration and habitat improvement, soil and water protection, and forest recreation enhancement. As their project developed however, the scope and needs of the project changed. KKV has been very successful in connecting with and engaging the Kalihi Valley community. This focus on increasing public engagement has resulted in a significant number of volunteers participating in forest management activities at the nature park every week. As such, the goals of the project have changed to focus on restoring balance to Kalihi's watershed and native upland forest by utilizing a community-based, adaptive management approach to reforestation as a way of strengthening the long-term relationship between the community and the forest. Due to the high amount of volunteers, the project has shifted away from using herbicides for weed control to utilizing an organic method to manage the forest. KKV is also incorporating agroforestry practices as part of their management to provide a community connection to the forest resources.

KKV has revised their management plan to better reflect the changes in their overall project vision and goals. More specifically, the management objectives, associated FSP practices, and implementation schedule have been modified and updated to account for the change in project scope. Additionally, KKV is requesting an increase to their cost-share allocation of \$6,384.00 for the remaining 2 years of their Forest Stewardship Agreement. This additional cost-share support accounts for inflation in costs and is consistent with the intensity of the management required for these practices to be implemented successfully.

The Division and Forest Stewardship Advisory Committee reviewed and recommended the approval of the KKV management plan revision at their meeting on May 29, 2015 (Exhibit B). The Division is requesting Board approval of the revised Kokua Kalihi Valley Forest Stewardship management plan and additional cost-share support of \$6,384.00 for Fiscal Year 2016-2017, equaling a total of \$361,904 through the authorized Forest Stewardship Program Agreement.

Per their Forest Stewardship Agreement, Attachment 4, Section 2, Board approval of the Kokua Kalihi Valley management plan revision is required, given that significant changes are being made to their approved management plan and budget to adapt to current conditions.

#### CHAPTER 343 – ENVIRONMENTAL ASSESSMENT

An environment assessment was completed in May 2006, for the Kalihi Valley Nature Park and Active Living Center. It was found that the project would not have significant impacts and was issued a finding of no significant impacts (FONSI).

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

RECOMMENDATIONS:

That the Board:

1. Approve the revised Forest Stewardship management plan for the Kokua Kalihi Valley;
2. Approve a total cost-share support in the amount of \$361,904 for the implementation of the Kokua Kalihi Valley Forest Stewardship management plan;
3. Authorize the Chairperson to amend, finalize, and execute an amendment to the Forest Stewardship Agreement with Kokua Kalihi Valley to participate in the State Forest Stewardship Program subject to the following:
  - A. Availability of State Forest Stewardship funds; and
  - B. Review and approval as to form of the Forest Stewardship Agreement amendment by the Department of the Attorney General.


Respectfully submitted,



GALEN K. KAWAKAMI, Acting Administrator  
Division of Forestry and Wildlife

Attachments: Exhibit A and B

APPROVED FOR SUBMITTAL:



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SUZANNE D. CASE, Chairperson  
Board of Land and Natural Resources

Final Stewardship Plan  
State of Hawaii, Department of Land and Natural Resources  
Department of Forestry and Wildlife  
Forest Stewardship Program

# Kokua Kalihi Valley: Kalihi Valley Nature Park Reforestation Project



February, 2007  
**KOKUA KALIHI VALLEY**  
(Comprehensive Family Services)  
2239 North School Street, Honolulu, HI 96819  
Phone (808) 791-9400 ♦ Fax (808) 848-0979

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## I. Cover Sheet

Name: Kokua Kalihi Valley

Address: 2239 North School Street  
Honolulu, HI 96819

Email: [lisaf@kkv.net](mailto:lisaf@kkv.net) or [david@kkv.net](mailto:david@kkv.net)

Phone: 808-791-9400 or 808-791-9469

Fax: 808-845-9905

TMK No.: 1-4-014:0026, 1-4-014:001, 1-4-016:003

State Land Use Classification: Urban and Conservation

County Zoning Designation: P1 and P2 General Preservation

Total Acreage: 99.65

Stewardship Management Area: 30 acres

Consultant's Name: Bill Sager, Forestry Consultant

Address: 53-567 Kamehameha Hwy.  
Honolulu, HI 96717

Phone: 235-0757 or 375-1114

Email: [bsager@lava.net](mailto:bsager@lava.net)

Date of Plan Completion: February 21, 2007

## II. SIGNATURE PAGE

**Kalihi Valley Nature Park Reforestation Project  
Forest Stewardship Plan Signature Page**

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

Prepared by:  
Bill Sager, Forestry Consultant  
44-211 Mikiola Drive  
Honolulu, HI 96744

Professional Resource Consultant's Signature/ Date:



Professional Resource Consultant's Name

Bill Sager

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

Prepared for:  
Kokua Kalihi Valley  
2239 North School St.  
Honolulu, HI 96819

Applicant's Signature/ Date



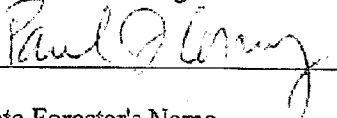
Applicant's Name

Dr. David Derauf, Executive Director, Kokua Kalihi Valley

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

Approved by:

State Forester's Signature/ Date

 11/10/08

State Forester's Name

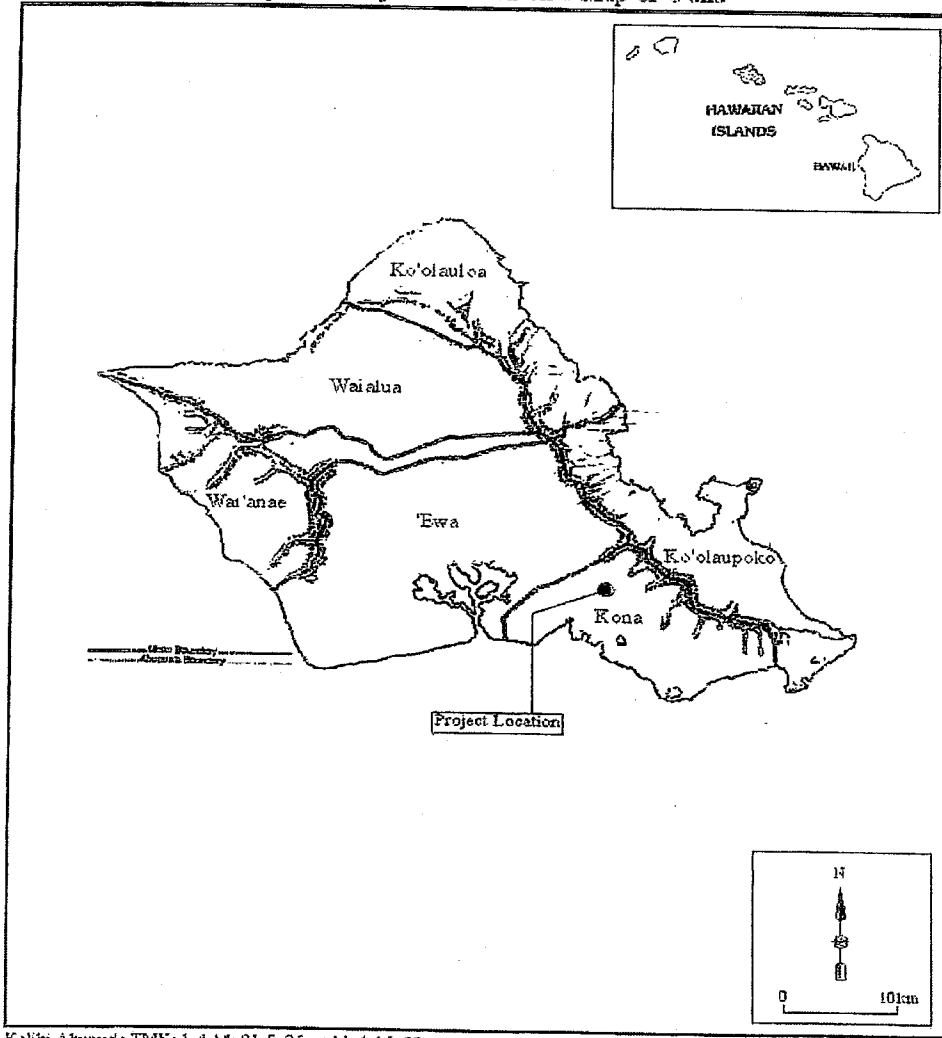
### III. INTRODUCTION

#### 1. General Description

##### A. Property size and location

The Kalihi Valley Nature Park is located on 99.65 acres of land at the head of Kalihi Valley. The property stretches from the center of Kalihi Stream to the top of Kamañaki Ridge. Access to the site is at the mauka end of Kalihi Street, past the last wooden bridge. The historic land division (ili) of Maluawai and a portion of Ouaua combine to make the park site.

Figure 1: Project Location on a Map of O'ahu



Kalihi Aikupua TMK: 1-4-14-01 & 26 and 1-4-16-03

source: Adopted from Nogelmeier in Snelcberg 1990

The 100-acre site includes two residential structures, agricultural terraces that may date to prehistoric times and the remains of facilities from a defunct nursery operation. The lower elevation of the site is covered by introduced species while some native plants remain nearer the Kamaikai ridge summit. Parts of the property are littered with old, rusting abandoned vehicles, car parts, trash and nursery equipment. Mauka of the site is undeveloped watershed and forest land. Makai of the site lie private residences on either side of Kalihi Street.

**B. Description of access routes to property**

Access to the site is at the mauka end of Kalihi Street, past the last wooden bridge.

At one time, three residences were occupied on the site. The house at 3635 Kalihi St. was once occupied by the proprietors of a nursery operation on the upper slopes of the park site. This home will be converted into a bunkhouse as part of a nature camp.

Several old driveways remain on the property. A long driveway to the mauka nursery site is overgrown and eroded and can only be traveled by foot as a walking path.

**C. Property tax map key**

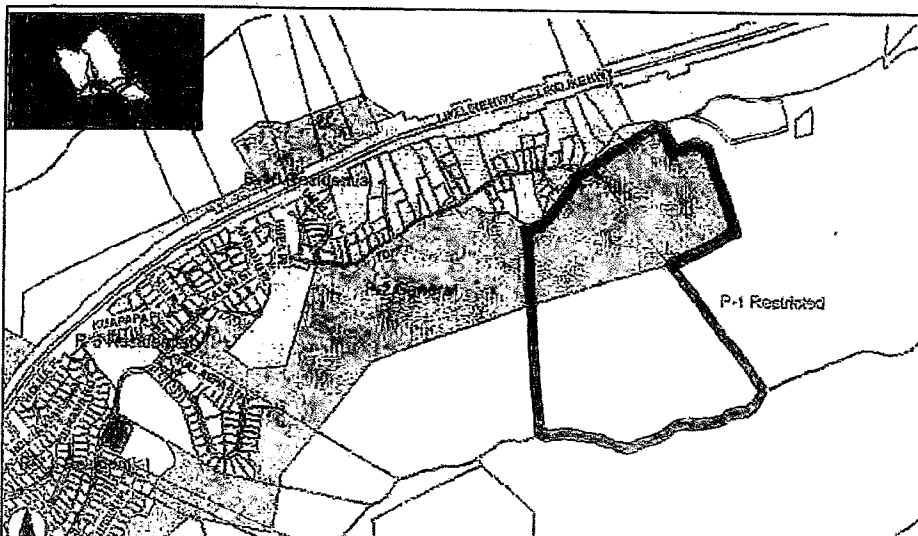
Tax Map Keys: 1-4-014:0026, 1-4-014:001, 1-4-016:003

**D. Property zoning**

State Land Use Classification: Urban and Conservation  
 County Zoning Designation: P1 and P2 General Preservation

The portion of the site nearest to Kalihi Stream (about 42 acres) is designated as Urban by the state. Approximately 57 acres of up-slope land nearest the crest of Kamaikai Ridge are designated as Conservation land and therefore more tightly regulated. The City zoning of the site is Preservation (P1 and P2) consistent with park lands on Oahu.

Figure 2: Zoning map of Kalihi Nature Park. The lower 44 acres zoned P2 is also in the state Urban District. The P1 zoned area is in the state Conservation District.



### **E. Topography, elevation and climate**

The project site ranges in altitude from a low point of nearly 500 feet above sea level at the Kalihi Stream channel to a height of approximately 1,400 feet along the top of Kamaikai Ridge. Kalihi Stream runs through a steep sided channel in places nearly 40 feet deep. Immediately above the stream channel much of the project site is relatively level, gently sloping land. Some of the land on the stream side of the property has been graded into wide terraces or excavated during the time of commercial nursery operations. A series of shallow gullies run generally perpendicular to the stream up to the valley ridge to the south. Slopes along the lower portion of these gullies are generally moderate and easily traversed. A wide plateau lies about halfway up the slope to the ridgeline. This is the site of the mauka nursery operation. Evidence of significant earth movement and grading are clearly visible at this location. Above this plateau, the valley walls become steeper. The gullies climb to become narrow gulches stepping up with sheer rock cliffs and dry waterfalls. Steep side ridges reach up from the lower valley and intersect the top of Kamaikai Ridge.

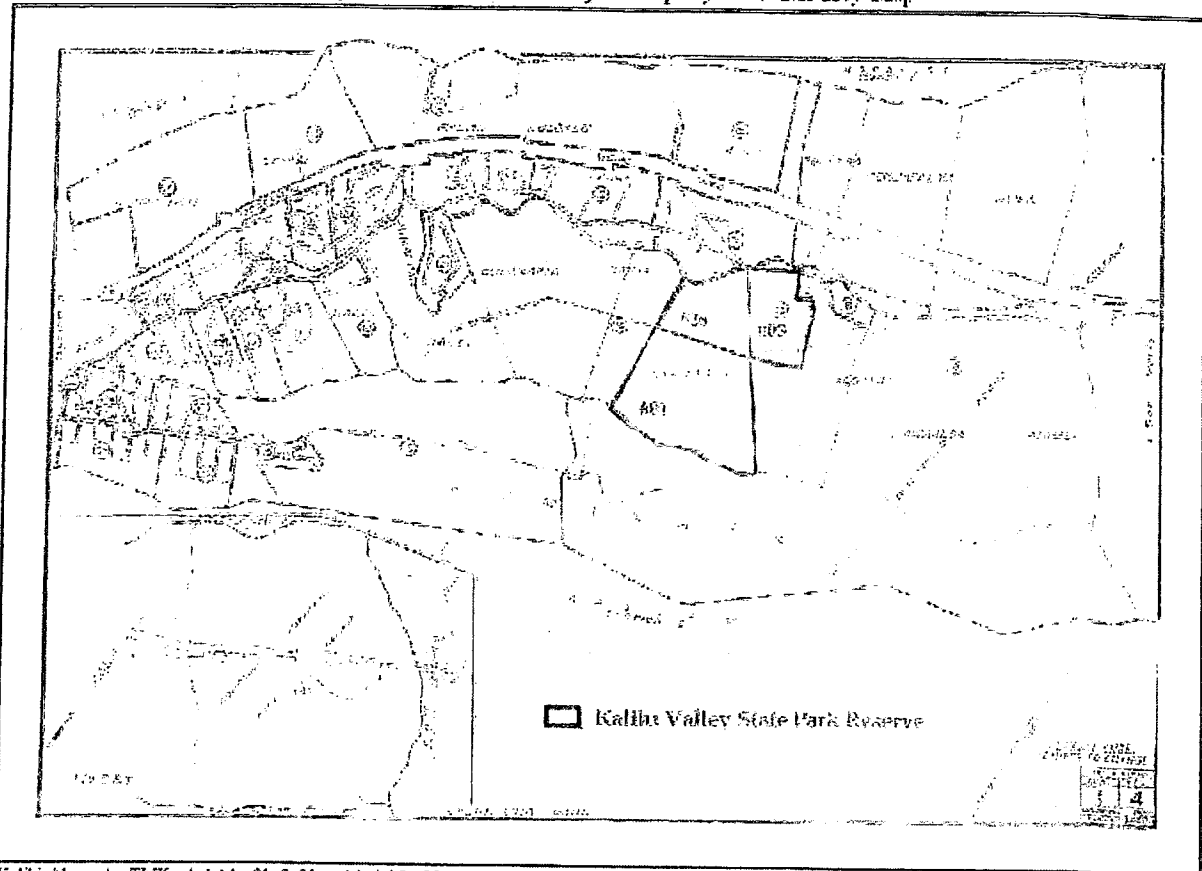
The climate of Kalihi Valley is typical of lands near the Koolau Mountains. Rainfall is moderately heavy in the area averaging well over 100 inches annually at the BWS Kalihi Reservoir and the upper portions of the valley. The majority of precipitation occurs between November and April when winter storms add to trade wind rainfall. Predominant trade winds from the Northeast blow through the windward pass of the Koolau summit and down the valley toward Honolulu. Temperatures at Honolulu International Airport range between 70 and 84 degrees Fahrenheit. Upper Kalihi Valley can be expected to be somewhat cooler than the temperature recorded at the Airport.

### **F. Brief history of uses/description of present condition**

This region of Kalihi Valley was once intensively cultivated by Hawaiian people prior to western contact. Three complexes of stone-lined water channels and surrounding agricultural terraces remain in varying stages of disrepair. It is assumed that these stone features date from pre-historic times. An agricultural heiau is reported to have once been located not on, but nearby the park site. At the time of the Great Mahele, when land in the islands was first converted to private ownership, the ili of Maluawai was deeded to Kamamalu, the sister of King Kamehameha IV and V.

In historic times the land was used for grazing cattle. By the mid-1800s, few trees stood in the valley floor and most of the property was grassland. In the later part of the 19<sup>th</sup> century and most of the 20<sup>th</sup> century, trees began to grow again in the area as a result of re-forestation efforts by the government and private land owners. Today, nearly the entire site is covered by exotic species such as albizzia, rose apple and bamboo.

Figure 3: Location of Subject Property on a Tax Key Map



Kalihi Ahupua'a TMK: 1-4-14: 01 & 26 and 1-4-16: 03

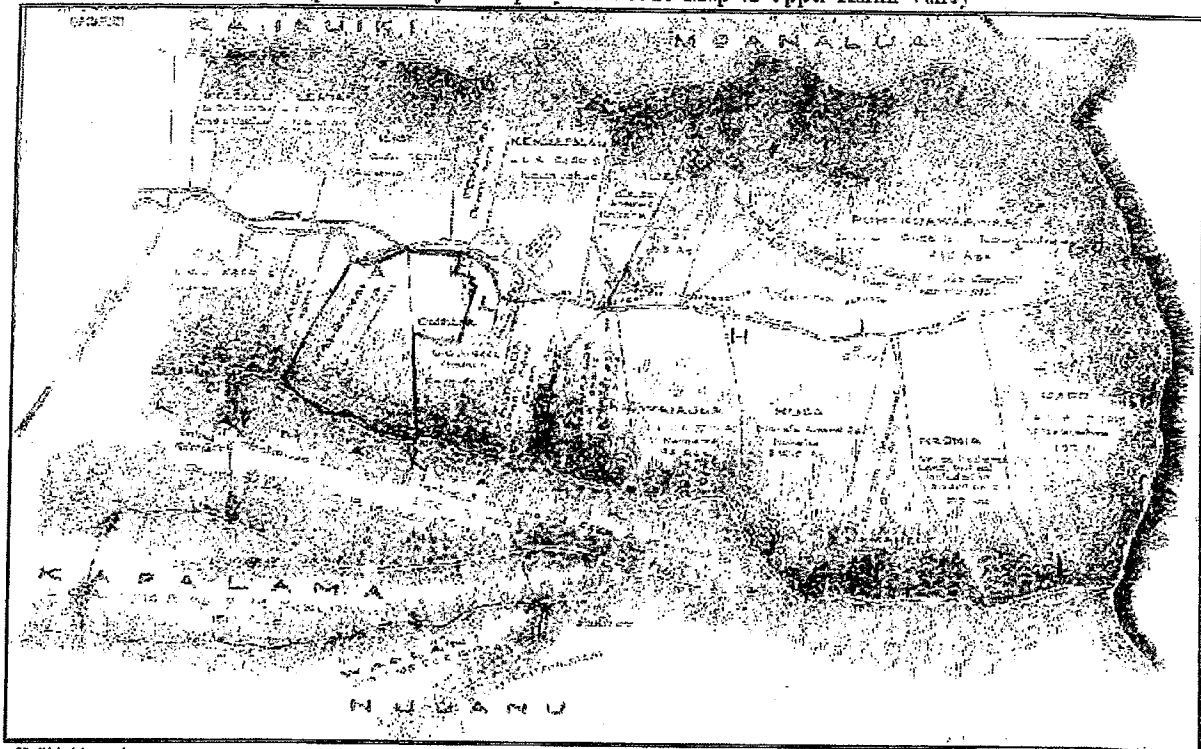
source: Department of Taxation, Tax Maps Bureau 1992

The properties that now make up the park have changed hands a number of times over the years. Much of the land mauka of the park site was condemned to preserve a watershed to protect Honolulu's drinking water supply and is currently owned by the Honolulu Board of Water Supply. In the 1970's a developer proposed to construct a residential subdivision on the site. In response to community concerns, in 1980, the City and County of Honolulu purchased the 100 acres for a park.

After years of inaction by the City, the park land was conveyed to the State in a land exchange that concluded in 1997. The State Parks Division currently has jurisdiction over the site. Unable to secure funding to develop a nature park, State Parks sought the involvement of private organizations to make the park a reality. In 2004 Kokua Kalihi Valley began discussions with State Parks to seek a long-term lease of the site for the purpose of finally bringing the park to life. In December of 2004, the Board of Land and Natural Resources approved a 20 year lease over the 99-acre park land to KKV.

KKV began a community-based planning effort to design the park in keeping with the expressed interest of Kalihi residents and parameters established by the state. This plan is a byproduct of guidance by a community park planning committee and input by many members of the public.

Figure 4: Subject Property on a 1923 Map of Upper Kalihi Valley



Kalihi Ahupua'a  
 TMK: 1-4-14, 01 & 26 and 1-4-16: 03

Source: Board of Agriculture and Forestry,  
 map no. O-33, 1923  
 (on file: Hawaii State Archives)

## 2. Description of specific management objectives

Kokua Kalihi Valley, a non-profit community organization, has a 20-year lease on 100 acres of public land to develop the Kalihi Valley Nature Park and reforestation project. The project will include the creation of new walking paths and hiking trails, a nature camp with a bunk house and a tent camping area. Currently the site is overgrown with exotic species. Exotic plants will be removed and native species restored. The Park will be privately operated but open to the public as a place of quiet recreation, nature studies, health education and the preservation of Hawaiian culture.

The specific management objectives of this proposal are 1) **Native Species Restoration and Habitat Improvement** – regeneration of a native Koa forest with a mixed understory of native and Polynesian Introduced species on approximately 30-acres of the 100-acre Kalihi Valley Nature Park; 2) **Soil and Water Protection and Improvement** – an integrated component of the Project's other two objectives; and 3) **Forest Recreational Enhancement** -- increase and improve public access to the 30 acres of regenerated Koa forested and mixed understory areas for recreational, educational and cultural purposes and develop a trail to the summit of Kamaikai ridge for purpose of forest recreation and natural resource interpretation.



## IV. LAND AND RESOURCE DESCRIPTION

### 1. Existing vegetation/cover types

The forest below 800 ft is mostly dominated by naturalized alien tree species, with only small patches of native vegetation remaining. Much of the forest canopy is composed of albizzia (*Falcataria moluccana*). Other common alien trees are rose apple (*Syzygium jambos*), gunpowder tree (*Trema orientalis*), black bamboo (*Phyllostachys nigra*), koka (*Bischofia javanica*), strawberry guava (*Psidium cattleianum*), common guava (*Psidium guajava*), shoebutton ardisia (*Ardisia elliptica*), ironwood (*Casuarina equisetifolia*), fiddlewood (*Citharexylum caudatum*), kukui (*Aleurites moluccana*) and Formosan koa (*Acacia confusa*). There are also some trees in the parcel that were planted in the early 1900's, but have not spread very much, such as the Cook pine (*Araucaria columnaris*), and eucalyptus (*Eucalyptus* sp.).

The vegetation below 700 ft is almost totally alien in composition. Above 700 ft native plants within the alien forest are more frequently encountered. The native plants observed here include `ohi`a (*Metrosideros* spp.), koa (*Acacia koa*), hapu`u pulu (*Cibotium chamissoi*), `ie`ie (*Freycinetia arborea*), papala kepau (*Pisonia umbellifera*), mamaki (*Pipturus albidus*), lama (*Diospyros sandwicensis*), alahe'e (*Psydrax odorata*), and uluhe (*Dicranopteris linearis*). Polynesian introductions seen below 800 ft included kukui, kamani (*Calophyllum inophyllum*), ti (*Cordyline fruticosa*), `ohi`a `ai (*Syzygium malaccensis*), coconut (*Cocos nucifer*), and hau (*Hibiscus tileaceus*; possibly native). A variety of ornamental plant species persists around abandoned nursery structures and residences.

The vegetation of the steep valley wall portion of the parcel is largely dominated by alien plant species; but a larger percentage of the vegetation here is native compared to the alien forest of the valley bottom portion. The native plants observed here were common mesic forest plants.

### 2. Existing forest health

Prior to western contact, the park site was intensively used by Hawaiians for agriculture. At that time, the valley floor was stripped of much of its original flora to make way for native food crops. In the past 200 years, grazing animals such as cows converted much of the valley into grasslands. The site has been reforested by the introduction of exotic tree species planted by the government and private land owners. A botanical survey found that no rare or endangered plants were found anywhere on the 100-acre park site. While the upper reaches of the valley walls remain home to some native species such as Koa and Ohia, most of the site is completely overrun by exotic trees and weeds.

The notorious exotic weed miconia was introduced to the site by the previous nursery operation. Crews of volunteers have been working to remove miconia from the site. This eradication effort will be supported and accelerated as part of the Nature Park operation. Other exotic flora such as rose apple trees, bamboo and clidemia that blanket the park site will be removed and replaced by native plants.

### **3. Soils and their conditions, general slope and aspect**

Geologically, the Kalihi Valley Nature park site is situated in a very old valley eroded into Koolau volcanic shield. Older alluvium underlies the floor and slopes of the valley. Younger Kalihi lava of the Honolulu Volcanic Series were deposited 450,000 years ago from vents in Kalihi and Kamanaike Valleys. Kalihi Stream cut a channel and deposited stream terraces of younger alluvium. The slope of Kamanaike Ridge on the southern half of the site is classified as rock land. Soil underlying the more gently sloping valley floor is classified as lokekaa silty clay.

### **4. Water resources and their condition**

#### **Groundwater:**

The project site overlies aquifers perched within the alluvium and Kalihi basalt. Rainfall over areas underlain by Koolau basalt infiltrates deeply into the volcanic rock of Oahu to recharge dike-confined aquifers and the basal aquifer water. An average of approximately 10 million gallons of water each day enters the Kalihi groundwater system. Both the perched and basal aquifers are tapped as drinking water sources for Honolulu. There are 10 drinking water wells currently operated by the Honolulu Board of Water Supply in the Kalihi area and two by Kamehameha Schools in the basal aquifer. BWS also has an artesian perched well above the park site. The sustainable yield of the Kalihi aquifer is estimated by the Commission on Water Resource Management to be 9 million gallons per day. The average pumpage from the Kalihi system is 9 million gallons per day.

#### **Surface Water:**

Kalihi Stream flows perennially along the northern boundary of the project site. The average stream flow of Kalihi Stream is 7.3 mgd but minimum flow may fall below 0.5 mgd in dry years. Upstream of the project site, the stream drains the relatively undeveloped Kalihi watershed. The watershed is host to the Likelike Highway, a major transportation corridor between windward Oahu and Honolulu's downtown. Old Kalihi Street also penetrates the watershed and serves the Board of Water Supply reservoir and water pipelines. Negative impacts on stream water quality in this upper region include alien plants and animals that hinder the ability of the land to absorb rainwater and increase muddy runoff into the stream. During heavy rain events, flow increases dramatically and stream water typically becomes brown and turbid. Kalihi Stream flows down slope through residential and industrial districts of Honolulu to meet the sea at Keehi Lagoon. Kalihi Stream has been listed as an impaired water body by the State Department of Health under the provisions of the federal Clean Water Act.

The park site includes 4 gullies that host small fresh water seeps or springs. Each spring sends its water trickling down slope and into Kalihi Stream.

### **5. Wood resources**

Wood resources available within the park site are limited to the predominant alien exotic species mentioned above. Of these, the albizzia is the only species currently identified to be utilized as a

resource for the making of canoes by schools. Any other wood available from alien species removed will be used on site for park purposes such as benches, signs, and shelters.

## **6. Wetland resources**

No significant wetland resources exist on site.

## **7. Significant historic and cultural resources**

The site contains numerous archeological structures that are presumed to date to pre-historic times. These structures include a network of stone-lined irrigation channels and agricultural terraces that bear witness to the long history of agricultural use in Kalihi Valley. The Kalihi Valley area also has a prominent place in Hawaiian legends and is claimed to have been the dwelling place of the original male and female progenitors of the Hawaiian race, Wakea and Papahānaumoku. The close proximity of the Project site to the urban center of Honolulu makes it an accessible and significant resource recalling the former agricultural foundations and cultural history of the area.

## **8. Threatened and endangered species existing on property**

No listed endangered or threatened native plants nor any other rare native plants were found during a botanical reconnaissance in June, 2005. This was not unexpected, given the long history of alteration and destruction of native vegetation of the valley bottoms in the Honolulu area in pre-Western times up until today. There is little potential for the discovery of rare plants that may have been missed on this reconnaissance based on the documented patterns of occurrence of rare and endangered native plants in the valleys in the Honolulu area.

The potential for the discovery of rare plants is greater in the valley wall part of the property than in the valley bottom portion. These upper elevations would require further survey for rare and endangered plants should any park development be planned there.

The predominant exotic plant forest in the valley bottom is not known to provide habitat for any native animal. The higher slopes of the Koolau Range provide habitat for the Hawaiian forest bird, `elepaio. There have not been any recorded `elepaio sightings on the park property and such sightings would not be expected at this elevation.

Alien animal species that are known to inhabit the park property include a wide range of introduced bird species such as thrushes, doves, mynahs and finches. Feral pigs are known to visit the property to feed on fallen fruit and roots. A colony of Australian Brush-Tailed Rock Wallaby has been established nearby and there is evidence that some wallabies visit the park site. Introduced mosquitoes are common at the park site, multiplying in great numbers in the dark, wet forest environment.

## 9. Existing recreational and aesthetic values

*The Active Living Center* – KKV has raised and invested over \$200,000 in funds over the last year, and over 2,000 hours of volunteer community labor, to convert a 3-bedroom 1930's residence, attached studio, courtyard and surrounding grounds within the 100-acre park site into the Kalihi Valley Active Living Center. The Center will be the central meeting point and program headquarters for all the environmental, health and recreational related activities being developed throughout the 100-acre Nature Park.



The Active Living Center

An additional 3-bedroom residence is located on the upper slope of the park site near the abandoned nursery operation. This home is in relatively intact condition and is scheduled to be renovated as a bunk house for overnight camping groups.



Nature Camp Bunkhouse

## V. RECOMMENDED TREATMENTS AND PRACTICES

The primary goal of the Kalihi Valley Reforestation Project is to cultivate and regenerate a Koa (*Acacia koa*) mesic forest with a mixed species understory (mid story and groundcover) on 20 acres of the 100-acre Kalihi Valley Nature Park. The Reforestation Project will focus on preserving, propagating and expanding existing Koa and other native and Polynesian Introduced (PI) tree species currently growing on-site (mamaki, lama, ie'ie, alahe'e, papala kepau), as well as propagating and establishing new native/PI tree species not on site, but which are appropriate for the Kalihi Valley habitat (naio, ahahea lau li'i, palapalai, 'akala, 'akoko, 'a'ali'i, u'ala, kokio keokeo, etc.). Additionally, the Reforestation Project will involve trail building activities within the reforestation area to increase access for educational, recreational and cultural purposes.

The three specific management objectives of this Reforestation Project are 1) Native Species Restoration and Habitat Improvement, 2) Soil and Water Protection and Improvement, and 3) Forest Recreation Enhancement. These three objectives are described in more detail below.

### 1. Native Species Restoration and Habitat Improvement

**Forest Type Planned** – The project goal is to develop 20 acres of Koa mesic forest in a tiered, mixed species arrangement. Koa will comprise the forest canopy, followed by a diverse middle story of predominantly native species.

While the project site is at a low elevation for the healthy development of a Koa forest, we are seeking to utilize Koa as the primary overstory species based on the continued existence of a number of remaining Koa trees found within the 100-acre Nature Park at the 800 foot elevation level and beyond. A broad diversity of other native tree species are being planted throughout the reforestation area and will be allowed to fill in throughout the lower elevation reforestation areas wherever the Koa seedlings and maturing trees do not survive

Groundcover throughout the reforestation area will be planted in two phases. The first phase will involve fast growing, weed suppressing native/PI cover crops that will later be cut back and supplemented in phase two with less aggressive native/PI groundcover and fern species.

**Overall Reforestation Strategy** – The reforestation area is currently dominated by albizzia, rose apple and strawberry guava. The reforestation plan involves clearing these invasive species, establishing a fast growing groundcover to assist with weed and erosion control, and to intersperse amongst this groundcover a first phase planting of Koa (overstory) seedlings followed by a second phase planting after 1 year with a variety of native/PI mid-story seedlings. Within the shade of the growing overstory and mid-story trees (after approximately 3 years), a wider variety of slower growing native/PI groundcovers will be planted.

**Arrangement in Landscape** – The 20-acre project area can be classified into two different landscape types – lower elevation disturbed lands and steeper side ridges that lead up to the main

Kamanaiki ridge. While both will be included within the overall tiered Koa mesic forest, they will all involve slightly different reforestation strategies

- **Lower Elevation Disturbed Areas**– Totaling 10 acres in area, the reforestation area will be just above a growing community garden area and surrounding a traditional agricultural terrace area currently being restored. The area contains the more gentle sloping lower ridges, steeper ridges towards the top and an eroding intermittent stream valley.

Within the lower elevations, *Carex*, 'ilie'e, palapalai, other natives and sweet potato ('uala) will be the dominant groundcovers planted. Seedlings of koa and other mesic tree species listed by Wagner and Herbst as components of koa mesic forests will be planted in an offset, diamond pattern at 10 feet on center. This is based on an attrition or thinning rate of 50% so that developing trees will be approximately 20 feet on center. We will start with species that still remain on the property (in very small numbers) and expand according to availability of seed or nursery stock.

Approximately one year after Koa seedlings have been planted (approximately 5 feet of growth), a variety of mid-story native/PI seedlings will be planted. Within each 10'x10' diamond perimeter created by Koa seedlings, 2-4 mid-story seedlings will be planted, depending upon plant species.

After approximately 3 years, any remaining 'uala groundcover will be replaced with a wider variety of slower growing ferns and groundcovers.

- **Side Ridges** – There are two main side ridges in the project area. Reforestation efforts will not cover the entire ridges, but will be concentrated only in the area immediately surrounding hiking trails leading up to Kamanaiki ridge. This area covers approximately 10 acres. Existing natives will be freed from encroachment by alien species. In some areas, koa and other mesic tree seedlings will be planted alongside the hiking trail at 20' intervals, followed 1 year later with intermittent plantings of mid-story seedlings every 5' – 7' feet. After 3 years, or once adequate shade is provided, native/PI groundcovers will be planted within this corridor.
- **Trail Corridors** – Approximately 10 acres of trail corridor will be established. Alien species will be controlled and native trees and groundcovers planted to replace them within the corridors.

**Site Preparation** -- Large albizzia and banyan trees as well as remnant junk such as old cars and farm equipment will require mechanical removal. This will require the use of heavy equipment that will remove these trees and remnant junk from the plateaus and gulleys in the reforestation area during the first year of the Stewardship/Reforestation plan. Any skid roads resulting from the use of heavy equipment will have water bars installed to prevent erosion and will be coordinated with groundcover plantings to cover exposed areas and reduce weed repopulation.

Any additional weed growth in these areas caused by heavy equipment removal and uncontrolled by groundcover plantings will be hand cleared at the appropriate time, as described below.

After heavy equipment removal of remnant junk and large albizzia trees, primary site preparation will involve hand clearing one acre of the lower elevation reforestation area each year for a total of 10 years. In addition, each year one acre where there are existing natives on the ridges will have alien species removed and native trees and groundcovers will be planted to replace them. Hand clearing will involve the use of chain saws, power trimmers and other hand tools. After cutting down unwanted alien trees, where practical, wood will be chipped using a power chipper to create a weed suppressing, organic mulch around new plantings. Additional trees will be piled in low stacks for quick decomposition and to prevent the harboring and proliferation of harmful pests.

**Weed Control** – Weed control will be practiced through the use of aggressively growing, leafy groundcovers ('uala, mamaki and others) and a wood chip mulch created on-site from removed trees. If these practices are not able to adequately control weed regeneration, a chemical herbicide such as Roundup or Garlon will be utilized. Beyond these practices, additional light hand weeding will be required around seedlings until they are firmly established (approximately 3 years). Where practical, biofilm mulch plastic (highly biodegradable) will be utilized.

**Seedling Acquisition** – The majority of plants will be grown in a nursery established in the community gardens area of the Kalihi Valley Nature Park. Plant stock/seed will be collected from plant materials as near the site as possible. While this is not an area of native forest and the goal is to establish a demonstration forest, care will be taken to minimize genetic contamination by not introducing plant material from other islands and to the extent possible working with local plant materials.

Seedlings will be grown in 4" plastic tree pots that are wedge-shaped and approximately a foot deep. These pots allow for deeper root growth before being hardened off and transplanted. Poorly growing seedlings will be thinned out during this stage. Transplanted seedlings will be grown to at least a foot in height before being out planted. Most seedlings will initially be grown in a shade house but before planting they will be placed in an open environment and allowed to harden off.

If seeds or stock material is not available on site, seedlings will be purchased from a native/PI nursery for either immediate out planting or for further growth and hardening off on-site in the Kalihi Valley Nature Park.

Seeds/Stock material located on-site for Reforestation Project include:

Koa (*Acacia koa*)  
 'Ohi'a (*Metrosideros polymorpha*)  
 Mamaki (*Pipturis albidus*)  
 Lama (*Diospyros sandwicensis*)  
 Ie'ie (*Freycinetia arborea*)  
 Alahe'e (*Psydrax rubiaceae*)

Papala kepau (*Pisonia brunoniana*)  
 Hapu`u pulu (*Cibotium chamissoi*)  
 Ti (*Cordyline fruticosa*)

Seedlings/Stock material needed to be obtained off-site include:

Palapalai (*Microlepia strigosa*)  
 Kupukupu (*Nephrolepis exaltata*)  
 `Ahahea lau li`i (*Bobea brevipes*)  
 `Akoko (*Chamaesyce multiformis*)  
 `Uki`uki (*Dianella sandwicensis*)  
 `A`ali`i (*Dodonaea viscosa*)  
 Manono (*Hedyotis terminalis*)  
 Naio (*Myoporum sandwicensis*)  
 Ho`awa (*Pittosporum confertiflorum*)  
 `Akia (*Wikstroemia oahuensis*)  
 `Akala (*Rubus Hawaiensis*)  
 Koki`o ke`oke`o (*Hibiscus arnottianus*)  
 `Uala (*Ipomoea batatas*)

**Planting** – After hand clearing an identified reforestation area of alien, shade-producing trees and chipping the removed trees for mulch, initial plantings of koa will be done. Competing vegetation and weeds will be removed throughout the area, with special attention for weed removal in a one and a half foot radius around the planting site. Koa seedlings will be out planted in an offset pattern, 10' on center. Plantings will be done by hand and planter will look for the best micro-site within a few feet of the planting location. Particularly, the planter will look for shade from the afternoon sun and pick a site with the best possible drainage. Plantings of Koa will be immediately followed with intermittent groundcover plantings in each 10' x 10' perimeter of either `uala cuttings, mamaki seedlings, or other natives depending upon site location.

After 1 year, additional plantings of 2-4 mid-story seedlings will be included within each 10' x 10' perimeter. As in Koa plantings, an area of approximately three feet in radius will be cleared, and holes will be dug by hand.

Weeding is expected to be necessary in years two and three after planting, and definitely will be required until plantings are well established.

Feral pigs in the area are currently being controlled by local pig hunters who have hunted in Kalihi Valley for many years.

**Irrigation** – A rainfall catchment system will be installed above the lower elevation reforestation areas to allow watering in of seedlings and occasional irrigation during summer drought periods. Small catchment systems like those at Hono`uli`uli may be installed for the upper elevation areas if it is determined they are necessary after the first year of plantings. These areas will be planted in the rainiest season or mid-winter.



**Fertilization and Soil Amendments** – Soil tests show that phosphorus fertilizer will be helpful for koa and mid-story tree plantings. A wide variety of vegetation thrives within this soil and climate, and all plants to be utilized in this project have been selected for their adaptability within the Kalihi Valley environment so rates should be minimal and will follow the recommendations of the UH Diagnostic Lab Services. Seedlings will be fertilized in the nursery as necessary.

For groundcover plantings, a one-time treatment of 15-15-15 fertilizer will be used to help cuttings in their initial establishment and to promote greater leaf and vine growth.

Mulch from chipped alien trees in the area will also be applied as a weed suppressant and to provide additional organic material to the soil.

**Archeological Sites in Reforestation Area** – There will be no structural disturbance and minimal soil disturbance around all archeological sites in the reforestation area. Plantings of new seedlings and groundcovers will all be done at a sufficient distance from these sites. KKV is working closely with the Department of Land and Natural Resources to follow all regulations regarding protection and preservation of these cultural resources.

**Number of Seedlings Anticipated (may vary in some areas depending on existing species)**

<u>Overstory</u>	
Koa	4,788
<u>Mid-Story</u>	
‘Ohi’a	1,000
Lama	1,000
Ie’ie	1,000
Alahe’e	1,000
Papala kepau	1,000
Ti	2,770
‘Ahahea lau li’i	1,000
‘Akoko	1,000
‘Uki’uki	1,000
‘A’ali’i	1,000
Manono	1,000
Ho’awa	1,000
‘Akia	1,000
‘Akala	1,000
Koki’o ke’oke’o	1,000
<u>Groundcovers</u>	
‘Uala	32,000
Mamaki	2,000
Palapalai	1,522
Kupukupu	1,522
Hapu’u pulu	1,522

Naio 1,522

**Planting Schedule** – The Table below outlines the planting schedule for each of the different forest tiers. Reforestation activities during the first four years will take place in the plateaus. Reforestation activities during the next four years will take place in the gullies. Reforestation in the final two years will take place along the trail corridor.

YEAR	KOA	MID-STORY	GROUNDCOVERS PHASE I	GROUNDCOVERS PHASE II
1	435/acre 870 total		2,000/acre 4,000 total	
2	435/acre 870 total	1,306/acre 2,612 total	2,000/acre 4,000 total	
3	435/acre 870 total	1,306/acre 2,612 total	2,000/acre 4,000 total	
4	435/acre 870 total	1,306/acre 2,612 total	2,000/acre 4,000 total	435/acre 870 total
5	109/acre 218 total	1,306/acre 2,612 total	1,750 acre 3,500 total* *3,000 'uala 500 mamaki	435/acre 870 total
6	109/acre 218 total	653/acre 1,306 total	1,750 acre 3,500 total*	435/acre 870 total
7	109/acre 218 total	653/acre 1,306 total	1,750 acre 3,500 total*	435/acre 870 total
8	109/acre 218 total	653/acre 1,306 total	1,750 acre 3,500 total*	435/acre 870 total
9	109/acre 218 total	653/acre 1,306 total	1,000 acre 2,000 total	435/acre 870 total
10	109/acre 218 total	270/acre 540 total	1,000 acre 2,000 total	435/acre 870 total

## 2. Soil and Water Protection and Improvement

These practices will focus on maintaining or improving the productivity of the forest soils and preventing erosion of forest land within the native reforestation area. Strategies will include the use of native soil protecting plants in critical areas prone to erosion and maintaining existing water diversion channels in reforestation areas. The protection and improvement of soil and water throughout the reforestation area is an integral aspect of the Native Species Restoration and Habitat Improvement objective above and the Forest Recreation Enhancement objective below.

### **3. Forest Recreation Enhancement**

Forest recreation enhancement will involve the development of hiking trails and walking paths throughout the Kalihi Valley Nature Park supporting increased recreational and educational uses.

A network of interconnecting hiking trails will be created over the 12 acres within the 100 acre site. Some of these trails will be less strenuous and relatively flat. Some trails will be designed to allow bicycle riding. It is likely that these trails will be mulched or gravel paved to minimize slippery and muddy conditions. Trails will lead people to sites of interest on the property including archaeological sites and camp ground area. Access to the top of Kamaikai ridge will be established by the construction of a switchback trail that climbs the southern slope. Trails will be developed and maintained to the standards created by the State Na Ala Hele program.

Trails will be built by hand, 3 feet wide and with a grade of not more than 10% except on the steep upper ridges. Power wheelbarrows or tractors may be used for the hauling of gravel. Clearing will be done 3 feet on each side of the trail with 7 foot vertical clearance. Exceptions may be made when required by topography or where native species or other considerations make such exceptions necessary or desirable.

Care will be taken to remove water build up from the trail. Trail surface will be slightly sloped to the outside of the trail and waterbars will be provided as necessary. Most importantly, trails will be physically located to provide good drainage. If it is necessary for a trail to cross an archeological feature, steps will be taken to protect the feature from damage. Sign posts will be constructed on all trail intersections and at points where the direction of the trail may not be clear.

### **4. Human Resources**

To successfully implement this project throughout the ten-year time period a variety of skilled and unskilled labor is needed. Skilled labor needed for the project includes both Kokua Kalihi Valley staff and a few contracted consultants involved with heavy equipment operation and professional tree cutting. Kokua Kalihi Valley staff involved in this project includes the Active Living by Design Program Coordinator, recently hired Park Arborist, and the Kalihi Valley Nature Park Caretaker. These staff will be responsible for coordinating volunteers and school groups, scheduling and organizing work days, purchasing supplies and materials, collecting and propagating seeds, selecting and hiring consultants, record keeping and report writing.

The majority of site prep work for this project will be accomplished by staff. Planting will be done primarily by volunteers. Kokua Kalihi Valley has already secured over 4,000 hours of volunteer labor at the Kalihi Valley Nature Park for structural renovation, site clearing and initial trail building activities. So far, volunteer groups have included the Kalakaua Lion's Club, the U.S. Army, Kuhio Park Terrace Teen Club, the Sierra Club, Hawaii Trail and Mountain Club, Boy Scouts, Kaiser Permanente, Farrington High School biology classes, Radford High School Peace Club and the KKV Chuukese Women's Gardening group. Two schools in the area, Halau Lokahi Charter School and Farrington High School, have adopted the Nature Park as a regular

site for outdoor science and cultural learning activities. They will be involved in all reforestation efforts and will be including an average class size of 15-20 students each month.

As the Nature Park and Active Living Center continues to develop as a natural and cultural resource in the community, additional volunteers and schools in the area are anticipated. Publicity continues to grow, support from the Kokua Kalihi Valley Health Center is extremely strong, and there continues to be a high degree of interest throughout Hawaii for environmental projects that promote sustainable development and cultural appreciation.

## VI: PRACTICE IMPLEMENTATION SCHEDULE

### Year 1

Practice Component	Units	Cost/Unit	Total Cost	Land Owner Share	State Share
Management Plan	1 Plan	\$6,400	\$6,400	\$1,600	\$4,800
Special Areas*	6 acres	10,000	\$62,000	\$32,000	\$30,000
Site Preparation	2 acre	2000	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling (plus \$2000 greenhouse const.)	\$5,045	\$3,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Trail Construction	5280 feet	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Irrigation	Catchment	30,000	30,000	15,000	15,000
<b>TOTALS</b>			<b>\$144,845</b>	<b>\$72,823</b>	<b>\$72,022</b>

### Year 2

Practice Component	Units	Cost/Unit	Total Cost	Land Owner Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Special Areas*	6 acres	10,000	\$60,000	\$30,000	\$30,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	4 acres	\$250/acre	\$1,000	\$500	\$500
<b>TOTALS</b>			<b>\$105,445</b>	<b>\$52,723</b>	<b>\$52,722</b>

Year 3

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Special Areas*	6 acres	10,000	\$60,000	\$30,000	\$30,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	6 acres	\$250/acre	\$1,500	\$750	\$750
Streambank Restoration	2 acres	\$10,000/acre	\$20,000	\$10,000	\$10,000
<b>TOTALS</b>			\$125,945	\$62,973	\$62,972

Year 4

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	8 acres	\$250/acre	\$2,000	\$1,000	\$1,000
<b>TOTALS</b>			\$46,445	\$23,223	\$23,222

Year 5\*\* (Please see note below)

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	10 acres	\$250/acre	\$2,500	\$1,250	\$1,250
<b>TOTALS</b>			\$46,945	\$23,473	\$23,472

Year 6

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	12 acres	\$250/acre	\$3,000	\$1,500	\$1,500
TOTALS			\$47,445	\$23,723	\$23,722

Year 7

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	14 acres	\$250/acre	\$3,500	\$1,750	\$1,750
TOTALS			\$47,945	\$23,973	\$23,972



Year 8

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	16 acres	\$250/acre	\$4,000	\$2,000	\$2,000
TOTALS			\$48,445	\$24,223	\$24,222

Year 9

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	18 acres	\$250/acre	\$4,500	\$2,250	\$2,250
TOTALS			\$48,945	\$24,473	\$24,472

Year 10

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	20 acres	\$250/acre	\$5,000	\$2,500	\$2,500
TOTALS			\$49,445	\$24,723	\$24,722

**\*Special Areas-** Large senescing, dangerous albizzia and rapidly spreading Chinese banyan trees need to be removed in the first three years from most of the area to make them safe for reforestation and trail construction. Removal is expensive and requires the services of a certified arborist.

\*\* After Year 5, practice rates (cost/unit) will be increased to reflect updated hold-down rates after they are approved.

### Cost Justification

Higher cost rates have been used in this budget for Site Preparation and Planting. This is due to the extremely overgrown quality of the forest environment where reforestation efforts are planned, for the hilly terrain and side ridges that limit vehicular access and increase access time by foot, and for the aggressive number of reforestation seedlings and cuttings that are being planned for planting activities.

## VII. Budget Summary

Year	Total	Land Owner Share	State Share
1	\$144,845	\$72,823	\$72,022
2	\$105,445	\$52,723	\$52,722
3	\$125,945	\$62,973	\$62,972
4	\$46,445	\$23,223	\$23,222
5	\$46,945	\$23,473	\$23,472
6	\$47,445	\$23,723	\$23,722
7	\$47,945	\$23,973	\$23,972
8	\$48,445	\$24,223	\$24,222
9	\$48,945	\$24,473	\$24,472
10	\$49,445	\$24,723	\$24,722
	\$711,850	\$356,330	\$355,520

## VI. PRACTICE IMPLEMENTATION SCHEDULE

### Year 1

Practice Component	Units	Cost/Unit	Total Cost	Land Owner Share	State Share
Management Plan	1 Plan	\$6,400	\$6,400	\$1,600	\$4,800
Special Areas*	6 acres	10,000	\$62,000	\$32,000	\$30,000
Site Preparation	2 acre	2000	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling (plus \$2000 greenhouse const.)	\$5,045	\$3,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Trail Construction	5280 feet	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Irrigation	Catchment	30,000	30,000	15,000	15,000
<b>TOTALS</b>			\$144,845	\$72,823	\$72,022

### Year 2

Practice Component	Units	Cost/Unit	Total Cost	Land Owner Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Special Areas*	6 acres	10,000	\$60,000	\$30,000	\$30,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	4 acres	\$250/acre	\$1,000	\$500	\$500
<b>TOTALS</b>			\$105,445	\$52,723	\$52,722

Year 3

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Special Areas*	6 acres	10,000	\$60,000	\$30,000	\$30,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	6 acres	\$250/acre	\$1,500	\$750	\$750
Streambank Restoration	2 acres	\$10,000/acre	\$20,000	\$10,000	\$10,000
TOTALS			\$125,945	\$62,973	\$62,972

Year 4

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	8 acres	\$250/acre	\$2,000	\$1,000	\$1,000
<b>TOTALS</b>			\$46,445	\$23,223	\$23,222

Year 5\*\* (Please see note below)

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	10 acres	\$250/acre	\$2,500	\$1,250	\$1,250
<b>TOTALS</b>			\$46,945	\$23,473	\$23,472

Year 6

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	12 acres	\$250/acre	\$3,000	\$1,500	\$1,500
TOTALS			\$47,445	\$23,723	\$23,722

Year 7

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	14 acres	\$250/acre	\$3,500	\$1,750	\$1,750
TOTALS			\$47,945	\$23,973	\$23,972

Year 8

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	16 acres	\$250/acre	\$4,000	\$2,000	\$2,000
TOTALS			\$48,445	\$24,223	\$24,222

Year 9

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	18 acres	\$250/acre	\$4,500	\$2,250	\$2,250
TOTALS			\$48,945	\$24,473	\$24,472



Year 10

Practice Component	Units	Cost/Unit	Total Cost	LO Share	State Share
Site Preparation	2 acres	\$2,000/acre	\$4,000	\$2,000	\$2,000
Seedling Acquisition	2 acres @ 435 seedlings per acre	\$3.50/seedling	\$3,045	\$1,523	\$1,522
	2,000 cuttings per acre	\$.50/cutting	\$2,000	\$1,000	\$1,000
Planting	2 acres	1000/acre	\$2,000	\$1,000	\$1,000
Ground Cover Establishment	2 acres	2000/acre	\$4,000	\$2,000	\$2,000
Weed Control and Mulching	2 acres	\$600/acre	\$1,200	\$600	\$600
Fertilization/Soil Amendments	2 acres	\$500/acre	\$1,000	\$500	\$500
Trail Construction	5,280 ft.	\$5.00/ft.	\$26,400	\$13,200	\$13,200
Trail Signs	4 signs	\$200/sign	\$800	\$400	\$400
Tree Protection (control pigs)	20 acres	\$250/acre	\$5,000	\$2,500	\$2,500
TOTALS			\$49,445	\$24,723	\$24,722

**\*Special Areas-** Large senescing, dangerous albizzia and rapidly spreading Chinese banyan trees need to be removed in the first three years from most of the area to make them safe for reforestation and trail construction. Removal is expensive and requires the services of a certified arborist.

\*\* After Year 5, practice rates (cost/unit) will be increased to reflect updated hold-down rates after they are approved.

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Higher cost rates have been used in this budget for Site Preparation and Planting. This is due to the extremely overgrown quality of the forest environment where reforestation efforts are planned, for the hilly terrain and side ridges that limit vehicular access and increase access time by foot, and for the aggressive number of reforestation seedlings and cuttings that are being planned for planting activities.

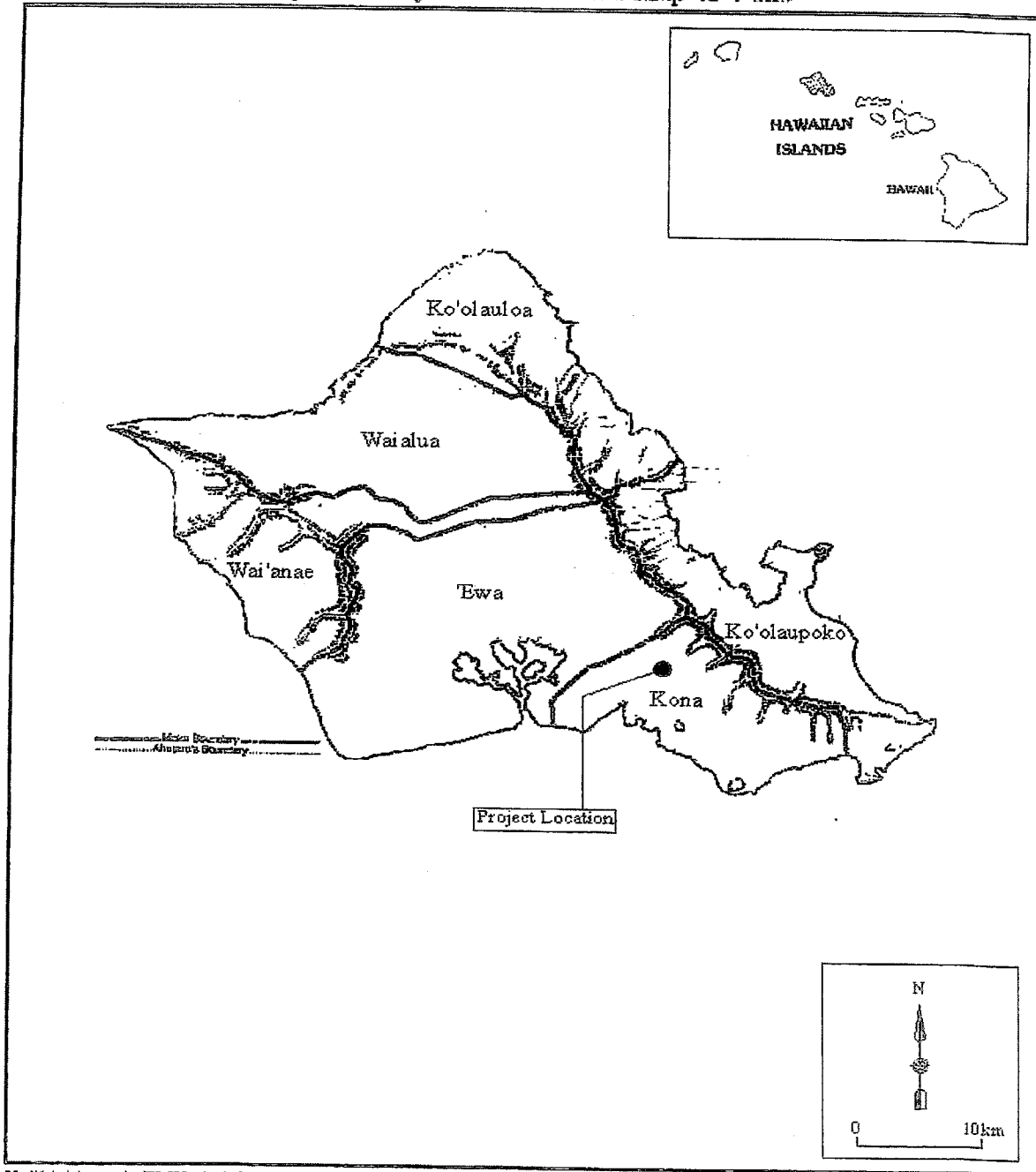
## VII. Budget Summary

Year	Total	Land Owner Share	State Share
1	\$144,845	\$72,823	\$72,022
2	\$105,445	\$52,723	\$52,722
3	\$125,945	\$62,973	\$62,972
4	\$46,445	\$23,223	\$23,222
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8	\$48,445	\$24,223	\$24,222
9	\$48,945	\$24,473	\$24,472
10	\$49,445	\$24,723	\$24,722
	\$711,850	\$356,330	\$355,520

## VIII. ATTACHMENTS

### 1. Location Map

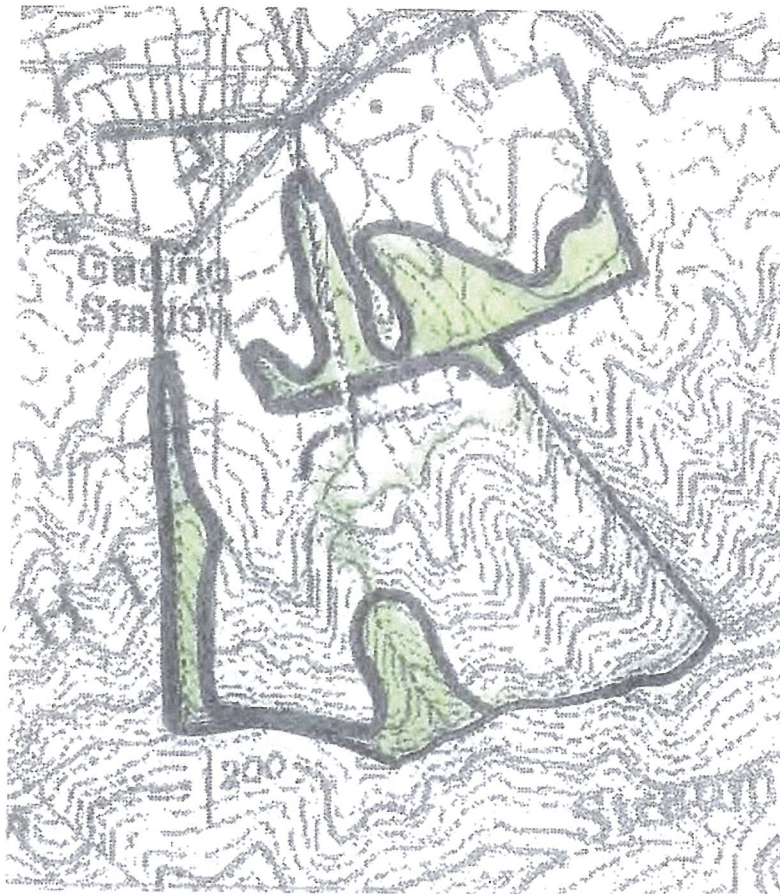
Figure 1: Project Location on a Map of O'ahu



Kalihi Ahupua'a TMK: 1-4-14: 01 & 26 and 1-4-16: 03

source: Adapted from Nogelmeier in Snakenberg 1990

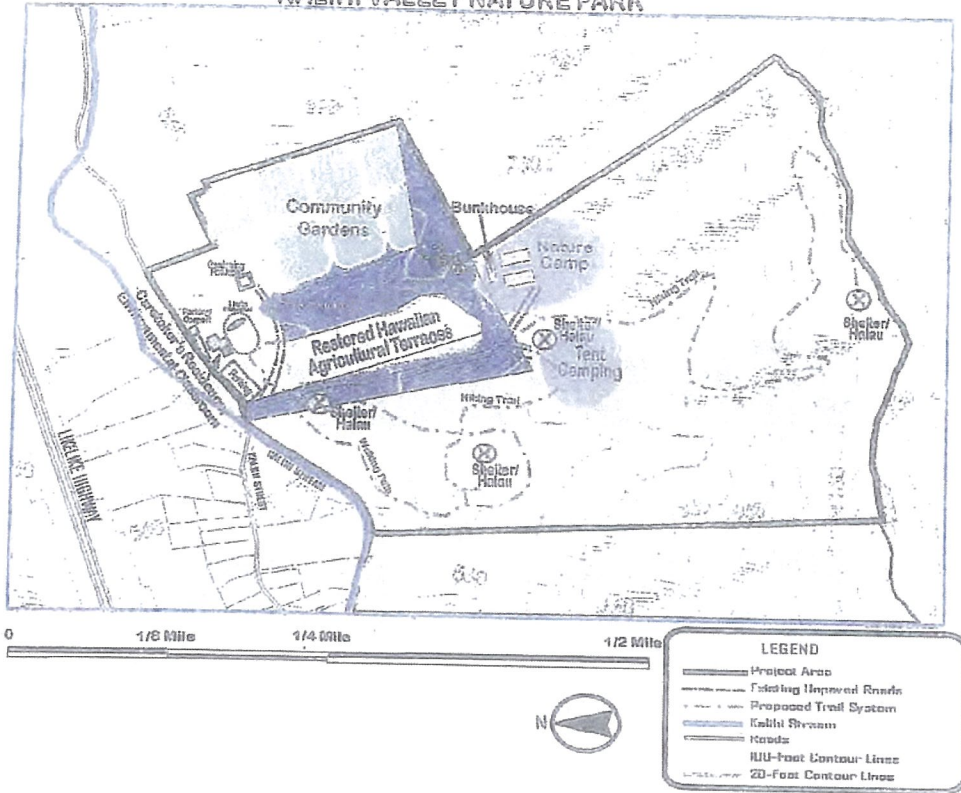
## 2. Topographic Map



### **KALIHI VALLEY NATURE PARK FOREST STEWARDSHIP AREAS**

Stewardship areas are highlighted in yellow.  
Trails are marked with dotted lines highlighted in yellow.

PRELIMINARY MASTER PLAN MAP OF THE ACTIVE LIVING CENTER  
KALIHI VALLEY NATURE PARK



# **Koa ‘Aina**

*“Restoring Health and Balance to  
Kalihi's Watershed and Native Upland Forest”*

An Updated Native Reforestation Project of

**Ho‘oulu ‘Aina**

Kalihi Valley Nature Preserve

**KOKUA KALIHI VALLEY COMPREHENSIVE FAMILY SERVICES**

This plan was developed for and with the support of the

**Forest Stewardship Program**

**Department of Forestry and Wildlife**

**State of Hawai‘i, Department of Land and Natural Resources**

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## **I. COVER SHEET**

Name: Kokua Kalihi Valley Comprehensive Family Services

Address: 2239 North School Street  
Honolulu, HI 96819

Email: [aina@kkv.net](mailto:aina@kkv.net) or [dderauf@kkv.net](mailto:dderauf@kkv.net)

Phone: 808-791-9400 or 808-841-7504

Fax: 808-845-9905

TMK No.: 1-4-014:026, 1-4-014:001, 1-4-016:003

State Land Use Classification: Urban and Conservation

County Zoning Designation: P1 and P2 General Preservation

Total Acreage: 99.65

Stewardship Management Area: 20 acres

Date of Plan Revision: 3/31/2015

This document revises an original document prepared with the assistance of Bill Sager, Forestry Consultant.



**II. SIGNATURE PAGE**

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

Prepared by: RISHANN JACKSON  
Professional Resource Consultant's Name

Professional Resource Consultant's Signature: [Handwritten Signature]

Date:

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

Prepared for: JO AYERS  
Applicant's Name

Applicant's Signature: [Handwritten Signature]

Date: 8/5/2015

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

Approved by: Galen K. Kawakami, Acting Administrator  
State Forester's Name

State Forester's Signature: [Handwritten Signature]

Date: 5/13/2015

Forest Stewardship Advisory Committee Approval: This plan was reviewed and approved by the Forest Stewardship Advisory Committee on May 29, 2015

Date of approval

### III. INTRODUCTION

#### 1. General Property Description

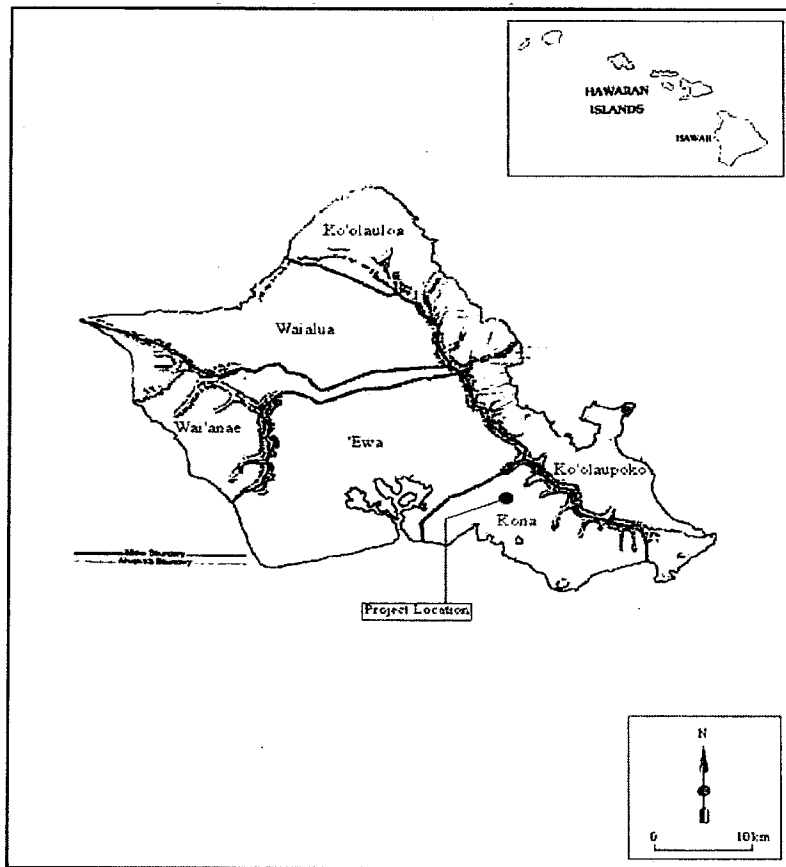
##### A. Property size and location

The Kalihi Valley Nature Preserve is located on 99.65 acres of land at the mauka end of the Kalihi ahupua'a on the island O'ahu. The property stretches from the center of Kalihi Stream to the top of Kamañaki Ridge. The 'ili of Maluwai and a portion of the 'ili of Ouaua combine to make the preserve site.

This location has cultural, social, and historical significance for the community of Kalihi and all of Hawai'i. Hawaiian tradition places the home of Papahānaumoku (the Earth Mother) and Wakea (Sky Father) at Kilohana peak in the back of Kalihi valley. Travelers in ancient times would have passed through the property on pilgrimages to Kilohana to honor these cosmological ancestors.

Today, the site is very near urban Honolulu, which makes it ideal for people from all walks to access, learn about, and participate in native forestry and watershed protection. Directly makai of the site lie private residences on either side of Kalihi Street up unto the property itself, but mauka of the site remains undeveloped watershed and forestland.

Figure 1: Project Location on a Map of O'ahu



Kalihi Ahupua'a TMK: 1-4-14 01 & 26 and 1-4-16 02

source: Adapted from Nogelmeier in Snakenberg 1990

**B. Description of access routes to property and physical assets/structures**

Access to the site is at the mauka end of Kalihi Street, past the last wooden bridge. Two driveways provide varying degrees of access to the property. The driveway at 3659 Kalihi St. has been improved and allows access to a small gravel parking lot and the main building facilities on property. A long driveway at 3635 Kalihi St., leading to the upper portion of the property and the former mauka nursery site, is semi-improved with recycled concrete, largely eroded, and only accessible by four-wheel drive.

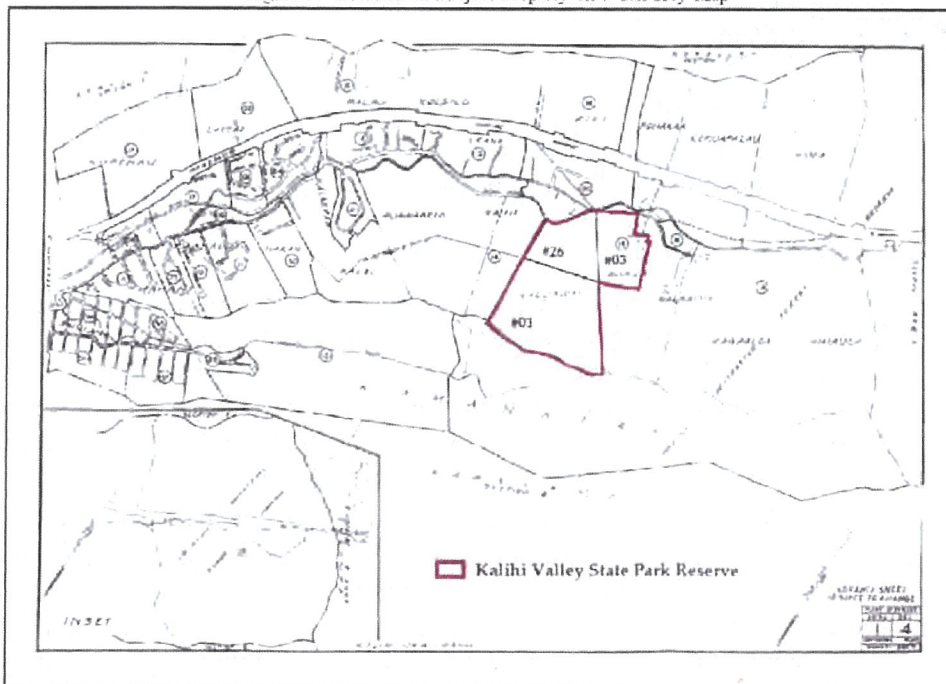
At the inception of the project, the 100-acre site included two residential structures, the remains of facilities from a defunct nursery operation, and many ancient agricultural terraces. The lower elevation of the site was covered by introduced species while some native plants remain nearer the Kamaikai ridge summit. Reflecting the long history of degradation, parts of the property remained littered with old, rusting abandoned vehicles, car parts, trash, and nursery equipment.

Since 2006, Ho'oulu 'Aina, Kokua Kalihi Valley Comprehensive Family Services (HA/KKV) has worked to restore a healthier balance between the native and invasive plants of both upland and lowland forest, removed tons of metal and abandoned junk and equipment, started restoration work on the agricultural terraces in Maluwai, and restored the residential structures to allow for community access and educational programming so that youth and other volunteers can engage in multi-day programs that support community-based forestry.

**C. Property tax map key**

Tax Map Keys: 1-4-014:0026, 1-4-014:001, 1-4-016:003

Figure 3 Location of Subject Property on a Tax Key Map



Kalihi Ahupua'a T.M.K. 1-4-14 01 & 26 and 1-4-16 03

source: Department of Taxation, Tax Maps Bureau 1932

#### D. Property zoning

State Land Use Classification: Urban (43 acres) and Conservation (57.65 acres)  
County Zoning Designation: P1 and P2 General Preservation

The portion of the site nearest to Kalihi Stream (about 42 acres) is designated as Urban by the state. Approximately 57 acres of up-slope land nearest the crest of Kamaikai Ridge are designated as Conservation land and therefore more restricted for land use change due to zoning laws. The City zoning of the site is Preservation (P1 and P2) consistent with park lands on O'ahu.



Figure 2: Zoning map of Kalihi Nature Preserve. The lower 44 acres zoned P2 is also in the state Urban District. The P1 zoned area is in the state Conservation District.

#### E. Topography, elevation and climate

The rain of the valley is called Ko'ilipilipi, named 'sharp adze' for its cold and constant presence. Managing the hydrology of the site requires much attention, as the rain over years can tend to carve away at the soil and erode the hillsides. Portions of ancient, stone-lined irrigation systems remain intact, the most significant of which leads away from stone agricultural terraces, indicating the eroding or flooding potential of this rain. Kalihi Stream itself runs through a steep sided channel in places nearly 40 feet deep.

Immediately above the stream channel much of the project site is relatively level, gently sloping land. Some of the land on the streamside of the property has been graded into wide terraces or excavated during the time of commercial nursery operations. A series of shallow gullies run generally perpendicular to the stream up to the valley ridge to the south. Slopes along the lower portion of these gullies are generally moderate and easily traversed. A wide plateau lies about halfway up the slope to the ridgeline. This is the site of the former nursery operation. Evidence of significant earth movement and grading are clearly visible

at this location. Above this plateau, the valley walls become steeper. The gullies climb to become narrow gulches stepping up with sheer rock cliffs and dry/ephemeral waterfalls. Steep side ridges reach up from the lower valley and intersect the top of Kamaikai Ridge.

The project site ranges in elevation from a low point of nearly 500 feet above sea level at the Kalihi Stream channel to a height of approximately 1,400 feet along the top of Kamaikai Ridge.

The overall climate of Kalihi Valley is typical of lands near the Ko'olau Mountains. Rainfall is moderately heavy in the area, averaging well over 100 inches annually at the BWS Kalihi Reservoir and the upper portions of the valley. The majority of precipitation occurs between November and April when winter storms add to trade wind rainfall. The traditional name of the wind is Haupe'epe'e, or 'hide-and-peek', known to swirl in and around the steep valley walls, appearing and disappearing playfully. However, predominant trade winds from the Northeast blow through the windward pass of the Ko'olau summit and down the valley toward Honolulu.

Temperatures in the uplands are consistently cooler than the nearest official recording site at Honolulu International Airport, which range between 70 and 84 degrees Fahrenheit. While nights on property have been recorded as low as 53 and days have reached into the low 90s, most experience the weather as cool and pleasant.

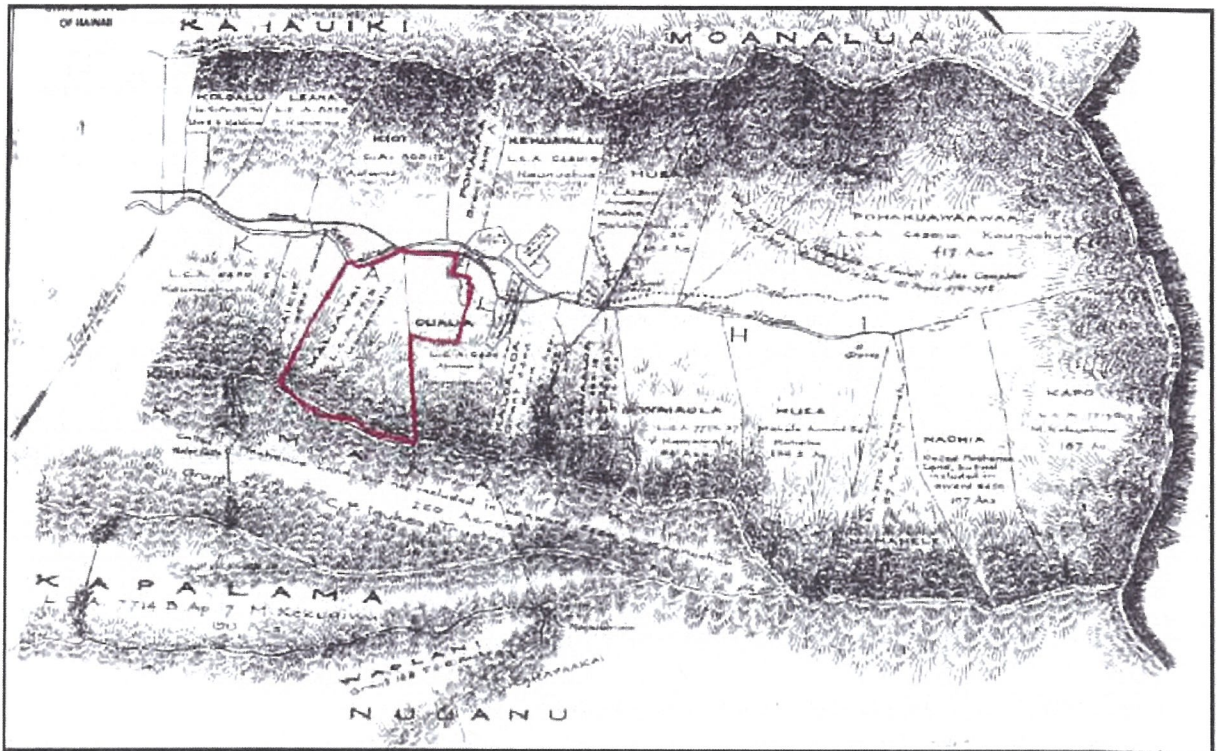
#### **F. Brief history of uses/description of present condition**

This region of Kalihi Valley was once intensively cultivated by Native Hawaiians, prior to western contact and continuing up until the early 1900s. Three complexes of stone-lined water channels and surrounding agricultural terraces remain in varying stages of (dis)repair. These stone features date from pre-historic times. An agricultural heiau is reported to have once been located not on, but nearby the park site. At the time of the Mahele, when land in the islands was first converted to private ownership, the 'ili of Maluwai was deeded to Kamamalu, the sister of King Kamehameha IV and V.

In historic times, the land was used for grazing cattle. By the mid-1800s, few trees stood in the valley floor and most of the property was grassland. In the later part of the 19<sup>th</sup> century and most of the 20<sup>th</sup> century, trees began to grow again in the area as a result of re-forestation efforts by the government and private landowners.

The property was passed down through family lines until it was sold in the early 1970s to a land developer. Inspired by a sense of community stewardship, Kalihi Valley residents advocated to protect the land from plans to build a gated, luxury home development. In response to these concerns, in 1980, the City and County of Honolulu purchased the 100 acres for a park. The parkland was subsequently conveyed to the State in a land exchange that concluded in 1997. Today, the State Parks Division, under the Hawai'i State Department of Land and Natural Resources, holds jurisdiction over the site. Unable to secure funding to develop a nature preserve, State Parks sought the involvement of private organizations to make the park a reality.

In 2004 Kokua Kalihi Valley Comprehensive Family Services (KKV) began discussions with State Parks to seek a long-term lease of the site for the purpose of finally bringing the park to life. In December of 2004, the Board of Land and Natural Resources approved a 20-year lease over the 99-acre parkland to KKV. The site is a unique example of partnership between State and non-profit organizations for the betterment of Hawai'i's people and natural environment.



Kalihi Ahiupua'a  
TMK 1-4-14: 01 & 26 and 1-4-16: 03

Source: Board of Agriculture and Forestry,  
map no O-33 1923  
(on file: Hawaii State Archives)

Figure 4: Subject Property on a 1923 Map of Upper Kalihi Valley

In 2005, KKV conducted community-based planning efforts to design the park in keeping with the expressed interest of Kalihi residents and parameters established by the state. The original Forest Stewardship plan was a byproduct of guidance by a community park planning committee and input by many members of the public. Ho’oulu ‘Aina, Kokua Kalihi Valley Comprehensive Family Services (HA), was established as the department of KKV charged with the management of the 100 acres.

For the last 7 years, under a program called Koa 'Aina, we have been clearing invasive weed trees, planting natives and other Pacific Island agroforestry plants, engaging community members and educational groups in the active reforestation, and employing an adaptive management approach with continued community and expert input. HA/KKV efforts have created and protected *kipuka* of native species on approximately 14 acres of the site. While large portions of the site remain largely overgrown with exotic species, the new plan proposes management practices developed and proven on site over the past 7 years to reduce the number of invasive exotic plants and increase the health and number of native species in managed areas.

Under the operation of HA/KKV, the park allows for safe public access as a place of quiet recreation, nature studies, health education and the preservation of Hawaiian culture. Since HA/KKV's management of the site, community engagement has significantly transformed in character. Prior to this, our people used the site as a rubbish dump and a place for sordid activities. In the last five years, the number of visitors and participants in restoring watershed and community health has risen to more than 100 visitors per week.

## 2. Project Vision and Goals

The primary goal of the Koa 'Aina project is to *restore balance to Kalihi's watershed and native upland forest*. Community members work together to cultivate and regenerate the Koa mesic forest that exists in Kalihi's historical descriptions and photos, in our ancient stories, and in the seed bank itself. The work involves preserving, propagating, establishing, and expanding existing Koa and other native and Polynesian Introduced (PI) species historical or appropriate to Kalihi valley. Community engagement in the work strengthens the long-term relationship between people and the forest.

On the 100-acre property, we are aiming to restore 20 acres in 10 years. This acreage goal is based on the high level of invasives and the steep nature of the terrain. Restoration will decrease the number and prevalence of the invasive species, and increase the number and vibrancy of native species in the targeted 20 acres, using the minimal but existing healthy, tiered, mixed native species forest examples on property as a model.

## 3. Description of specific management objectives

As part of HA's mission to *sustain and propagate the connections between the health of the land and the health of the people*, the Koa 'Aina project aims to *restore health and balance to Kalihi's watershed and native upland forest*. Our specific management objectives are:

- 1) **Native Species Restoration and Habitat Improvement:** Regenerate a native koa forest with a mixed understory of native and Polynesian introduced species on approximately 20-acres of the 100-acre Kalihi Valley Nature Preserve;
- 2) **Soil and Water Protection and Improvement:** Restore soil health and fertility to support reforestation and improve water quality through soil remediation and the prevention of erosion; and
- 3) **Community Forest Engagement:** Increase public engagement through volunteer, educational, and cultural programming to establish and foster an enduring stewardship relationship between the people of Kalihi and their forest.

## IV. LAND AND RESOURCE DESCRIPTION

### 1. Existing vegetation/cover types

Unmanaged forest below 800 feet is mostly dominated by naturalized alien tree species, with only small patches of native vegetation remaining. Much of the forest canopy is composed of albizia (*Falcataria moluccana*). Other common alien trees are rose apple (*Syzygium jambos*), gunpowder tree (*Trema orientalis*), black bamboo (*Phyllostachys nigra*), koka (*Bischofia javanica*), strawberry guava (*Psidium cattleianum*), common guava (*Psidium guajava*), shoebutton ardisia (*Ardisia elliptica*), ironwood (*Casuarina equisetifolia*), fiddlewood (*Citharexylum caudatum*), kukui (*Aleurites moluccana*), and Formosan koa (*Acacia confusa*). There are also some trees in the parcel that were planted in the early 1900's, but have not spread very much, such as the Cook pine (*Araucaria columnaris*), and eucalyptus (*Eucalyptus* sp.).

Above 700 ft. native plants within the alien forest are more frequently encountered. The native plants observed here include `ohi`a (*Metrosideros* spp.), koa (*Acacia koa*), hapu`u pulu (*Cibotium chamissoi*), `ie`ie (*Freycinetia arborea*), papala kepau (*Pisonia umbellifera*), mamaki (*Pipturus albidus*), lama (*Diospyros sandwicensis*), alahe'e (*Psydrax odorata*), and uluhe (*Dicranopteris linearis*). Polynesian introductions seen below 800 ft included kukui, kamani

(*Calophyllum inophyllum*), ti (*Cordyline fruticosa*), 'ohi'a 'ai (*Syzygium malaccensis*), coconut (*Cocos nucifer*), and hau (*Hibiscus tileaceus*; possibly native). A variety of ornamental plant species persists around abandoned nursery structures and residences.

The vegetation of the steep valley wall portion of the parcel is largely dominated by alien plant species, but a larger percentage of the vegetation here is native compared to the alien forest of the valley bottom portion. The native plants observed here were common mesic forest plants.

## 2. Existing forest health

Prior to western contact, the site was intensively used by Hawaiians for agriculture, as reported in Kalihi oral histories and evidenced by existing dry-stack stone irrigation and terracing. At that time, the valley floor was utilized for the production of native food crops. Like many Pacific island cultures, ancient Hawaiian agroforestry practices enhanced watershed balance and health, especially stream and water health.

In the past 200 years, the landscape was transformed by introduced farming and ranching practices, converting some lands into grasslands that persisted in that state until the early 1900's. During that time, the site was reforested with exotic tree species planted by the government and private landowners. An initial botanical survey found that no rare or endangered plants were found anywhere on the 100-acre park site. Subsequent surveys of upland forest areas and rock cliffs reveal many species of native and endemic plants. Even in the pervasive presence exotic trees and weeds throughout the property, the upper reaches of the valley walls remain home to native species such as Koa, 'Ohi'a, Lama, 'Ie'ie, Naupaka Kuahiwi, Papala Kepau, 'Ekaha, Palapalai, Hoe a Maui, and other cherished endemic species.

The noxious exotic weed miconia was introduced to the site by the previous nursery operation. In early years of KKV stewardship, crews of volunteers and staff worked intensively to remove found miconia from the site. While this invasive plant is intensely colonizing and continual monitoring and removal is necessary, recent surveys by the O'ahu Invasive Species Council indicate that this eradication effort has been widely successful. Other exotic flora such as albizia, rose apple, bamboo and clidemia that blanket the site are being removed and replaced by native plants in strategic, managed areas.

## 3. Soils and their conditions, general slope and aspect

Geologically, the Kalihi Valley Nature Preserve site is situated in a very old valley eroded into the Ko'olau volcanic shield. Older alluvium underlies the floor and slopes of the valley. Younger Kalihi lava of the Honolulu Volcanic Series was deposited 450,000 years ago from vents in Kalihi and Kamanaiki Valleys. Kalihi Stream cut a channel and deposited stream terraces of younger alluvium. The slope of Kamanaiki Ridge on the southern half of the site is classified as rock land. Soil underlying the more gently sloping valley floor is classified as loleka'a silty clay.

## 4. Water resources and their condition

A. **Groundwater:** The project site overlies aquifers perched within the alluvium and Kalihi basalt. Rainfall over areas underlain by Ko'olau basalt infiltrates deeply into the volcanic rock of Oahu to recharge dike-confined aquifers and the basal aquifer water. An average of approximately 10 million gallons of water each day enters the Kalihi groundwater system. Both the perched and basal aquifers are tapped as drinking water sources for Honolulu. There are 10 drinking water wells currently operated by the Honolulu Board of



Water Supply (BWS) in the Kalihi area and two by Kamehameha Schools in the basal aquifer. BWS also has an artesian perched well above the park site. The sustainable yield of the Kalihi aquifer is estimated by the Commission on Water Resource Management to be 9 million gallons per day. The average pumpage from the Kalihi system is 9 million gallons per day.

**B. Surface Water:** Kalihi Stream flows perennially along the northern boundary of the project site. The average stream flow of Kalihi Stream is 7.3 mgd but minimum flow may fall below 0.5 mgd in dry years. Upstream of the project site, the stream drains the relatively undeveloped Kalihi watershed. The watershed is host to the Likelike Highway, a major transportation corridor between windward O'ahu and Honolulu's downtown. Old Kalihi Street also penetrates the watershed and serves the BWS reservoir and water pipelines. Negative impacts on stream water quality in this upper region include alien plants and animals that hinder the ability of the land to absorb rainwater and increase muddy runoff into the stream. During heavy rain events, flow increases dramatically and stream water typically becomes brown and turbid. Kalihi Stream flows down slope through residential and industrial districts of Honolulu to meet the sea at Ke'ehi Lagoon. Kalihi Stream has been listed as an impaired water body by the State Department of Health under the provisions of the federal Clean Water Act.

The site includes 4 gullies that host small fresh water seeps or springs. Each spring sends its water trickling down slope and into Kalihi Stream. Additionally, a system of 'auwai exists on site. While some of these traditional irrigation and drainage channels are in good repair (and retain their dry stack stone structures), most were not preserved. Understanding the implications of surface water quantity and quality for watershed function and water quality downstream and in the Ke'ehi Lagoon estuary, KKV/HA has engaged with a hydrologist to design a water restoration plan for the property. The hydrological and cultural functions of the 'auwai system (important to taro cultivation in Kalihi Valley) inspired KKV/HA to enlist the support of a master stone mason from Hawai'i Island who assists in the repair of irrigation channels (and agricultural terraces for taro) and train staff and Kalihi community members in the stone building techniques.

## **5. Timber resources**

Invasive species removed during reforestation will be repurposed where possible. This repurposing may create forest products for onsite uses, as well as value added products that may be sold to build sustainable funding streams for the project. Sales of such products would first require review and approval from DLNR.

As the objectives of the project protect the existing native woods from being harvested, wood resources available within the preserve site are limited to the predominant alien exotic species mentioned above. Of these, the albizia is being utilized as a resource for the making of canoes for educational and cultural purposes. Any other wood available from alien species removed will be used on site for purposes such as facility repair, carving education, benches, signs, and shelters. Examples of other invasive timbers to be considered for repurposing include koka (*Bischofia javanica*), ironwood (*Casuarina equisetifolia*), guava spp, and rose apple (*Syzygium jambos*).

## **6. Wetland resources**

No significant wetland resources exist on site

## **7. Significant historic and cultural resources**

Celebrated as the dwelling place of the original male and female progenitors of the Hawaiian race, Wakea and Papahānaumoku, Kalihi valley holds a prominent place in Hawaiian cosmological narratives. The close proximity of the Project site to the urban center of Honolulu makes it an accessible and significant resource recalling the former agricultural foundations and cultural history of the area.

The site contains numerous archeological structures that are presumed to date to pre-historic times. These structures include a network of stone-lined irrigation channels and agricultural terraces that bear witness to the long history of agricultural use in Kalihi Valley. A grant from the Office of Hawaiian Affairs (OHA) partly funds the restoration of these stone structures, as well as training to propagate knowledge of dry-stone stack techniques among KKV/HA staff and the Kalihi Valley community.

With the intent to protect such cultural resources, access to portions of the property by heavy equipment is restricted. Backhoe and excavator access for clearing and moving large slash and debris is limited to areas already highly impacted by nursery activities of the 1960s and 70s. Management practices surrounding dry-stack stone terraces and irrigation channels as well as deeper gullies and intermittent streambeds depend on many hands for clearing, passing, cutting, etc. At most, hand-held machinery is limited to chainsaws, weed eaters and augers.

HA/KKV has worked closely with the Department of Land and Natural Resources to follow regulations regarding protection and preservation of these cultural resources, including an archeological survey in 2005. These sites are being restored with the support of master stone builders training and working together with staff and community members through grants from the Office of Hawaiian Affairs and the Hawai'i Tourism Authority. Included in these grants is funding to restore the surrounding forest supplementing the current FS funding. The overall objective is to restore not only the site itself, but also the knowledge of stone building in the valley. This work impacts the cultural, ecological, and socio-economic value of forestry in communities through the training and educational engagement of students from youth planting and weeding activities to graduate student field evaluators contributing to an indigenous evaluation system which links native reforestation efforts to community investment and cultural engagement.

## **8. Threatened and endangered species existing on property**

No listed endangered or threatened native plants or any other rare native plants were found during a botanical reconnaissance in June 2005. This was not unexpected, given the long history of alteration and destruction of native vegetation of the valley bottoms in the Honolulu area in pre-Western times up until today. There is little potential for the discovery of rare plants that may have been missed on this reconnaissance based on the documented patterns of occurrence of rare and endangered native plants in the valleys in the Honolulu area.

The potential for the discovery of rare plants is greater in the valley wall part of the property than in the valley bottom portion. These upper elevations would require further survey for rare and endangered plants should any park development be planned there.

The predominant exotic plant forest in the valley bottom is not known to provide habitat for any native animal. The higher slopes of the Ko'olau Range provide habitat for the Hawaiian forest bird, 'elepaio. To date there have not been any recorded 'elepaio sightings at the Preserve, but as more native *kipuka* are secured through the native reforestation efforts, there is hope that birds sighted in neighboring valleys may return to the site.

Alien animal species that are known to inhabit the park property include a wide range of introduced bird species such as thrushes, doves, mynahs and finches. Feral pigs, mongoose, rats, and wild chickens are known to live on the property. A colony of Australian Brush-Tailed Rock Wallaby has been established nearby and there is evidence that some wallabies visit the park site. Introduced mosquitoes are common at the park site, multiplying in great numbers in the dark, wet forest environment.

### 9. Existing aesthetic values

In 2005, KKV/HA raised and invested over \$200,000 in funds and over 2,000 hours of volunteer community labor, with the support of a Robert Wood Johnson Active Living grant, to convert a 3-bedroom 1930's residence, attached studio, courtyard and surrounding grounds within the 100-acre preserve site into a welcoming center. The Ho'okipa Center now includes the building structure and surrounding gardens and gathering tent and is the central meeting point and program headquarters for all the environmental, health, educational and related activities being developed throughout the 100-acre nature preserve.

A 'bunkhouse', located on the upper slope of the park site near the abandoned nursery operation had fallen into disrepair. In keeping with the obligation of the lessee to repair and maintain all facilities on site, KKV/HA has partnered with the University of Hawai'i School of Architecture and Citizen Architecture community groups to make the bunkhouse safe and usable again. The space will be used by groups seeking a multi-day experience for forest restoration, malama 'aina, and sustainability experience and education. In the restoration work, every effort was made to reflect conservation principles: recycled materials were used when possible, grey water is reused, an earthen floor was utilized, and albizia was even used for detail treatments (e.g., entryway pavers, kitchen counter tops, etc.).

## V. MANAGEMENT OBJECTIVES AND PRACTICES

KKV/HA will utilize a community-based, adaptive-management approach to do reforestation. This approach calls for 1) wide *engagement* of large numbers of community members of all ages and skill levels and 2) careful *observation* and story-gathering among staff and community members to assess and adapt applied practices according to success indicators learned over time. The intent of this approach is to affect the sustainable health of the valley over generations, impacting the watershed beyond the time constraints of the given Forest Stewardship grant through community stewardship, engagement, education, and investment.

The three specific management objectives of this reforestation project are 1) **Native Species Restoration and Habitat Improvement**, 2) **Soil and Water Protection and Improvement**, and 3) **Community Forest Engagement**. These three objectives are described in more detail below.

### 1. Native Species Restoration and Habitat Improvement

**A. Forest Type Planned:** To the best degree possible and with the resources available, HA/KKV aims to restore a native forest specific to this place and time. The koa forest here in Kalihi valley is unique. We have found naturally occurring koa in every stage from

viable seed to immature leaflet seedlings to fully mature, seeding trees as low as 700 ft. elevation. Naturally occurring natives including koa, 'ohi'a, 'iliahi, lama, uluhe, 'ie'ie, papala kepau, naupaka kuahiwi, maile, mamaki, hala, kalo, moa, kupukupu, palapalai, pala'a, and a'ea'e, though small in number, continue to survive. While no longer found naturally, pili grass at once had a strong presence in the valley as we learned from photographs and stories from elders from the valley.

The existing native species and those described in the valley's history are the foundation for the planned reforestation strategy. We supplement this list with other koa mesic natives based on availability of seed and seedlings of complimentary species. These include koki'o ke'oke'o, 'ohe makai, ha'uo'i, and ko'oko'olau. The existing forest is overwhelmingly invasive, and it is our intention to slowly shift the balance to allow for thriving natives.

#### **B. Arrangement in Landscape: The Wao Akua and the Wao Kanaka.**

- 1. The Wao Akua:** Most of the existing natives on property are in deeper pockets and ridgelines of the Wao Akua, which occurs around 900 ft elevation and above. Generally, plants like mamaki and moa are found in the pockets and 'ohi'a, 'iliahi, and maile are found along the ridgelines. While the 'ohi'a and koa still stand majestically over rolling uluhe, and the 'ie'ie hold fast their ground-crawling band around the mountain, invasives such as the enduring Christmas berry, the monocropping strawberry guava and clydemia, the spring-tapping banyan, the monster albizia, and the ever-notorious miconia are slowly dominating.

The Wao Akua will comprise 10 of the 20 acres planned for management and restoration. To restore and protect the Wao Akua, we employ two strategies:

- 1) Identify and manage existing, thriving natives and native ecosystems, and protect and enhance the kipuka in which they are thriving by reducing the surrounding, aggressive invasives and planting more natives. This strategy employed on 2.5 of HA's upper-most acres, mostly along ridgelines.

- 2) Cut down large invasives such as banyan and albizia in a concentrated (one-half to two acre) area and employ techniques of the Wao Kanaka to 'hold' the area in kalo, sweet potato, or other space-holding plants until the Wao Akua species establish themselves, at which time the agricultural plants are to be harvested and a native/endemic understory can be established. This strategy employed on 7.5 acres.

- 2. The Wao Kanaka:** In the Wao Kanaka, we are battling a more aggressive invasive establishment. Here, the albizia, rose apple, clydemia, artesia, maile pilau, sprawling bamboo, and various grasses dominate the landscape. Our strategy for reclaiming this forest is to look to ancient planting systems of agroforestry. The large invasives are cut in concentrated areas. Native/endemic plants and trees are planted alongside and around more agricultural-style Pacific Island plants such as kalo, 'olena, and sweet potato. Agroforestry trees and mid story plants such as 'ulu, noni, 'ohi'a 'ai, ko'oko'olau, and 'olena help to secure a multi-level forest and healthy watershed, as well as provide food and medicine for the community while the slow-growing trees establish. Introduced species can be harvested for timber when appropriate, while endemic trees such as koa and 'ohi'a will be permanent. The Wao Kanaka will comprise 10 of the 20 acres planned for management and restoration.

## 2. Soil and Water Protection and Improvement

These practices focus on maintaining or improving the productivity of the forest soils and preventing erosion of forestland within the native reforestation area.

- A. Soil:** Strategies to prevent soil erosion include planting native soil protecting plants and building terraces made of logs in critical areas prone to erosion. These strategies maintain existing water diversion channels in reforestation areas.

The project has worked with UH soil scientist, Dr. Jonathan Deenik, to assess soil quality and fertility and determine appropriate action for amending soil. HA/KKV has entered into synergistic relationships with local arborists and tree trimming companies to create large-scale compost and mulching capacity. Green waste is brought to HA by local tree trimmers where it is later applied as mulch or compost for plantings and weed suppression. From 2010-2011 HA/KKV received quantities (each load was approximately 4 tons, and 2 deliveries were made per week for approximately one year) of invasive seaweed from the Malama Maunaloa project.

- B. Water:** With assistance from a hydrologist contracted through a grant from the Office of Hawaiian Affairs, HA/KKV is developing a water management plan to control water flow and erosion throughout the property. Recognizing that water quality mauka has significant impacts upon water quality throughout the watershed, notably the Kalihi Stream and the Ke'ehi Lagoon estuary, we continue to conduct restoration work along 'auwai and stream banks. Through a partnership with Kalihi Ahupua'a Ulu Pono Ahahui (KAUPA), HA/KKV supports the gathering of longitudinal water quality data with local school science teachers and students. This will enable HA to monitor the efficacy of soil and water management practices.

## 3. Community-Based Forestry Stewardship through Engagement

KKV/HA will increase public engagement through educational, cultural, and volunteer programming to ensure a durable stewardship relationship between the people of Kalihi and the forest of their home ahupua'a. Over the years, engagement has increased to hundreds of volunteers on a weekly basis, with the daily work focus depending on community needs (# of volunteers, time of year, etc). In the next five years, we expect that this engagement will continue to grow, and we have already witnessed much positive effect of this level of engagement in both the land and the people.

- A. Education:** We believe that increasing place-based awareness has long-term effects on the sustainability of forestry and other ecological endeavors, especially with the engagement targets children and families. With the many partnerships that KKV/HA has built with the schools and educational programs in Kalihi and beyond, Kalihi's watershed benefits from the volunteering of the students, and the students benefit from the hands-on learning experienced here in the valley. The potential of teaching and learning healthy forest management builds a sense of utility into local curricula in a manner that will serve both land and human for generations.
- B. Culture:** As Kalihi is the home to many Pacific islanders, and KKV/HA manages the nature preserve with a Hawaiian cultural grounding, native forestry allows for deep cultural sharing and learning. The struggle to establish and maintain a healthy forest is increasingly difficult throughout the Pacific, but Kalihi benefits from the support and input of many culturally grounded leaders from both Hawaiian and Micronesian cultures, such foresters

from such island groups as Palau and Pohnpei who are demonstrating leadership in Pacific island forestry management. These connections help the community connect beyond differences, also, and in this way forestry builds an opportunity for cultural peace-making in Kalihi, where cultural divides are often severe.

- C. **Volunteer:** Because Kalihi's community is generationally accustomed to growing food, medicine, and cultural plants in a forest setting, the Wao Kanaka component encourages community engagement in forest management and sets up long-term stewardship. This kind of volunteer engagement allows for more labor-intensive, organic practices such as hand-weeding and the avoidance of chemical pesticides, a practice less feasible without high levels of volunteership and community involvement. The reciprocal benefit is a healthier human community grounded in root cultures. Native philosophy teaches us, '*ai i kekahi, malama i kekahi*, encouraging us to harvest some now and leave some for the future. Volunteers are able to experience the natural reciprocity between land and human.

#### 4. Practices

Each of the forestry activities below fall under a category allowed for Forest Stewardship Cost Share. Over the past seven years, we have found that the total actual cost of the work is much higher than the allowable cost share rates. Please see the 'special consideration' sections under each practice for justification of higher costs.

##### A. Site Preparation

Site preparation is a staged process that can occur in one day or two months depending on the area, types of invasives, and level of engagement.

**Stage 1.** Primary site preparation involves clearing invasive trees such as albizia, banyan, tremma, fiddlewood, and rosey apple with chainsaws, power trimmers, and other hand tools. Hand clearing allows for more detailed and careful removal of invasives without damaging existing natives or those within the seed bank. It also allows for gentle clearing around sacred sites, steep inclines, and generally hard-to reach areas that cannot be accessed with machines. The intimacy of hand clearing provides the opportunity to train staff and the community in plant identification, while strengthening the relationship between the land and its care-giving community. The tilling action mechanical means of manual control can also provide the soil scarification needed to stimulate the seed bank. We have found this to be particularly effective with *koa*.

Taller trees with extensive canopies require tree climbers to first trim back and sometime top the trees before they can be dropped. Albizia trees with diameters larger than 2ft have been girdled in the past with some success. Overall signs of dying start after 2 to 3 years, with the loss of all leaves. After this stage, the areas around and below the tree become more dangerous and off limits to volunteers because of the sudden dropping of limbs and eventual dropping of the entire tree. For this reason, the girdling can only be employed in limited areas. As a side note, we have witnessed a remarkable regeneration of trees that have been girdled, the outer bark healing back over up to 4ft of deep girdle. In these instances, re-girdling has been required.

In some areas that contain large invasive trees and remnant "junk", a backhoe and/or excavator is used to effectively manage intense slash piles. The use of mechanical equipment only occurs in flat areas that have already been disturbed by previous land managers, avoiding any undisturbed areas where natives exist and where stone terracing

remain. Due to rental costs, this kind of clearing only occurs once a year during a focused effort of one month with machinery, with at least one month of follow-up to manage smaller slash.

**Stage II.** The Earth is prepared for planting by hand-weeding the last of the grasses and vines, picking out roots, and exposing the soil. This intense hand weeding and clearing effort calls for hundreds of man hours every month. To alleviate cost and to perpetuate longevity into the project, HA/KKV employs the use of volunteers. Each volunteer group is hosted and educated by HA/KKV staff to insure safety of plant and people. Volunteer engagement allows for hand-weeding with varied rates and outcomes. The time needed per square foot decreases with increased number and skill of volunteers. Experience with seeding rhythms allows for quicker, more effective hand weeding.

In the upper elevation forest where the Wao Akua is still thriving, site preparation involves careful clearing around existing natives to remove surrounding invasive trees and weed plants. We depend on hand clearing and constant care and involvement of volunteers, specifically in steep 'pocket' areas around streams and gullies, and in areas where dry-stack terracing and irrigation remain.

**Stage III. Woody residue treatment:** After cutting down unwanted alien trees, where practical, wood is chipped using a power chipper to create a weed suppressing, organic mulch on trails and around new plantings. Additional trees are piled in low, organized stacks for chipping, burning, or quick decomposition and to prevent the harboring and proliferation of harmful pests. Stacked logs can form terraces to prevent erosion of steeper areas until the establishment of planted and regenerated natives. Larger logs will be removed and repurposed. Forestry staff will take care to preserve the repurposable logs.

**Special Consideration:** The rental of an excavator for one month per year is crucial for moving the size of logs that our site preparation calls for, particularly for moving the albizia slash, which can produce logs up to 50 ft. long and 4-5 ft. in diameter. The height and canopy of the tree varieties call for professional tree trimmers, which we contract at least twice per year.

## **B. Tree and Shrub Establishment:**

Generally, planting can begin immediately after site prep is complete. In special cases when soil health is extremely depleted by trees such as bamboo or pine, a remediation period of 1 to 6 months will precede tree and shrub establishment.

### **1. Seedling Acquisition:**

- a. On-site:** Seeds and cuttings from seeding plants on property that occur naturally or have been planted within the last five years are gathered and propagated on property in on-site nurseries. Staff collect seeds in the Wao Akua twice a year. Hiking to upper regions of property for seed monitoring and gathering can be costly in terms of staff time. To alleviate cost, HA/KKV depends on reports of which species are in seed or flower from a partnering organization, the O'ahu Invasive Species Coalition, whose efforts focus on upper regions. New seedlings in the nursery are fertilized with biochar, fish-based organic 'crumbles', Natural Farming products such as EM or IMO, and sometime vermicast.
- b. Other sites or nurseries:** If seeds or stock material is not available on site, seedlings will be or purchased from a native plant nursery for either immediate out

planting or for further growth and hardening off on-site. Time in the nursery can increase the inherent cost of a seedling. Endemic plants have a particularly long incubation period and the ideal out-planting age/size of a seedling in the sites existing condition tends to be older/bigger. For example, 'ulei seeds can take up to 6 months to germinate, and up to a year to be ready for out-planting. The initial cost per seedling was estimated to be \$1.00 to \$3.50. Currently, the average cost is \$12.00 per seedling, with the out-plantable size varying by species. In some cases, a seedling of a certain size can be purchased and then grown in the on-site nursery until it is large enough for outplanting.

- c. **Donations:** Donations are another way that seedlings make their way to HA/KKV. Many community organizations and school groups offer native plants from the nursery as their ho'okupu when visiting the site for service-learning and retreat. HA/KKV communicates directly with the nursery which species are desired, and in most cases, the donating organization is able to plant their donations.

**Seedlings/stock material located on-site include:**

'A'ali'i ( <i>Pandanus tectorius</i> )	Maile ( <i>Alyxia oliviformis</i> )
'Ahu'awa ( <i>Mariscus javanicus</i> )	Mamaki ( <i>Pipturis albidus</i> )
Alahe'e ( <i>Psydrax rubiaceae</i> )	Ma'o hauhele ( <i>Hibiscus brackenridgei</i> )
Akoko	Milo ( <i>thespsia populnea</i> )
'Awa ( <i>Piper methysticum</i> )	Moa ( <i>Psilotum nudum</i> )
Hala ( <i>Pandanus tectorius</i> )	Naio ( <i>Myoporum sandwicense</i> )
Hao ( <i>Rauvolfia sandwicensis</i> )	Naupaka kuahiwi ( <i>Scaevola gaudichaudiana</i> )
Hapu'u pulu ( <i>Cibotium chamissoi</i> )	Noni ( <i>Morinda citrifolia</i> )
Ho'i'o ( <i>Diplazium esculentum</i> )	'Ohi'a ( <i>Metrosideros polymorpha</i> )
'Ie'ie ( <i>Freycinetia arborea</i> ) Kalo (spp.)	'Olena ( <i>Curcuma longa</i> )
'Iliahi ( <i>Santalum</i> )	Papala kepau ( <i>Pisonia brunoniana</i> )
Ko ( <i>Saccharum officinarum</i> )	Ti ( <i>Cordyline fruticosa</i> )
Kamani ( <i>Calophyllum inophyllum</i> )	Pili ( <i>Heteropogon contortus</i> )
Koa ( <i>Acacia koa</i> )	'Uki'uki ( <i>Dianella sandwicensis</i> )
Kokio keokeo and ula ( <i>Hibiscus arnottianus</i> )	Ha'uo'i ( <i>Stachytarpheta cayennensis</i> )
Ko'oko'olau ( <i>Bidens micrantha subsp. kalealaha</i> )	Popolo ( <i>Solanum americanum</i> )
Lama ( <i>Diospyros sandwicensis</i> )	Pohinahina ( <i>Vitex rotundifolia</i> )
Laukahi ( <i>Plantago major</i> )	Wauke ( <i>Broussonetia papyrifera</i> )
Lonomea ( <i>Sapindus oahuensis</i> )	Uluhe ( <i>Dicranopteris linearis</i> )
	Ulei ( <i>Osteomeles anthyllidifolia</i> )

**Seedlings/stock material needed to be obtained off-site include:**

'Ahakea lau li'i ( <i>Bobea brevipes</i> )	Naio ( <i>Myoporum sandwicensis</i> )
'Akoko ( <i>Chamaesyce multiformis</i> )	Native Bamboo ( <i>Schizostachyum glaucifolium</i> )
'A'ali'i ( <i>Dodonaea viscosa</i> )	'Olona ( <i>Touchardia latifolia</i> )
'Akia ( <i>Wikstroemia oahuensis</i> )	
'Akala ( <i>Rubus Hawaiensis</i> )	Naio ( <i>Myoporum sandwicensis</i> )
Ho'awa ( <i>Pittosporum confertiflorum</i> )	Native Bamboo ( <i>Schizostachyum glaucifolium</i> )
'Iliahi ( <i>Santalum</i> )	'Olona ( <i>Touchardia latifolia</i> )
'Ilima ( <i>Sida fallax</i> )	Pala'a ( <i>Sphenomeris chinensis</i> )
Kauwila ( <i>Alphitonia ponderosa</i> )	



Koki'o ke'oke'o ( <i>Hibiscus arnottianus</i> )	Palapalai ( <i>Microlepidia strigosa</i> )
Kupukupu ( <i>Nephrolepis exaltata</i> )	Pili ( <i>Heteropogon contortus</i> )
Loulu ( <i>Pritchardia</i> )	Ti ( <i>Cordyline fruticosa</i> )
Manono ( <i>Hedyotis terminalis</i> )	'Uala ( <i>Ipomoea batatas</i> )
Milo ( <i>thespsia populnea</i> )	'Ulei ( <i>Osteomeles anthyllidifolia</i> )
	'Uki'uki ( <i>Dianella sandwicensis</i> )

- d. **Agroforestry seed/stock material:** While agroforestry plants support the establishment and maintenance of the specific objectives of the plan, to establish native Hawaiian forest plants, KKV/HA will depend on community donations and other fund sources for the support of agroforestry seedling acquisition. FS funds for seedling acquisition are *exclusively* for the purchase of native plants. No Forest Stewardship funds will be used to purchase agroforestry seed/stock material.

**On site seed stock:** Mountain Apple, Kalo, Niu , Ko, Noni, Tapioca/Casava, Uhi, Citrus, Banana, Kamani, Nioi, Avocado, Curry

**Off-site seed stock:** Ulu, Ipu, Longan, Vanilla, Pear, Cashews, Pili nut, Surinam, Lychee, Fig, Cacao

2. **Planting:** "Ke kanu nei au, ia 'oe ka ulu." *I am planting you, it is for you to grow.* A chant recalled by Nana Veary from her youth articulates the epistemological relationship between humans and plants that we hope to perpetuate through our community-engaged programming. Planting is one of the most valued activities of our volunteer groups; we find more than 50 percent of average new participants have never planted anything before in their lives!
- a. **Timing:** Following Hawaiian cultural protocols for planting, we *plant by the moon*. Ideal planting moons are closest to the full moon, and most often we do majority of our planting on the full moon days.
- b. **Space holding plants:** In the Wao Kanaka, *fast growing food plants* such as kalo, 'uala, 'awa, and tapioca can 'hold space' by suppressing weeds and limiting soil erosion until the area is ready for the planting of long-term forest plants, or until planted long-term forest plants are better established. For example, two cycles of kalo are grown in some areas to help improve soil conditions and fertility before other forestry species are planted. The nature of the soil determines how long an area is held in this way. Kalo, 'uala, and 'awa are used as indicators of soil fertility to assess the time needed to repair and revitalize the soil's nutrient-holding capabilities. The varying schedules may be one month, six months, or one year. Afterward, a hybrid agroforestry and endemic forestry planting system is used until the slower-growing endemic plants are well established. Areas where large trees may fall in future stages are particularly good for 'space holding' systems. After visiting a similar project in Kipahulu, HA/KKV is interested in exploring other kinds of 'space holding' plants.
- c. **Forest Structure:** Plantings are done by hand. Planters will look for the best micro-site within a few feet of the planting location, as determined by sun exposure, drainage, and species height. Ideally, a 1 to 10 ratio of upper to mid and low-story plants are outplanted.

Over the years, we have found the most success in ‘planning’ out a healthy mixed-height forest by planting multiple stories within a few feet of one another. For example, an ‘ohia, a koki’o, and several carex will be planted to create a mini-ecosystem. Although it will be a while before the koki’o is outgrown by the ‘ohi’a, and the two will eventually trade places as upper/mid story plants. In many cases, an understory and overstory plant can be planted at the same time. Most often, the canopy tree will take much longer to establish than the lower-story plants, but the protection that the others give as the tree establishes itself is beneficial. As the plants grow, a second cycle of understory outplantings may be needed, and in ideal cases taking the cuttings from the already-established mid- and understory.

Similar to the ‘space-holding’ schedule described above, there are cases when the understory is outplanted without canopy trees with the intent that the upperstory will follow. Spacing varies by the steepness of the planting area or by species. Whenever possible, a larger plant is surrounded by a log box with the under-story plants at the ‘corners’ of the box, or wherever the logs join. This allows for clear areas for mulching, a good communication to future volunteer hand-weeders, and for a protective barrier for future weedeating around the planted areas. Planted areas will need monthly hand-weeding for at least two years, and sometimes a *follow-up planting* of additional lower story plants will help as the area gets established.

**Special Consideration:** Because of the steep slopes in some planting areas, HA/KKV utilizes slash to create planting terraces along slopes to reduce erosion of the slope and to support plantings while the root systems are being established. Invasive trees are removed from an area before planting, but heavy root systems remain often requiring the use of an auger to allow for planting. The initial FS plan called for over a thousand plants per acre; however, the cost of seedlings has been much more than the allotted amount and even with the on-site nursery and hundreds of donations per year, we are still striving to meet our ideal out-planting objectives by variety.

**Planting Schedule:** The table below outlines the planting schedule for each of the different forest tiers

Year	Upper-story	Mid-story	Groundcover
8	36/acre 72 total	145/acre 290 total	219/acre 438total
9	36/acre 72 total	145/acre 290 total	219/acre 438total
10	36/acre 72 total	145/acre 290 total	219/acre 438total

### C. Ground Cover Establishment

During initial planting, aggressive ground covers such as ‘uala, *carex*, kupukupu, ahu ‘awa, ‘uki‘uki, pohinahina, ko’oko’olau, ha’uoi, ‘ilie’e, and others are planted to suppress weeds and limit soil erosion. Regular hand weeding is employed, and additional groundcovers, such as kupukupu and palapalai ferns, *carex*, ‘uki’uki, and ‘ulei, are added as needed as mid and upper-story plants establish themselves.

The planting and care of lower mid-story plants such as ko'oko'olau, ha'uoi, and popolo are assisted by ground covers. We have found pohekula, an existing introduced species and a 'hanai' plant for la'au lapa'au practitioners, to be a useful ground-cover plant that keeps weeds down in an area, but it does not overcome even the smallest of plantings.

**Special Consideration:** Maintenance during ground cover establishment was thought at first to be one-year. We recognize now the need for at least two years of hand-weeding after an initial planting before ground covers are well established.

#### D. Nutrient Management

While a wide variety of vegetation thrives within this soil and climate, there are portions of the property where soil fertility is enhanced by organic treatments and amending materials listed in each practice below as well as bioflora, sustained bokashi, soil buster, fermented plant juices and black cinders. These organic soil amendments are sometimes made on-site.

**1. On-site composting system:** Logs are used to create composting bins for hand-cleared vegetation and are stacked for decomposition. After the bins have been filled and the vegetation has decomposed over time, the bins can be refilled again and again or used as planters, emulating a practice described in Native Planters using hapu'u stumps for planting 'uala.

Large piles of tree trimmers' chips are fed fish and bone meal, chicken and horse manure, food waste, and green waste to create a rich composted soil. This compost is turned regularly by the backhoe and is used especially for new out-plantings and in the nursery.

**2. Fertilization during outplanting:** Fertilization can include putting composted soil into the planting hole, or applying invasive seaweed, fish and bone meal, or organic crumbles on the surface after the plant is planted. Bundles of non-seeding, leafy, green weeds from hand-clearing, and/or tree trimming mulch can be used around the plantings both as a weed suppressant and to provide additional organic material to the soil. While the woodiness of the chipped material is high in carbon and acts only as a weed suppressant at first, over time, the piles of chipped material biodegrade to provide a decent compost base to which can be added various forms of nitrogen and phosphate.

**Special Consideration:** The backhoe is used daily to manage large piles of compost and mulch and to deliver compost and mulch to special 'drop' areas, located throughout the project site to allow for easier access by staff and volunteers in order to deliver material by hand to managed planting areas. Also, many of the organic-practice materials are produced on site, which adds to the time needed for this practice.

#### E. Mulching

Mulches are created on-site from removed trees and leafy invasives, and are delivered by local tree trimming companies. Mulch is applied across all planted acres in the project area, specifically to cleared areas, newly planted areas, and managed areas as a weed suppressant and organic material to strengthen soil. The number of times mulch is applied varies by weed grow-back, which is impacted by weather and volunteer management. Minimally, mulch must be applied after clearing and after outplanting. Community involvement with mulching has increased dramatically over time. With many hands, moving large amounts of mulch with buckets and wheelbarrows can happen in a short amount of time. The activity provides a low-impact means to get large amounts of mulch to areas where there is only

foot access, and even young children can learn and contribute in a meaningful way to the reforestation efforts.

**Special Area Practice:** Heavy mulching depends on regular use of a backhoe for moving and turning mulch/compost piles.

## F. Weed Control

KKV/HA recognizes that invasive weed suppression is one of the greatest challenges for forest restoration, and is an endeavor requiring a robust combination of effort and resources. We employ a process of *organic invasive species reduction*, by utilizing and depending on ground covers, mulch, and hand weeding by volunteers. Weed control will occur across all planted acres in the project area.

**1. Intense hand-clearing efforts by volunteers:** We engage hundreds on a weekly and monthly basis by employing a community-focused technique that encourages regular revisiting of a planted area by new and/or repeat volunteer community members. Annual volunteer access is in excess of 10,000 volunteers spending on average 3.5 hours helping to clear, plant, and hand-weed. The detail and intimacy of hand-weeding allows for highly efficient management. For example, the one acre area called Pasifika in the entryway to the forest, is hand weeded by 6 to 10 individuals spending 2.5 hours weekly. Broader spaces in Pasifika are weed-whacked monthly.

After initial planting, systematic weeding is expected to be necessary depending on conditions, but is typically once every other month for two years. Reapplications of mulch, vine removal, and increasing native groundcover will also take place continually after initial planting. Although weeding will be required until plantings are well established, the amount of effort to manage planted areas decreases significantly over time.

**2. Benefits of mechanical and manual weed control:** Using mechanical and manual methods of invasive species removal rather than chemicals, has had manifold benefits for Kalihi valley. The relatively greater availability of effort (person hours) for an organization like ours – with strong community engagement and limited resources – is just one of many reasons HA/KKV continues its commitment to physical (manual and mechanical), rather than chemical suppression techniques:

- Manual control is highly valuable for **safe community-based forest education**. KKV/ HA combines education on plant identification and balanced ecosystems with volunteer groups participating in weed removal. Engaging students and other members of the community in this way would not be possible if chemicals were used for invasive suppression.
- The tilling action of manual control and mechanical means of invasive control can also provide the **soil scarification** needed to stimulate the seed bank. We have found this to be particularly effective with *koa*.
- Institutional and cultural preferences for non-chemical approaches to weed control.
- As a **community health center**, KKV/HA is increasingly striving to make choices that embrace organic and low carbon footprint principles.

- Responsive to community cultural preference, avoiding chemical herbicides provides assurance to **traditional medicine practitioners** of both native Hawaiian and broader Pacific Island cultures, many of whom live and practice here in Kalihi valley. Assuring that these cultural plants are clean for medicinal use protects a delicate ancient traditional healing knowledge and insures engagement from this community in caring for the forest in perpetuity for generations.

## G. Forest Health and Protection

1. **Animal Control:** Feral pigs are controlled by the local hunters who have hunted generationally in the area for many years. The entire 100 acre property is hunted up to twice a week by the local hunting community. The local hunting method utilizes dogs and does not allow for guns of any kind. The regular presence of dogs in the various reforestation areas largely deters the pigs from rooting around and damaging new plantings. In certain situations, hunters will set box and corral traps, but only in monitored areas that are managed daily. This method of pig control requires more observation of pig patterns and regular communication with the pig hunters, than other methods such as fencing or snares.

The community engagement component of the reforestation work is crucial to the long-term success of the project. This method builds a sense of stewardship and responsibility with the pig hunters, a community committed to the preservation of the forest in Kalihi as demonstrated by their strong advocating (over 30 years) for the 100-acre nature preserve to be protected from development. While the hunters donate their time, KKV incurs costs to communicate, plan and manage gate access to the hunters.

2. **Animal barriers:** Protective barriers are erected around plants of desire to feral pigs. 'Ulu, kalo, and tapioca are the most desired. We use methods such as, pallets, bamboo, wire and electric fences, logs, and corrugated metal. Horse fencing is the most effective but the most expensive, while bamboo is the least effective and the least expensive.

## H. Trail Construction

Trails connect upper and lower elevation areas and provide a network of safe and functioning access to managed areas. These trails will grow and stabilize over time with increased use. While trails can eventually function as recreation space for hiking and the enjoyment of nature, the initial and primary function of trails will be to provide both forestry staff and community members working access for forest management and education.

Trails are built by hand using picks and shovels after larger trees and branches are cut away with chainsaw and machete. We aim to keep trails at least 3 ft. wide to allow for wheelbarrow access. When necessary, steps are made with cut logs and scored for extra grip and safety. Maintenance of well-travelled trails includes covering of trails with chips in a layer 3 to 5 inch thick to increase safety from slipping and protect against erosion. Trails that are walked daily usually remain clear, while trails that are used less often or seasonally need to be cut back yearly. Up to year 6, HA has completed 4 acres of trails, calculating for a 10ft corridor. Beginning in year 7, we will build 1000 ft of trail yearly.

**Special Consideration:** Steep slopes throughout the property make trail building extra laborious. The slopes also call for extra care to avoid erosion, especially on ridge trails.

High rainfall also contributes to erosion. High levels of fast-growing invasive species make all trails high maintenance.

## **I. Monitoring**

Monitoring includes the cost of staff time to visit and assess areas that have been cleared and planted. Staff assesses the growth of natives, regrowth of invasives, and future needs of areas. For example, some areas require increased planting and/or weeding, while other areas only require routine assessment. Monitoring takes place daily or weekly in the Wao Kanaka areas, and semi-annually in Wao Akua areas. The monitoring of upper areas can take one or two staff members a full day's hike. Monitoring results in quarterly reports that include data and photo-documentation.

Since 2010, KKV/HA has begun to monitor forestry areas using GPS technology. KKV/HA staff participated in GPS and clinometer training provided by DOFAW staff and utilize this training in the monitoring of trails and acreage. Monitoring results in a detailed Koa Aina property map that is used in weekly staff meetings to guide staff assignments.

Since 2013, HA has begun to document forest stewardship training in three areas:

- Volunteer hours spent in targeted areas of our forest are tracked alongside number of natives planted and invasives managed. In-kind donations are assessed. Social media presence is captured.
- Detailed interviews with staff, volunteers and interns about mentorship and stewardship are analyzed to document the rate of forestry skill development and transmission.
- Professional photography of forest stewardship activity is used to document impact.

These three data collection streams are triangulated within an indigenous evaluation system developed by HA called Uluhoku. Uluhoku operates quarterly to generate reports that may be used for grant reporting, grant acquisition, and stewardship training.

## **J. Fencing**

Community engagement at HA requires fencing to control movement of animals to be implemented in one-acre or less increments with moveable and removable fencing materials. Electric fencing, horse fencing, bamboo fencing, and dry-stack stone walls vary in cost for material, installation, and maintenance. Materials have cost between \$1.40 and \$10.00 per foot. Labor for installation has cost between \$0.28 and \$33.60 per linear foot. Finally, labor for maintenance has cost between \$0 and \$25.50 per week. HA continues to utilize the various fencing methods depending on the terrain and the available staffing.

Fencing to control the movement of people at HA applies to three existing driveway/entranceways whose gates are currently in functioning order

## **5. Human Resources**

To successfully implement this project throughout the ten-year time period, a variety of skilled and unskilled labor is needed. KKV/HA has realized the efficacy and cost effectiveness of employing staff members with skills critical to successful operations and so has invested in highly skilled workers. KKV/HA staff involved in this project include two caretakers with reforestation expertise and the ability to operate heavy equipment and provide arborist services, staff committed to education and volunteer engagement critical for KKV/HA's community

education and engagement approach to forest stewardship, and a program coordinator. These staff members are responsible for coordinating volunteers and school groups, scheduling and organizing work days, purchasing supplies and materials, collecting and propagating seeds, selecting and hiring consultants, record keeping and report writing. Consultants and contractors are required on occasion to provide specialized input, such as for felling extremely large or dangerous trees, providing hydrology or soil assessments, etc.

The majority of site prep work for this project is accomplished by staff. Planting and maintenance is done primarily by the community/volunteers. KKV/HA now engages community members in approximately 13,000 volunteer hours per year at the Kalihi Valley Nature Preserve for structural renovation, site clearing, out planting, and trail building activities. So far, volunteer groups have included the Kalakaua Lion's Club, the U.S. Army, Kuhio Park Terrace Teen Club, the Sierra Club, Hawaii Trail and Mountain Club, Boy Scouts, Kaiser Permanente, Farrington High School biology classes, Radford High School Peace Club and the KKV Chuukese Women's Gardening group, Kalihi and Leeward YMCA, Women's Way, UH School of Nursing, UH School of Architecture, UH Department of Urban Planning, UH Center for Hawaiian Studies, Hands in Helping Out (HiHo), Waiiau Elementary, Dole Middle School, Mililani Middle School, Men's Leadership Hawaii Foundation, Keiki O Ka 'Aina, KAUPA, Maryknoll High School, Punahou International Leadership Initiative, Kalihi Waena Elementary, KKV staff, and members of the Kalihi community. Two schools in the area, Halau Lokahi Charter School and Farrington High School, have adopted the nature preserve as a regular site for outdoor science and cultural learning activities. They will continue to be involved in a variety of reforestation efforts, bringing classes of 15-30 students three to four times per week.

The project will also be responsive to opportunities and lessons that emerge for new partnerships and practice areas.

As the site continues to develop as a natural and cultural resource in the community, additional volunteers and schools in the area are anticipated. Publicity continues to grow, support from the Kokua Kalihi Valley Comprehensive Family Services is extremely strong, HA/KKV continues to receive national and international recognition as a model for sustainable food and forest management with community engagement with reciprocal health benefits, and there continues to be a high degree of interest throughout Hawai'i for environmental projects that promote sustainable development and cultural appreciation.

## VI. PRACTICE IMPLEMENTATION SCHEDULE

\*The actual total cost for each practice is much higher than the allowable cost share rate, therefore the state share is on the high end. See "special considerations" for each practice in narrative.

### Year 8

Practice Component		Units	Cost/Unit*	Total Cost	LO Share	State Share
Tree and Shrub Site Preparation		2 acres	\$10,000/acre	\$20,000	\$19,000	\$1,000
Tree and shrub Establishment	Seedling Acquisition	2 acres @ 400 seedlings per acre	\$12/seedling	\$9,600	\$4,800	\$4,800
	Planting	2 acres	\$2,400/acre	\$4,800	\$3,800	\$1,000
Groundcover Establishment		2 acres	\$2,800/acre	\$5,600	\$2,800	\$2,800
Mulching		16 acres	\$400/acre	\$6,400	\$3,200	\$3,200
Weed Control		16 acres	\$600/acre	\$9,600	\$4,800	\$4,800
Nutrient Management		2 acres	\$1,300/acre	\$2,600	\$2,100	\$500
Trail Construction		1000 ft.	\$15.00/ft.	\$15,000	\$10,000	\$5,000
Forest Health and Protection		16 acres	\$250/acre	\$4,000	\$2,000	\$2,000
Fencing		1000 ft.	\$7/ft	\$7,000	\$3,500	\$3,500
<b>TOTALS</b>				<b>\$84,600</b>	<b>\$56,000</b>	<b>\$28,600</b>

### Year 9

Practice Component		Units	Cost/Unit*	Total Cost	LO Share	State Share
Tree and Shrub Site Preparation		2 acres	\$10,000/acre	\$20,000	\$19,000	\$1,000
Tree and shrub Establishment	Seedling Acquisition	2 acres @ 400 seedlings per acre	\$12/seedling	\$9,600	\$4,800	\$4,800
	Planting	2 acres	\$2,400/acre	\$4,800	\$3,800	\$1,000
Groundcover Establishment		2 acres	\$2,800/acre	\$5,600	\$2,800	\$2,800
Mulching		18 acres	\$400/acre	\$7,200	\$3,600	\$3,600
Weed Control		18 acres	\$600/acre	\$10,800	\$5,400	\$5,400
Nutrient Management		2 acres	\$1,300/acre	\$2,600	\$2,100	\$500
Trail Construction		1000 ft.	\$15.00/ft.	\$15,000	\$10,000	\$5,000
Forest Health and Protection		18 acres	\$250/acre	\$4,500	\$2,250	\$2,250
Fencing		1000 ft.	\$7/ft	\$7,000	\$3,500	\$3,500
<b>TOTALS</b>				<b>\$87,100</b>	<b>\$57,250</b>	<b>\$29,850</b>



**Year 10**

<b>Practice Component</b>		<b>Units</b>	<b>Cost/Unit*</b>	<b>Total Cost</b>	<b>LO Share</b>	<b>State Share</b>
Tree and Shrub Site Preparation		2 acres	\$10,000/acre	\$20,000	\$19,000	\$1,000
Tree and shrub Establishment	Seedling Acquisition	2 acres @ 400 seedlings per acre	\$12/seedling	\$9,600	\$4,800	\$4,800
	Planting	2 acres	\$2,400/acre	\$4,800	\$3,800	\$1,000
Groundcover Establishment		2 acres	\$2,800/acre	\$5,600	\$2,800	\$2,800
Mulching		20 acres	\$400/acre	\$8,000	\$4,000	\$4,000
Weed Control		20 acres	\$600/acre	\$12,000	\$6,000	\$6,000
Nutrient Management		2 acres	\$1,300/acre	\$2,600	\$2,100	\$500
Trail Construction		1000 ft.	\$15.00/ft.	\$15,000	\$7,500	\$7,500
Forest Health and Protection		20 acres	\$250/acre	\$5,000	\$2,500	\$2,500
Fencing		1000 ft.	\$7/ft	\$7,000	\$3,500	\$3,500
<b>TOTALS</b>				<b>\$87,600</b>	<b>\$56,000</b>	<b>\$31,600</b>

**VII. BUDGET SUMMARY**

<b>Year</b>	<b>Total Budget</b>	<b>Landowner Share</b>	<b>State Share</b>
1	\$140,845	\$68,823	\$72,022
2	\$105,445	\$52,723	\$52,722
3	\$105,445	\$52,723	\$52,722
4	\$46,445	\$23,223	\$23,222
5	\$47,445	\$23,723	\$23,722
6	\$47,445	\$23,723	\$23,722
7	\$47,445	\$23,723	\$23,722
8	\$84,600	\$56,000	\$28,600
9	\$87,100	\$57,250	\$29,850
10	\$87,600	\$56,000	\$31,600
<b>TOTALS</b>	<b>\$799,815</b>	<b>\$437,911</b>	<b>\$361,904</b>

**VIII. ATTACHMENTS**

1. Map of Reforestation Area



# **Koa ‘Aina**

*“Restoring Health and Balance to  
Kalihi’s Watershed and Native Upland Forest”*

An Updated Native Reforestation Project of

**Ho‘oulu ‘Aina**

Kalihi Valley Nature Preserve

KOKUA KALIHI VALLEY COMPREHENSIVE FAMILY SERVICES

This plan was developed for and with the support of the

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Department of Forestry and Wildlife

State of Hawai‘i, Department of Land and Natural Resources

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## **I. COVER SHEET**

Name: Kokua Kalihi Valley Comprehensive Family Services

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TMK No.: 1-4-014:026, 1-4-014:001, 1-4-016:003

State Land Use Classification: Urban and Conservation

County Zoning Designation: P1 and P2 General Preservation

Total Acreage: 99.65

Stewardship Management Area: 20 acres

Date of Plan Revision: 3/31/2015

This document revises an original document prepared with the assistance of Bill Sager, Forestry Consultant.

**II. SIGNATURE PAGE**

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

Prepared by: Ruby Ann Jackson  
Professional Resource Consultant's Name

Professional Resource Consultant's Signature: [Handwritten Signature]

Date:

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

Prepared for: Jo Ayers  
Applicant's Name

Applicant's Signature: [Handwritten Signature]

Date: 8/5/2015

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

Approved by: Galen K. Kawakami, Acting Administrator  
State Forester's Name

State Forester's Signature: [Handwritten Signature]

Date: 8/13/2015

Forest Stewardship Advisory Committee Approval: This plan was reviewed and approved by the Forest Stewardship Advisory Committee on May 29, 2015

Date of approval

### III. INTRODUCTION

#### 1. General Property Description

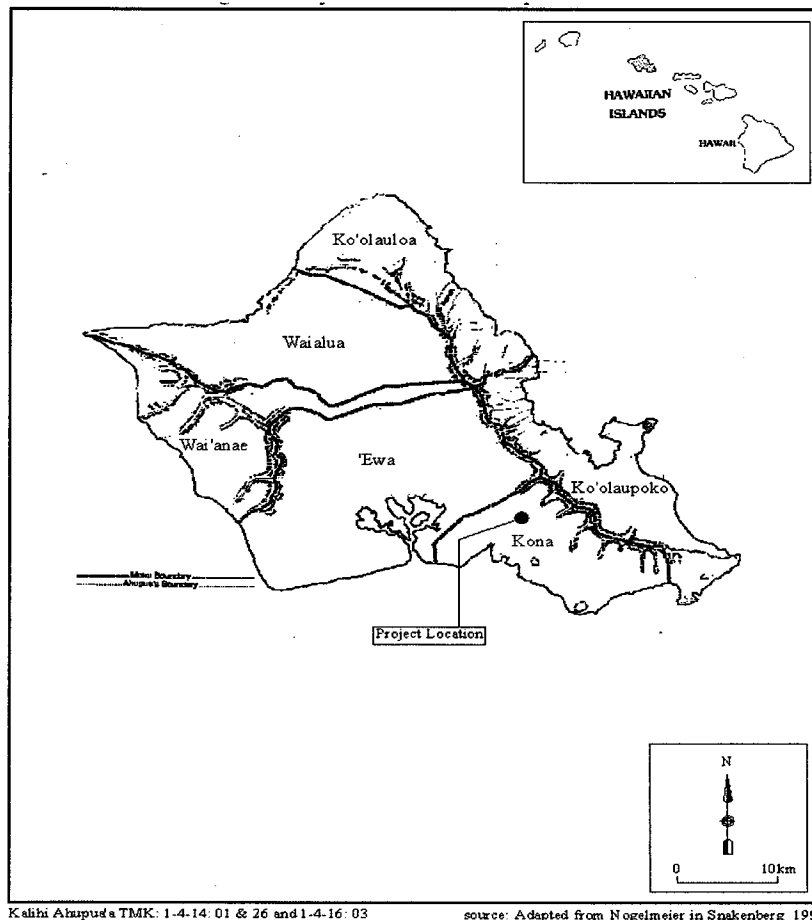
##### A. Property size and location

The Kalihi Valley Nature Preserve is located on 99.65 acres of land at the mauka end of the Kalihi ahupua'a on the island O'ahu. The property stretches from the center of Kalihi Stream to the top of Kamanaiiki Ridge. The 'ili of Maluwai and a portion of the 'ili of Ouaua combine to make the preserve site.

This location has cultural, social, and historical significance for the community of Kalihi and all of Hawai'i. Hawaiian tradition places the home of Papahanaumoku (the Earth Mother) and Wakea (Sky Father) at Kilohana peak in the back of Kalihi valley. Travelers in ancient times would have passed through the property on pilgrimages to Kilohana to honor these cosmological ancestors.

Today, the site is very near urban Honolulu, which makes it ideal for people from all walks to access, learn about, and participate in native forestry and watershed protection. Directly makai of the site lie private residences on either side of Kalihi Street up unto the property itself, but mauka of the site remains undeveloped watershed and forestland.

Figure 1: Project Location on a Map of O'ahu



## B. Description of access routes to property and physical assets/structures

Access to the site is at the mauka end of Kalihi Street, past the last wooden bridge. Two driveways provide varying degrees of access to the property. The driveway at 3659 Kalihi St. has been improved and allows access to a small gravel parking lot and the main building facilities on property. A long driveway at 3635 Kalihi St., leading to the upper portion of the property and the former mauka nursery site, is semi-improved with recycled concrete, largely eroded, and only accessible by four-wheel drive.

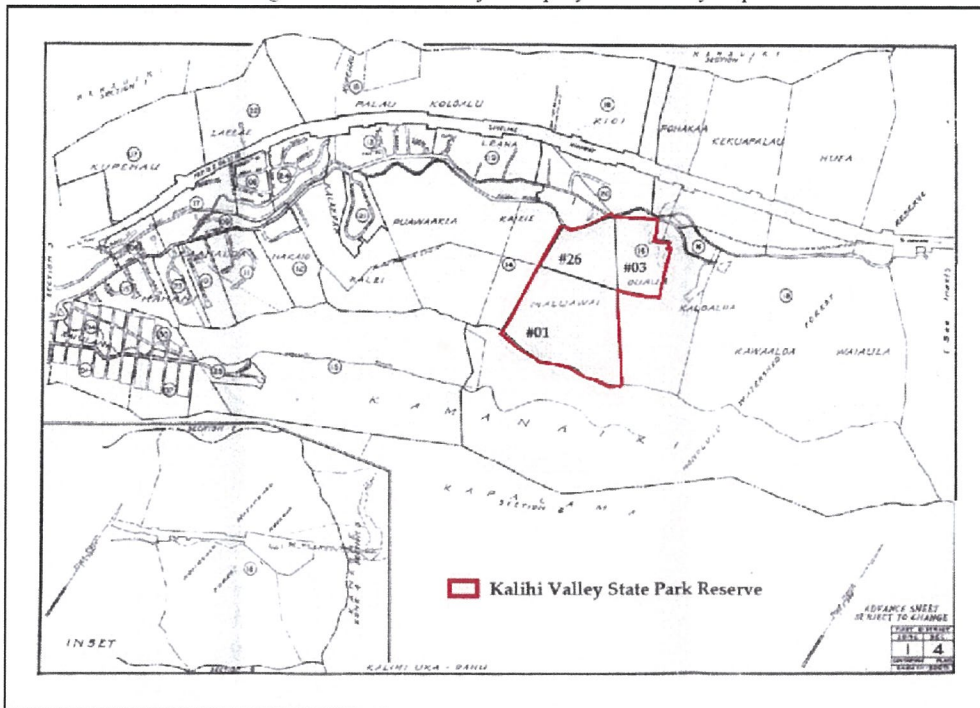
At the inception of the project, the 100-acre site included two residential structures, the remains of facilities from a defunct nursery operation, and many ancient agricultural terraces. The lower elevation of the site was covered by introduced species while some native plants remain nearer the Kamanaiki ridge summit. Reflecting the long history of degradation, parts of the property remained littered with old, rusting abandoned vehicles, car parts, trash, and nursery equipment.

Since 2006, Ho'oulu 'Aina, Kokua Kalihi Valley Comprehensive Family Services (HA/KKV) has worked to restore a healthier balance between the native and invasive plants of both upland and lowland forest, removed tons of metal and abandoned junk and equipment, started restoration work on the agricultural terraces in Maluawai, and restored the residential structures to allow for community access and educational programming so that youth and other volunteers can engage in multi-day programs that support community-based forestry.

## C. Property tax map key

Tax Map Keys: 1-4-014:0026, 1-4-014:001, 1-4-016:003

Figure 3: Location of Subject Property on a Tax Key Map



Kalihi Ahupua'a TMK: 1-4-14: 01 & 26 and 1-4-16: 03

source: Department of Taxation, Tax Maps Bureau 1932



#### D. Property zoning

State Land Use Classification: Urban (43 acres) and Conservation (57.65 acres)  
County Zoning Designation: P1 and P2 General Preservation

The portion of the site nearest to Kalihi Stream (about 42 acres) is designated as Urban by the state. Approximately 57 acres of up-slope land nearest the crest of Kamaikai Ridge are designated as Conservation land and therefore more restricted for land use change due to zoning laws. The City zoning of the site is Preservation (P1 and P2) consistent with park lands on O'ahu.

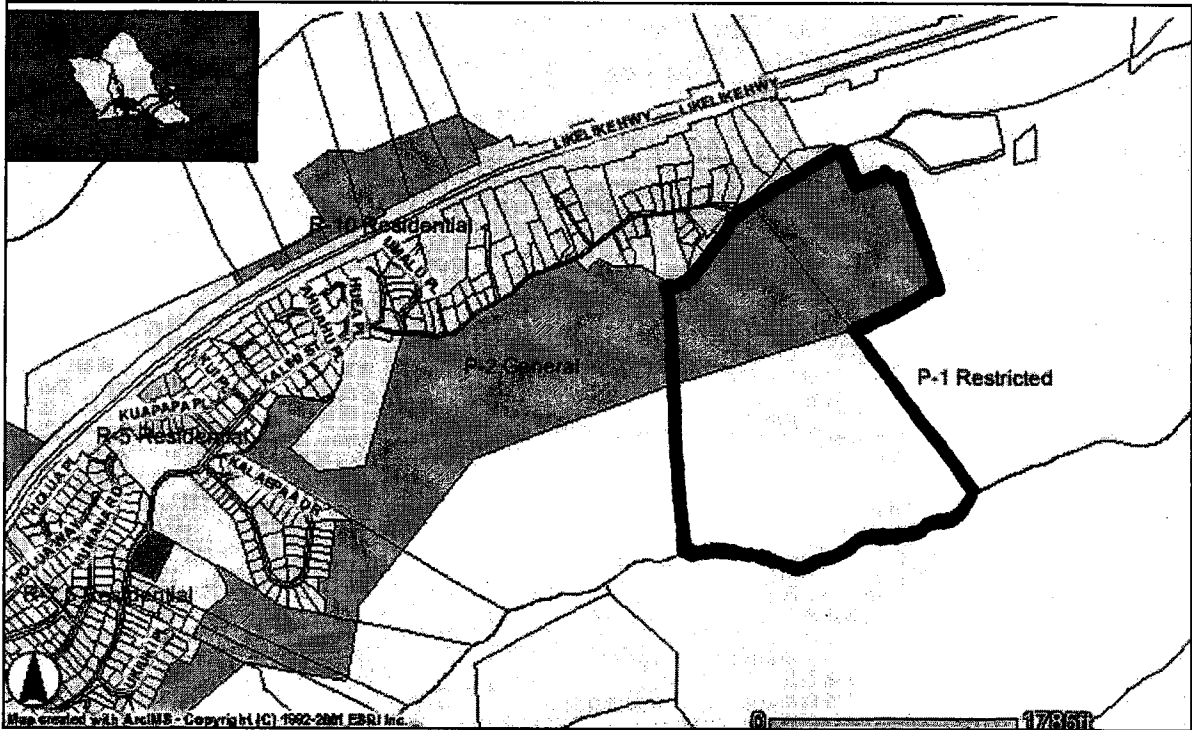


Figure 2: Zoning map of Kalihi Nature Preserve. The lower 44 acres zoned P2 is also in the state Urban District. The P1 zoned area is in the state Conservation District.

#### E. Topography, elevation and climate

The rain of the valley is called Ko'ilipilipi, named 'sharp adze' for its cold and constant presence. Managing the hydrology of the site requires much attention, as the rain over years can tend to carve away at the soil and erode the hillsides. Portions of ancient, stone-lined irrigation systems remain intact, the most significant of which leads away from stone agricultural terraces, indicating the eroding or flooding potential of this rain. Kalihi Stream itself runs through a steep sided channel in places nearly 40 feet deep.

Immediately above the stream channel much of the project site is relatively level, gently sloping land. Some of the land on the streamside of the property has been graded into wide terraces or excavated during the time of commercial nursery operations. A series of shallow gullies run generally perpendicular to the stream up to the valley ridge to the south. Slopes along the lower portion of these gullies are generally moderate and easily traversed. A wide plateau lies about halfway up the slope to the ridgeline. This is the site of the former nursery operation. Evidence of significant earth movement and grading are clearly visible

at this location. Above this plateau, the valley walls become steeper. The gullies climb to become narrow gulches stepping up with sheer rock cliffs and dry/ephemeral waterfalls. Steep side ridges reach up from the lower valley and intersect the top of Kamañaki Ridge.

The project site ranges in elevation from a low point of nearly 500 feet above sea level at the Kalihi Stream channel to a height of approximately 1,400 feet along the top of Kamañaki Ridge.

The overall climate of Kalihi Valley is typical of lands near the Ko`olau Mountains. Rainfall is moderately heavy in the area, averaging well over 100 inches annually at the BWS Kalihi Reservoir and the upper portions of the valley. The majority of precipitation occurs between November and April when winter storms add to trade wind rainfall. The traditional name of the wind is Haupe'epe'e, or 'hide-and-seeK', known to swirl in and around the steep valley walls, appearing and disappearing playfully. However, predominant trade winds from the Northeast blow through the windward pass of the Ko`olau summit and down the valley toward Honolulu.

Temperatures in the uplands are consistently cooler than the nearest official recording site at Honolulu International Airport, which range between 70 and 84 degrees Fahrenheit. While nights on property have been recorded as low as 53 and days have reached into the low 90s, most experience the weather as cool and pleasant.

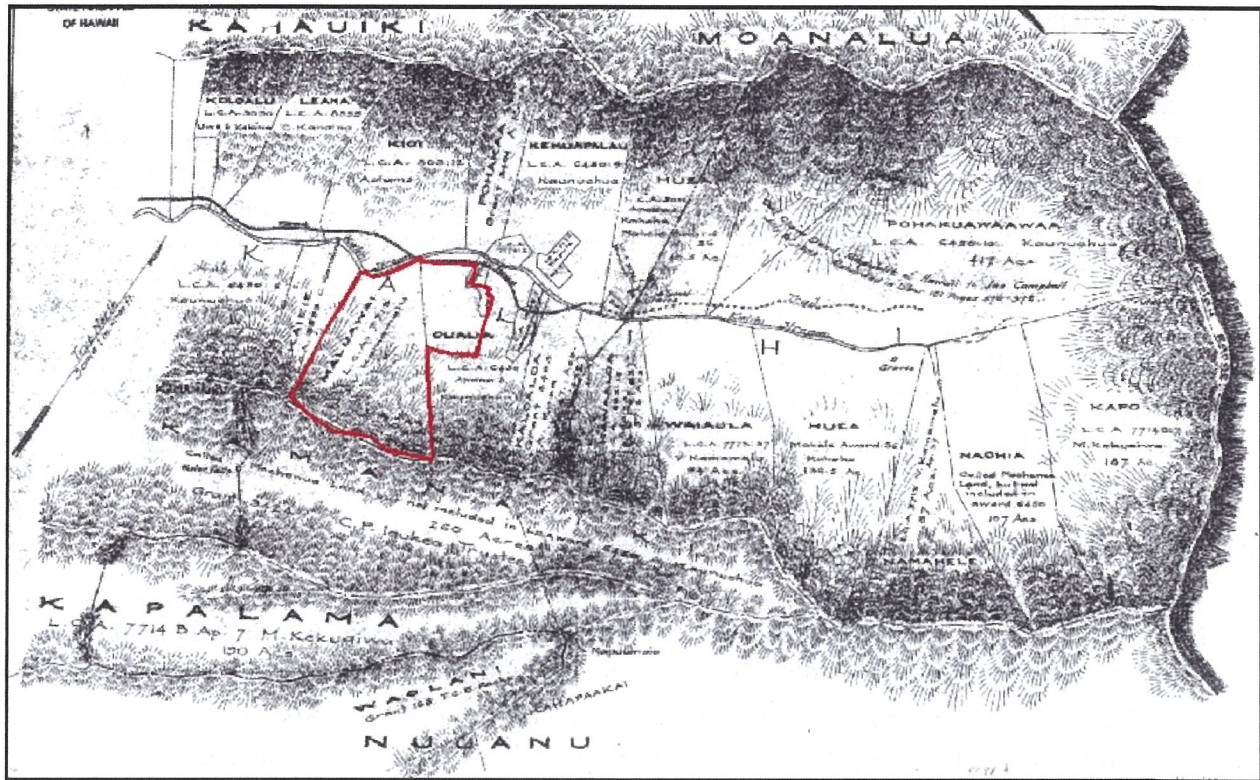
#### **F. Brief history of uses/description of present condition**

This region of Kalihi Valley was once intensively cultivated by Native Hawaiians, prior to western contact and continuing up until the early 1900s. Three complexes of stone-lined water channels and surrounding agricultural terraces remain in varying stages of (dis)repair. These stone features date from pre-historic times. An agricultural heiau is reported to have once been located not on, but nearby the park site. At the time of the Mahele, when land in the islands was first converted to private ownership, the `ili of Maluawai was deeded to Kamamalu, the sister of King Kamehameha IV and V.

In historic times, the land was used for grazing cattle. By the mid-1800s, few trees stood in the valley floor and most of the property was grassland. In the later part of the 19<sup>th</sup> century and most of the 20<sup>th</sup> century, trees began to grow again in the area as a result of re-forestation efforts by the government and private landowners.

The property was passed down through family lines until it was sold in the early 1970s to a land developer. Inspired by a sense of community stewardship, Kalihi Valley residents advocated to protect the land from plans to build a gated, luxury home development. In response to these concerns, in 1980, the City and County of Honolulu purchased the 100 acres for a park. The parkland was subsequently conveyed to the State in a land exchange that concluded in 1997. Today, the State Parks Division, under the Hawai'i State Department of Land and Natural Resources, holds jurisdiction over the site. Unable to secure funding to develop a nature preserve, State Parks sought the involvement of private organizations to make the park a reality.

In 2004 Kōkua Kalihi Valley Comprehensive Family Services (KKV) began discussions with State Parks to seek a long-term lease of the site for the purpose of finally bringing the park to life. In December of 2004, the Board of Land and Natural Resources approved a 20-year lease over the 99-acre parkland to KKV. The site is a unique example of partnership between State and non-profit organizations for the betterment of Hawai'i's people and natural environment.



Kalihi Ahupua'a  
 TMK: 1-4-14: 01 & 26 and 1-4-16: 03

Source: Board of Agriculture and Forestry,  
 map no. O-33, 1923  
 (on file: Hawaii State Archives)

Figure 4: Subject Property on a 1923 Map of Upper Kalihi Valley

In 2005, KKV conducted community-based planning efforts to design the park in keeping with the expressed interest of Kalihi residents and parameters established by the state. The original Forest Stewardship plan was a byproduct of guidance by a community park planning committee and input by many members of the public. Ho’oulu ‘Aina, Kokua Kalihi Valley Comprehensive Family Services (HA), was established as the department of KKV charged with the management of the 100 acres.

For the last 7 years, under a program called Koa 'Aina, we have been clearing invasive weed trees, planting natives and other Pacific Island agroforestry plants, engaging community members and educational groups in the active reforestation, and employing an adaptive management approach with continued community and expert input. HA/KKV efforts have created and protected *kipuka* of native species on approximately 14 acres of the site. While large portions of the site remain largely overgrown with exotic species, the new plan proposes management practices developed and proven on site over the past 7 years to reduce the number of invasive exotic plants and increase the health and number of native species in managed areas.

Under the operation of HA/KKV, the park allows for safe public access as a place of quiet recreation, nature studies, health education and the preservation of Hawaiian culture. Since HA/KKV's management of the site, community engagement has significantly transformed in character. Prior to this, our people used the site as a rubbish dump and a place for sordid activities. In the last five years, the number of visitors and participants in restoring watershed and community health has risen to more than 100 visitors per week.

## 2. Project Vision and Goals

The primary goal of the Koa 'Aina project is to *restore balance to Kalihi's watershed and native upland forest*. Community members work together to cultivate and regenerate the Koa mesic forest that exists in Kalihi's historical descriptions and photos, in our ancient stories, and in the seed bank itself. The work involves preserving, propagating, establishing, and expanding existing Koa and other native and Polynesian Introduced (PI) species historical or appropriate to Kalihi valley. Community engagement in the work strengthens the long-term relationship between people and the forest.

On the 100-acre property, we are aiming to restore 20 acres in 10 years. This acreage goal is based on the high level of invasives and the steep nature of the terrain. Restoration will decrease the number and prevalence of the invasive species, and increase the number and vibrancy of native species in the targeted 20 acres, using the minimal but existing healthy, tiered, mixed native species forest examples on property as a model.

## 3. Description of specific management objectives

As part of HA's mission to *sustain and propagate the connections between the health of the land and the health of the people*, the Koa 'Aina project aims to *restore health and balance to Kalihi's watershed and native upland forest*. Our specific management objectives are:

- 1) **Native Species Restoration and Habitat Improvement:** Regenerate a native koa forest with a mixed understory of native and Polynesian introduced species on approximately 20-acres of the 100-acre Kalihi Valley Nature Preserve;
- 2) **Soil and Water Protection and Improvement:** Restore soil health and fertility to support reforestation and improve water quality through soil remediation and the prevention of erosion; and
- 3) **Community Forest Engagement:** Increase public engagement through volunteer, educational, and cultural programming to establish and foster an enduring stewardship relationship between the people of Kalihi and their forest.

## IV. LAND AND RESOURCE DESCRIPTION

### 1. Existing vegetation/cover types

Unmanaged forest below 800 feet is mostly dominated by naturalized alien tree species, with only small patches of native vegetation remaining. Much of the forest canopy is composed of albizia (*Falcataria moluccana*). Other common alien trees are rose apple (*Syzygium jambos*), gunpowder tree (*Trema orientalis*), black bamboo (*Phyllostachys nigra*), koka (*Bischofia javanica*), strawberry guava (*Psidium cattleianum*), common guava (*Psidium guajava*), shoebutt ardisia (*Ardisia elliptica*), ironwood (*Casuarina equisetifolia*), fiddlewood (*Citharexylum caudatum*), kukui (*Aleurites moluccana*), and Formosan koa (*Acacia confusa*). There are also some trees in the parcel that were planted in the early 1900's, but have not spread very much, such as the Cook pine (*Araucaria columnaris*), and eucalyptus (*Eucalyptus* sp.).

Above 700 ft. native plants within the alien forest are more frequently encountered. The native plants observed here include `ohi'a (*Metrosideros* spp.), koa (*Acacia koa*), hapu`u pulu (*Cibotium chamissoi*), `ie`ie (*Freycinetia arborea*), papala kepau (*Pisonia umbellifera*), mamaki (*Pipturus albidus*), lama (*Diospyros sandwicensis*), alahe'e (*Psydrax odorata*), and uluhe (*Dicranopteris linearis*). Polynesian introductions seen below 800 ft included kukui, kamani

(*Calophyllum inophyllum*), ti (*Cordyline fruticosa*), `ohi`a `ai (*Syzygium malaccensis*), coconut (*Cocos nucifer*), and hau (*Hibiscus tiliaceus*; possibly native). A variety of ornamental plant species persists around abandoned nursery structures and residences.

The vegetation of the steep valley wall portion of the parcel is largely dominated by alien plant species, but a larger percentage of the vegetation here is native compared to the alien forest of the valley bottom portion. The native plants observed here were common mesic forest plants.

## **2. Existing forest health**

Prior to western contact, the site was intensively used by Hawaiians for agriculture, as reported in Kalihi oral histories and evidenced by existing dry-stack stone irrigation and terracing. At that time, the valley floor was utilized for the production of native food crops. Like many Pacific island cultures, ancient Hawaiian agroforestry practices enhanced watershed balance and health, especially stream and water health.

In the past 200 years, the landscape was transformed by introduced farming and ranching practices, converting some lands into grasslands that persisted in that state until the early 1900's. During that time, the site was reforested with exotic tree species planted by the government and private landowners. An initial botanical survey found that no rare or endangered plants were found anywhere on the 100-acre park site. Subsequent surveys of upland forest areas and rock cliffs reveal many species of native and endemic plants. Even in the pervasive presence exotic trees and weeds throughout the property, the upper reaches of the valley walls remain home to native species such as Koa, `Ohi`a, Lama, `Ie`ie, Naupaka Kuahiwi, Papala Kepau, `Ekaha, Palapalai, Hoe a Maui, and other cherished endemic species.

The noxious exotic weed miconia was introduced to the site by the previous nursery operation. In early years of KKV stewardship, crews of volunteers and staff worked intensively to remove found miconia from the site. While this invasive plant is intensely colonizing and continual monitoring and removal is necessary, recent surveys by the O`ahu Invasive Species Council indicate that this eradication effort has been widely successful. Other exotic flora such as albizia, rose apple, bamboo and clidemia that blanket the site are being removed and replaced by native plants in strategic, managed areas.

## **3. Soils and their conditions, general slope and aspect**

Geologically, the Kalihi Valley Nature Preserve site is situated in a very old valley eroded into the Ko`olau volcanic shield. Older alluvium underlies the floor and slopes of the valley. Younger Kalihi lava of the Honolulu Volcanic Series was deposited 450,000 years ago from vents in Kalihi and Kamanaiki Valleys. Kalihi Stream cut a channel and deposited stream terraces of younger alluvium. The slope of Kamanaiki Ridge on the southern half of the site is classified as rock land. Soil underlying the more gently sloping valley floor is classified as loleka`a silty clay.

## **4. Water resources and their condition**

**A. Groundwater:** The project site overlies aquifers perched within the alluvium and Kalihi basalt. Rainfall over areas underlain by Ko`olau basalt infiltrates deeply into the volcanic rock of Oahu to recharge dike-confined aquifers and the basal aquifer water. An average of approximately 10 million gallons of water each day enters the Kalihi groundwater system. Both the perched and basal aquifers are tapped as drinking water sources for Honolulu. There are 10 drinking water wells currently operated by the Honolulu Board of

Water Supply (BWS) in the Kalihi area and two by Kamehameha Schools in the basal aquifer. BWS also has an artesian perched well above the park site. The sustainable yield of the Kalihi aquifer is estimated by the Commission on Water Resource Management to be 9 million gallons per day. The average pumpage from the Kalihi system is 9 million gallons per day.

**B. Surface Water:** Kalihi Stream flows perennially along the northern boundary of the project site. The average stream flow of Kalihi Stream is 7.3 mgd but minimum flow may fall below 0.5 mgd in dry years. Upstream of the project site, the stream drains the relatively undeveloped Kalihi watershed. The watershed is host to the Likelike Highway, a major transportation corridor between windward O`ahu and Honolulu's downtown. Old Kalihi Street also penetrates the watershed and serves the BWS reservoir and water pipelines. Negative impacts on stream water quality in this upper region include alien plants and animals that hinder the ability of the land to absorb rainwater and increase muddy runoff into the stream. During heavy rain events, flow increases dramatically and stream water typically becomes brown and turbid. Kalihi Stream flows down slope through residential and industrial districts of Honolulu to meet the sea at Ke`ehi Lagoon. Kalihi Stream has been listed as an impaired water body by the State Department of Health under the provisions of the federal Clean Water Act.

The site includes 4 gullies that host small fresh water seeps or springs. Each spring sends its water trickling down slope and into Kalihi Stream. Additionally, a system of `auwai exists on site. While some of these traditional irrigation and drainage channels are in good repair (and retain their dry stack stone structures), most were not preserved. Understanding the implications of surface water quantity and quality for watershed function and water quality downstream and in the Ke`ehi Lagoon estuary, KKV/HA has engaged with a hydrologist to design a water restoration plan for the property. The hydrological and cultural functions of the `auwai system (important to taro cultivation in Kalihi Valley) inspired KKV/HA to enlist the support of a master stone mason from Hawai`i Island who assists in the repair of irrigation channels (and agricultural terraces for taro) and train staff and Kalihi community members in the stone building techniques.

## 5. Timber resources

Invasive species removed during reforestation will be repurposed where possible. This repurposing may create forest products for onsite uses, as well as value added products that may be sold to build sustainable funding streams for the project. Sales of such products would first require review and approval from DLNR.

As the objectives of the project protect the existing native woods from being harvested, wood resources available within the preserve site are limited to the predominant alien exotic species mentioned above. Of these, the albizia is being utilized as a resource for the making of canoes for educational and cultural purposes. Any other wood available from alien species removed will be used on site for purposes such as facility repair, carving education, benches, signs, and shelters. Examples of other invasive timbers to be considered for repurposing include koka (*Bischofia javanica*), ironwood (*Casuarina equisetifolia*), guava spp, and rose apple (*Syzygium jambos*).

## **6. Wetland resources**

No significant wetland resources exist on site

## **7. Significant historic and cultural resources**

Celebrated as the dwelling place of the original male and female progenitors of the Hawaiian race, Wakea and Papahānaumoku, Kalihi valley holds a prominent place in Hawaiian cosmological narratives. The close proximity of the Project site to the urban center of Honolulu makes it an accessible and significant resource recalling the former agricultural foundations and cultural history of the area.

The site contains numerous archeological structures that are presumed to date to pre-historic times. These structures include a network of stone-lined irrigation channels and agricultural terraces that bear witness to the long history of agricultural use in Kalihi Valley. A grant from the Office of Hawaiian Affairs (OHA) partly funds the restoration of these stone structures, as well as training to propagate knowledge of dry-stone stack techniques among KKV/HA staff and the Kalihi Valley community.

With the intent to protect such cultural resources, access to portions of the property by heavy equipment is restricted. Backhoe and excavator access for clearing and moving large slash and debris is limited to areas already highly impacted by nursery activities of the 1960s and 70s. Management practices surrounding dry-stack stone terraces and irrigation channels as well as deeper gullies and intermittent streambeds depend on many hands for clearing, passing, cutting, etc. At most, hand-held machinery is limited to chainsaws, weed eaters and augers.

HA/KKV has worked closely with the Department of Land and Natural Resources to follow regulations regarding protection and preservation of these cultural resources, including an archeological survey in 2005. These sites are being restored with the support of master stone builders training and working together with staff and community members through grants from the Office of Hawaiian Affairs and the Hawai'i Tourism Authority. Included in these grants is funding to restore the surrounding forest supplementing the current FS funding. The overall objective is to restore not only the site itself, but also the knowledge of stone building in the valley. This work impacts the cultural, ecological, and socio-economic value of forestry in communities through the training and educational engagement of students from youth planting and weeding activities to graduate student field evaluators contributing to an indigenous evaluation system which links native reforestation efforts to community investment and cultural engagement.

## **8. Threatened and endangered species existing on property**

No listed endangered or threatened native plants or any other rare native plants were found during a botanical reconnaissance in June 2005. This was not unexpected, given the long history of alteration and destruction of native vegetation of the valley bottoms in the Honolulu area in pre-Western times up until today. There is little potential for the discovery of rare plants that may have been missed on this reconnaissance based on the documented patterns of occurrence of rare and endangered native plants in the valleys in the Honolulu area.

The potential for the discovery of rare plants is greater in the valley wall part of the property than in the valley bottom portion. These upper elevations would require further survey for rare and endangered plants should any park development be planned there.

The predominant exotic plant forest in the valley bottom is not known to provide habitat for any native animal. The higher slopes of the Ko`olau Range provide habitat for the Hawaiian forest bird, `elepaio. To date there have not been any recorded `elepaio sightings at the Preserve, but as more native *kipuka* are secured through the native reforestation efforts, there is hope that birds sighted in neighboring valleys may return to the site.

Alien animal species that are known to inhabit the park property include a wide range of introduced bird species such as thrushes, doves, mynahs and finches. Feral pigs, mongoose, rats, and wild chickens are known to live on the property. A colony of Australian Brush-Tailed Rock Wallaby has been established nearby and there is evidence that some wallabies visit the park site. Introduced mosquitoes are common at the park site, multiplying in great numbers in the dark, wet forest environment.

## 9. Existing aesthetic values

In 2005, KKV/HA raised and invested over \$200,000 in funds and over 2,000 hours of volunteer community labor, with the support of a Robert Wood Johnson Active Living grant, to convert a 3-bedroom 1930's residence, attached studio, courtyard and surrounding grounds within the 100-acre preserve site into a welcoming center. The Ho'okipa Center now includes the building structure and surrounding gardens and gathering tent and is the central meeting point and program headquarters for all the environmental, health, educational and related activities being developed throughout the 100-acre nature preserve.

A 'bunkhouse', located on the upper slope of the park site near the abandoned nursery operation had fallen into disrepair. In keeping with the obligation of the lessee to repair and maintain all facilities on site, KKV/HA has partnered with the University of Hawai'i School of Architecture and Citizen Architecture community groups to make the bunkhouse safe and usable again. The space will be used by groups seeking a multi-day experience for forest restoration, malama `aina, and sustainability experience and education. In the restoration work, every effort was made to reflect conservation principles: recycled materials were used when possible, grey water is reused, an earthen floor was utilized, and albizia was even used for detail treatments (e.g., entryway pavers, kitchen counter tops, etc.).

## V. MANAGEMENT OBJECTIVES AND PRACTICES

KKV/HA will utilize a community-based, adaptive-management approach to do reforestation. This approach calls for 1) wide *engagement* of large numbers of community members of all ages and skill levels and 2) careful *observation* and story-gathering among staff and community members to assess and adapt applied practices according to success indicators learned over time. The intent of this approach is to affect the sustainable health of the valley over generations, impacting the watershed beyond the time constraints of the given Forest Stewardship grant through community stewardship, engagement, education, and investment.

The three specific management objectives of this reforestation project are 1) **Native Species Restoration and Habitat Improvement**, 2) **Soil and Water Protection and Improvement**, and 3) **Community Forest Engagement**. These three objectives are described in more detail below.

### 1. Native Species Restoration and Habitat Improvement

**A. Forest Type Planned:** To the best degree possible and with the resources available, HA/KKV aims to restore a native forest specific to this place and time. The koa forest here in Kalihi valley is unique. We have found naturally occurring koa in every stage from



viable seed to immature leaflet seedlings to fully mature, seeding trees as low as 700 ft. elevation. Naturally occurring natives including koa, 'ohi'a, 'iliahi, lama, uluhe, 'ie'ie, papala kepau, naupaka kuahiwi, maile, mamaki, hala, kalo, moa, kupukupu, palapalai, pala'a, and a'ea'e, though small in number, continue to survive. While no longer found naturally, pili grass at once had a strong presence in the valley as we learned from photographs and stories from elders from the valley.

The existing native species and those described in the valley's history are the foundation for the planned reforestation strategy. We supplement this list with other koa mesic natives based on availability of seed and seedlings of complimentary species. These include koki'o ke'oke'o, 'ohe makai, ha'uo'i, and ko'oko'olau. The existing forest is overwhelmingly invasive, and it is our intention to slowly shift the balance to allow for thriving natives.

**B. Arrangement in Landscape: The Wao Akua and the Wao Kanaka.**

- 1. The Wao Akua:** Most of the existing natives on property are in deeper pockets and ridgelines of the Wao Akua, which occurs around 900 ft elevation and above. Generally, plants like mamaki and moa are found in the pockets and 'ohi'a, 'iliahi, and maile are found along the ridgelines. While the 'ohi'a and koa still stand majestically over rolling uluhe, and the 'ie'ie hold fast their ground-crawling band around the mountain, invasives such as the enduring Christmas berry, the monocropping strawberry guava and clydemia, the spring-tapping banyan, the monster albizia, and the ever-notorious miconia are slowly dominating.

The Wao Akua will comprise 10 of the 20 acres planned for management and restoration. To restore and protect the Wao Akua, we employ two strategies:

- 1) Identify and manage existing, thriving natives and native ecosystems, and protect and enhance the kipuka in which they are thriving by reducing the surrounding, aggressive invasives and planting more natives. This strategy employed on 2.5 of HA's upper-most acres, mostly along ridgelines.
  - 2) Cut down large invasives such as banyan and albizia in a concentrated (one-half to two acre) area and employ techniques of the Wao Kanaka to 'hold' the area in kalo, sweet potato, or other space-holding plants until the Wao Akua species establish themselves, at which time the agricultural plants are to be harvested and a native/endemic understory can be established. This strategy employed on 7.5 acres.
- 2. The Wao Kanaka:** In the Wao Kanaka, we are battling a more aggressive invasive establishment. Here, the albizia, rose apple, clydemia, artesia, maile pilau, sprawling bamboo, and various grasses dominate the landscape. Our strategy for reclaiming this forest is to look to ancient planting systems of agroforestry. The large invasives are cut in concentrated areas. Native/endemic plants and trees are planted alongside and around more agricultural-style Pacific Island plants such as kalo, 'olena, and sweet potato. Agroforestry trees and mid story plants such as 'ulu, noni, 'ohi'a 'ai, ko'oko'olau, and 'olena help to secure a multi-level forest and healthy watershed, as well as provide food and medicine for the community while the slow-growing trees establish. Introduced species can be harvested for timber when appropriate, while endemic trees such as koa and 'ohi'a will be permanent. The Wao Kanaka will comprise 10 of the 20 acres planned for management and restoration.

## 2. Soil and Water Protection and Improvement

These practices focus on maintaining or improving the productivity of the forest soils and preventing erosion of forestland within the native reforestation area.

- A. Soil:** Strategies to prevent soil erosion include planting native soil protecting plants and building terraces made of logs in critical areas prone to erosion. These strategies maintain existing water diversion channels in reforestation areas.

The project has worked with UH soil scientist, Dr. Jonathan Deenik, to assess soil quality and fertility and determine appropriate action for amending soil. HA/KKV has entered into synergistic relationships with local arborists and tree trimming companies to create large-scale compost and mulching capacity. Green waste is brought to HA by local tree trimmers where it is later applied as mulch or compost for plantings and weed suppression. From 2010-2011 HA/KKV received quantities (each load was approximately 4 tons, and 2 deliveries were made per week for approximately one year) of invasive seaweed from the Malama Maunaloa project.

- B. Water:** With assistance from a hydrologist contracted through a grant from the Office of Hawaiian Affairs, HA/KKV is developing a water management plan to control water flow and erosion throughout the property. Recognizing that water quality mauka has significant impacts upon water quality throughout the watershed, notably the Kalihi Stream and the Ke'ehi Lagoon estuary, we continue to conduct restoration work along 'auwai and stream banks. Through a partnership with Kalihi Ahupua'a Ulu Pono Ahahui (KAUPA), HA/KKV supports the gathering of longitudinal water quality data with local school science teachers and students. This will enable HA to monitor the efficacy of soil and water management practices.

## 3. Community-Based Forestry Stewardship through Engagement

KKV/HA will increase public engagement through educational, cultural, and volunteer programming to ensure a durable stewardship relationship between the people of Kalihi and the forest of their home ahupua'a. Over the years, engagement has increased to hundreds of volunteers on a weekly basis, with the daily work focus depending on community needs (# of volunteers, time of year, etc). In the next five years, we expect that this engagement will continue to grow, and we have already witnessed much positive effect of this level of engagement in both the land and the people.

- A. Education:** We believe that increasing place-based awareness has long-term effects on the sustainability of forestry and other ecological endeavors, especially with the engagement targets children and families. With the many partnerships that KKV/HA has built with the schools and educational programs in Kalihi and beyond, Kalihi's watershed benefits from the volunteering of the students, and the students benefit from the hands-on learning experienced here in the valley. The potential of teaching and learning healthy forest management builds a sense of utility into local curricula in a manner that will serve both land and human for generations.
- B. Culture:** As Kalihi is the home to many Pacific islanders, and KKV/HA manages the nature preserve with a Hawaiian cultural grounding, native forestry allows for deep cultural sharing and learning. The struggle to establish and maintain a healthy forest is increasingly difficult throughout the Pacific, but Kalihi benefits from the support and input of many culturally grounded leaders from both Hawaiian and Micronesian cultures, such foresters

from such island groups as Palau and Pohnpei who are demonstrating leadership in Pacific island forestry management. These connections help the community connect beyond differences, also, and in this way forestry builds an opportunity for cultural peace-making in Kalihi, where cultural divides are often severe.

- C. **Volunteer:** Because Kalihi's community is generationally accustomed to growing food, medicine, and cultural plants in a forest setting, the Wao Kanaka component encourages community engagement in forest management and sets up long-term stewardship. This kind of volunteer engagement allows for more labor-intensive, organic practices such as hand-weeding and the avoidance of chemical pesticides, a practice less feasible without high levels of volunteerism and community involvement. The reciprocal benefit is a healthier human community grounded in root cultures. Native philosophy teaches us, '*ai i kekahi, malama i kekahi*', encouraging us to harvest some now and leave some for the future. Volunteers are able to experience the natural reciprocity between land and human.

#### 4. Practices

Each of the forestry activities below fall under a category allowed for Forest Stewardship Cost Share. Over the past seven years, we have found that the total actual cost of the work is much higher than the allowable cost share rates. Please see the 'special consideration' sections under each practice for justification of higher costs.

##### A. Site Preparation

Site preparation is a staged process that can occur in one day or two months depending on the area, types of invasives, and level of engagement.

**Stage 1.** Primary site preparation involves clearing invasive trees such as albizia, banyan, tremma, fiddlewood, and rosey apple with chainsaws, power trimmers, and other hand tools. Hand clearing allows for more detailed and careful removal of invasives without damaging existing natives or those within the seed bank. It also allows for gentle clearing around sacred sites, steep inclines, and generally hard-to reach areas that cannot be accessed with machines. The intimacy of hand clearing provides the opportunity to train staff and the community in plant identification, while strengthening the relationship between the land and its care-giving community. The tilling action mechanical means of manual control can also provide the soil scarification needed to stimulate the seed bank. We have found this to be particularly effective with *koa*.

Taller trees with extensive canopies require tree climbers to first trim back and sometime top the trees before they can be dropped. Albizia trees with diameters larger than 2ft have been girdled in the past with some success. Overall signs of dying start after 2 to 3 years, with the loss of all leaves. After this stage, the areas around and below the tree become more dangerous and off limits to volunteers because of the sudden dropping of limbs and eventual dropping of the entire tree. For this reason, the girdling can only be employed in limited areas. As a side note, we have witnessed a remarkable regeneration of trees that have been girdled, the outer bark healing back over up to 4ft of deep girdle. In these instances, re-girdling has been required.

In some areas that contain large invasive trees and remnant "junk", a backhoe and/or excavator is used to effectively manage intense slash piles. The use of mechanical equipment only occurs in flat areas that have already been disturbed by previous land managers, avoiding any undisturbed areas where natives exist and where stone terracing

remain. Due to rental costs, this kind of clearing only occurs once a year during a focused effort of one month with machinery, with at least one month of follow-up to manage smaller slash.

**Stage II.** The Earth is prepared for planting by hand-weeding the last of the grasses and vines, picking out roots, and exposing the soil. This intense hand weeding and clearing effort calls for hundreds of man hours every month. To alleviate cost and to perpetuate longevity into the project, HA/KKV employs the use of volunteers. Each volunteer group is hosted and educated by HA/KKV staff to insure safety of plant and people. Volunteer engagement allows for hand-weeding with varied rates and outcomes. The time needed per square foot decreases with increased number and skill of volunteers. Experience with seeding rhythms allows for quicker, more effective hand weeding.

In the upper elevation forest where the Wao Akua is still thriving, site preparation involves careful clearing around existing natives to remove surrounding invasive trees and weed plants. We depend on hand clearing and constant care and involvement of volunteers, specifically in steep 'pocket' areas around streams and gullies, and in areas where dry-stack terracing and irrigation remain.

**Stage III. Woody residue treatment:** After cutting down unwanted alien trees, where practical, wood is chipped using a power chipper to create a weed suppressing, organic mulch on trails and around new plantings. Additional trees are piled in low, organized stacks for chipping, burning, or quick decomposition and to prevent the harboring and proliferation of harmful pests. Stacked logs can form terraces to prevent erosion of steeper areas until the establishment of planted and regenerated natives. Larger logs will be removed and repurposed. Forestry staff will take care to preserve the repurposable logs.

**Special Consideration:** The rental of an excavator for one month per year is crucial for moving the size of logs that our site preparation calls for, particularly for moving the albizia slash, which can produce logs up to 50 ft. long and 4-5 ft. in diameter. The height and canopy of the tree varieties call for professional tree trimmers, which we contract at least twice per year.

## **B. Tree and Shrub Establishment:**

Generally, planting can begin immediately after site prep is complete. In special cases when soil health is extremely depleted by trees such as bamboo or pine, a remediation period of 1 to 6 months will precede tree and shrub establishment.

### **1. Seedling Acquisition:**

- a. On-site:** Seeds and cuttings from seeding plants on property that occur naturally or have been planted within the last five years are gathered and propagated on property in on-site nurseries. Staff collect seeds in the Wao Akua twice a year. Hiking to upper regions of property for seed monitoring and gathering can be costly in terms of staff time. To alleviate cost, HA/KKV depends on reports of which species are in seed or flower from a partnering organization, the O'ahu Invasive Species Coalition, whose efforts focus on upper regions. New seedlings in the nursery are fertilized with biochar, fish-based organic 'crumbles', Natural Farming products such as EM or IMO, and sometime vermicast.
- b. Other sites or nurseries:** If seeds or stock material is not available on site, seedlings will be or purchased from a native plant nursery for either immediate out

planting or for further growth and hardening off on-site. Time in the nursery can increase the inherent cost of a seedling. Endemic plants have a particularly long incubation period and the ideal out-planting age/size of a seedling in the sites existing condition tends to be older/bigger. For example, 'ulei seeds can take up to 6 months to germinate, and up to a year to be ready for out-planting. The initial cost per seedling was estimated to be \$1.00 to \$3.50. Currently, the average cost is \$12.00 per seedling, with the out-plantable size varying by species. In some cases, a seedling of a certain size can be purchased and then grown in the on-site nursery until it is large enough for outplanting.

- c. **Donations:** Donations are another way that seedlings make their way to HA/KKV. Many community organizations and school groups offer native plants from the nursery as their ho'okupu when visiting the site for service-learning and retreat. HA/KKV communicates directly with the nursery which species are desired, and in most cases, the donating organization is able to plant their donations.

**Seedlings/stock material located on-site include:**

'A'ali'i ( <i>Pandanus tectorius</i> )	Maile ( <i>Alyxia oliviformis</i> )
'Ahu'awa ( <i>Mariscus javanicus</i> )	Mamaki ( <i>Pipturis albidus</i> )
Alahe'e ( <i>Psyrdrax rubiaceae</i> )	Ma'o hauhele ( <i>Hibiscus brackenridgii</i> )
Akoko	Milo ( <i>thespsia populnea</i> )
'Awa ( <i>Piper methysticum</i> )	Moa ( <i>Psilotum nudum</i> )
Hala ( <i>Pandanus tectorius</i> )	Naio ( <i>Myoporum sandwicense</i> )
Hao ( <i>Rauvolfia sandwicensis</i> )	Naupaka kuahiwi ( <i>Scaevola gaudichaudiana</i> )
Hapu'u pulu ( <i>Cibotium chamissoi</i> )	Noni ( <i>Morinda citrifolia</i> )
Ho'i'o ( <i>Diplazium esculentum</i> )	'Ohi'a ( <i>Metrosideros polymorpha</i> )
'Ie'ie ( <i>Freycinetia arborea</i> ) Kalo (spp.)	'Olena ( <i>Curcuma longa</i> )
'Iliahi ( <i>Santalum</i> )	Papala kepau ( <i>Pisonia brunoniana</i> )
Ko ( <i>Saccharum officinarum</i> )	Ti ( <i>Cordyline fruticosa</i> )
Kamani ( <i>Calophyllum inophyllum</i> )	Pili ( <i>Heteropogon contortus</i> )
Koa ( <i>Acacia koa</i> )	'Uki'uki ( <i>Dianella sandwicensis</i> )
Kokio keokeo and ula ( <i>Hibiscus arnottianus</i> )	Ha'uo'i ( <i>Stachytarpheta cayennensis</i> )
Ko'oko'olau ( <i>Bidens micrantha subsp. kalealaha</i> )	Popolo ( <i>Solanum americanum</i> )
Lama ( <i>Diospyros sandwicensis</i> )	Pohinahina ( <i>Vitex rotundifolia</i> )
Laukahi ( <i>Plantago major</i> )	Wauke ( <i>Broussonetia papyrifera</i> )
Lonomea ( <i>Sapindus oahuensis</i> )	Uluhe ( <i>Dicranopteris linearis</i> )
	Ulei ( <i>Osteomeles anthyllidifolia</i> )

**Seedlings/stock material needed to be obtained off-site include:**

'Ahakea lau li'i ( <i>Bobea brevipes</i> )	Naio ( <i>Myoporum sandwicense</i> )
'Akoko ( <i>Chamaesyce multiformis</i> )	Native Bamboo ( <i>Schizostachyum glaucifolium</i> )
'A'ali'i ( <i>Dodonaea viscosa</i> )	'Olona ( <i>Touchardia latifolia</i> )
'Akia ( <i>Wikstroemia oahuensis</i> )	
'Akala ( <i>Rubus Hawaiensis</i> )	Naio ( <i>Myoporum sandwicense</i> )
Ho'awa ( <i>Pittosporum confertiflorum</i> )	Native Bamboo ( <i>Schizostachyum glaucifolium</i> )
'Iliahi ( <i>Santalum</i> )	'Olona ( <i>Touchardia latifolia</i> )
'Ilima ( <i>Sida fallax</i> )	
Kauwila ( <i>Alphitonia ponderosa</i> )	Pala'a ( <i>Sphenomeris chinensis</i> )

Koki'o ke'oke'o ( <i>Hibiscus arnottianus</i> )	Palapalai ( <i>Microlepia strigosa</i> )
Kupukupu ( <i>Nephrolepis exaltata</i> )	Pili ( <i>Heteropogon contortus</i> )
Loulu ( <i>Pritchardia</i> )	Ti ( <i>Cordyline fruticosa</i> )
Manono ( <i>Hedyotis terminalis</i> )	'Uala ( <i>Ipomoea batatas</i> )
Milo ( <i>thespsia populnea</i> )	'Ulei ( <i>Osteomeles anthyllidifolia</i> )
	'Uki'uki ( <i>Dianella sandwicensis</i> )

- d. **Agroforestry seed/stock material:** While agroforestry plants support the establishment and maintenance of the specific objectives of the plan, to establish native Hawaiian forest plants, KKV/HA will depend on community donations and other fund sources for the support of agroforestry seedling acquisition. FS funds for seedling acquisition are *exclusively* for the purchase of native plants. No Forest Stewardship funds will be used to purchase agroforestry seed/stock material.

**On site seed stock:** Mountain Apple, Kalo, Niu , Ko, Noni, Tapioca/Casava, Uhi, Citrus, Banana, Kamani, Nioi, Avocado, Curry

**Off-site seed stock:** Ulu, Ipu, Longan, Vanilla, Pear, Cashews, Pili nut, Surinam, Lychee, Fig, Cacao

2. **Planting:** “Ke kanu nei au, ia ‘oe ka ulu.” *I am planting you, it is for you to grow.* A chant recalled by Nana Veary from her youth articulates the epistemological relationship between humans and plants that we hope to perpetuate through our community-engaged programming. Planting is one of the most valued activities of our volunteer groups; we find more than 50 percent of average new participants have never planted anything before in their lives!
- a. **Timing:** Following Hawaiian cultural protocols for planting, we *plant by the moon*. Ideal planting moons are closest to the full moon, and most often we do majority of our planting on the full moon days.
- b. **Space holding plants:** In the Wao Kanaka, *fast growing food plants* such as kalo, ‘uala, ‘awa, and tapioca can ‘hold space’ by suppressing weeds and limiting soil erosion until the area is ready for the planting of long-term forest plants, or until planted long-term forest plants are better established. For example, two cycles of kalo are grown in some areas to help improve soil conditions and fertility before other forestry species are planted. The nature of the soil determines how long an area is held in this way. Kalo, ‘uala, and ‘awa are used as indicators of soil fertility to assess the time needed to repair and revitalize the soil’s nutrient-holding capabilities. The varying schedules may be one month, six months, or one year. Afterward, a hybrid agroforestry and endemic forestry planting system is used until the slower-growing endemic plants are well established. Areas where large trees may fall in future stages are particularly good for ‘space holding’ systems. After visiting a similar project in Kipahulu, HA/KKV is interested in exploring other kinds of ‘space holding’ plants.
- c. **Forest Structure:** Plantings are done by hand. Planters will look for the best micro-site within a few feet of the planting location, as determined by sun exposure, drainage, and species height. Ideally, a 1 to 10 ratio of upper to mid and low-story plants are outplanted.

Over the years, we have found the most success in ‘planning’ out a healthy mixed-height forest by planting multiple stories within a few feet of one another,. For example, an ‘ohia, a koki’o, and several carex will be planted to create a mini-ecosystem. Although it will be a while before the koki’o is outgrown by the ‘ohi’a, and the two will eventually trade places as upper/mid story plants. In many cases, an understory and overstory plant can be planted at the same time. Most often, the canopy tree will take much longer to establish than the lower-story plants, but the protection that the others give as the tree establishes itself is beneficial. As the plants grow, a second cycle of understory outplantings may be needed, and in ideal cases taking the cuttings from the already-established mid- and understory.

Similar to the ‘space-holding’ schedule described above, there are cases when the understory is outplanted without canopy trees with the intent that the upperstory will follow. Spacing varies by the steepness of the planting area or by species. Whenever possible, a larger plant is surrounded by a log box with the under-story plants at the ‘corners’ of the box, or wherever the logs join. This allows for clear areas for mulching, a good communication to future volunteer hand-weeders, and for a protective barrier for future weedeating around the planted areas. Planted areas will need monthly hand-weeding for at least two years, and sometimes *a follow-up planting* of additional lower story plants will help as the area gets established.

**Special Consideration:** Because of the steep slopes in some planting areas, HA/KKV utilizes slash to create planting terraces along slopes to reduce erosion of the slope and to support plantings while the root systems are being established. Invasive trees are removed from an area before planting, but heavy root systems remain often requiring the use of an auger to allow for planting. The initial FS plan called for over a thousand plants per acre; however, the cost of seedlings has been much more than the allotted amount and even with the on-site nursery and hundreds of donations per year, we are still striving to meet our ideal out-planting objectives by variety.

**Planting Schedule:** The table below outlines the planting schedule for each of the different forest tiers

Year	Upper-story	Mid-story	Groundcover
8	36/acre 72 total	145/acre 290 total	219/acre 438total
9	36/acre 72 total	145/acre 290 total	219/acre 438total
10	36/acre 72 total	145/acre 290 total	219/acre 438total

### C. Ground Cover Establishment

During initial planting, aggressive ground covers such as ‘uala, *carex*, kupukupu, ahu ‘awa, ‘uki’uki, pohinahina, ko’oko’olau, ha’uoi, ‘ilie’e, and others are planted to suppress weeds and limit soil erosion. Regular hand weeding is employed, and additional groundcovers, such as kupukupu and palapalai ferns, *carex*, ‘uki’uki, and ‘ulei, are added as needed as mid and upper-story plants establish themselves.

The planting and care of lower mid-story plants such as ko'oko'olau, ha'uo'i, and popolo are assisted by ground covers. We have found pohekula, an existing introduced species and a 'hanai' plant for la'au lapa'au practitioners, to be a useful ground-cover plant that keeps weeds down in an area, but it does not overcome even the smallest of plantings.

**Special Consideration:** Maintenance during ground cover establishment was thought at first to be one-year. We recognize now the need for at least two years of hand-weeding after an initial planting before ground covers are well established.

#### **D. Nutrient Management**

While a wide variety of vegetation thrives within this soil and climate, there are portions of the property where soil fertility is enhanced by organic treatments and amending materials listed in each practice below as well as bioflora, sustained bokashi, soil buster, fermented plant juices and black cinders. These organic soil amendments are sometimes made on-site.

**1. On-site composting system:** Logs are used to create composting bins for hand-cleared vegetation and are stacked for decomposition. After the bins have been filled and the vegetation has decomposed over time, the bins can be refilled again and again or used as planters, emulating a practice described in Native Planters using hapu'u stumps for planting 'uala.

Large piles of tree trimmers' chips are fed fish and bone meal, chicken and horse manure, food waste, and green waste to create a rich composted soil. This compost is turned regularly by the backhoe and is used especially for new out-plantings and in the nursery.

**2. Fertilization during outplanting:** Fertilization can include putting composted soil into the planting hole, or applying invasive seaweed, fish and bone meal, or organic crumbles on the surface after the plant is planted. Bundles of non-seeding, leafy, green weeds from hand-clearing, and/or tree trimming mulch can be used around the plantings both as a weed suppressant and to provide additional organic material to the soil. While the woodiness of the chipped material is high in carbon and acts only as a weed suppressant at first, over time, the piles of chipped material biodegrade to provide a decent compost base to which can be added various forms of nitrogen and phosphate.

**Special Consideration:** The backhoe is used daily to manage large piles of compost and mulch and to deliver compost and mulch to special 'drop' areas, located throughout the project site to allow for easier access by staff and volunteers in order to deliver material by hand to managed planting areas. Also, many of the organic-practice materials are produced on site, which adds to the time needed for this practice.

#### **E. Mulching**

Mulches are created on-site from removed trees and leafy invasives, and are delivered by local tree trimming companies. Mulch is applied across all planted acres in the project area, specifically to cleared areas, newly planted areas, and managed areas as a weed suppressant and organic material to strengthen soil. The number of times mulch is applied varies by weed grow-back, which is impacted by weather and volunteer management. Minimally, mulch must be applied after clearing and after outplanting. Community involvement with mulching has increased dramatically over time. With many hands, moving large amounts of mulch with buckets and wheelbarrows can happen in a short amount of time. The activity provides a low-impact means to get large amounts of mulch to areas where there is only



foot access, and even young children can learn and contribute in a meaningful way to the reforestation efforts.

**Special Area Practice:** Heavy mulching depends on regular use of a backhoe for moving and turning mulch/compost piles.

## F. Weed Control

KKV/HA recognizes that invasive weed suppression is one of the greatest challenges for forest restoration, and is an endeavor requiring a robust combination of effort and resources. We employ a process of *organic invasive species reduction*, by utilizing and depending on ground covers, mulch, and hand weeding by volunteers. Weed control will occur across all planted acres in the project area.

**1. Intense hand-clearing efforts by volunteers:** We engage hundreds on a weekly and monthly basis by employing a community-focused technique that encourages regular revisiting of a planted area by new and/or repeat volunteer community members. Annual volunteer access is in excess of 10,000 volunteers spending on average 3.5 hours helping to clear, plant, and hand-weed. The detail and intimacy of hand-weeding allows for highly efficient management. For example, the one acre area called Pasifika in the entryway to the forest, is hand weeded by 6 to 10 individuals spending 2.5 hours weekly. Broader spaces in Pasifika are weed-whacked monthly.

After initial planting, systematic weeding is expected to be necessary depending on conditions, but is typically once every other month for two years. Reapplications of mulch, vine removal, and increasing native groundcover will also take place continually after initial planting. Although weeding will be required until plantings are well established, the amount of effort to manage planted areas decreases significantly over time.

**2. Benefits of mechanical and manual weed control:** Using mechanical and manual methods of invasive species removal rather than chemicals, has had manifold benefits for Kalihi valley. The relatively greater availability of effort (person hours) for an organization like ours – with strong community engagement and limited resources – is just one of many reasons HA/KKV continues its commitment to physical (manual and mechanical), rather than chemical suppression techniques:

- Manual control is highly valuable for **safe community-based forest education**. KKV/ HA combines education on plant identification and balanced ecosystems with volunteer groups participating in weed removal. Engaging students and other members of the community in this way would not be possible if chemicals were used for invasive suppression.
- The tilling action of manual control and mechanical means of invasive control can also provide the **soil scarification** needed to stimulate the seed bank. We have found this to be particularly effective with *koa*.
- Institutional and cultural preferences for non-chemical approaches to weed control.
- As a **community health center**, KKV/HA is increasingly striving to make choices that embrace organic and low carbon footprint principles.

- Responsive to community cultural preference, avoiding chemical herbicides provides assurance to **traditional medicine practitioners** of both native Hawaiian and broader Pacific Island cultures, many of whom live and practice here in Kalihi valley. Assuring that these cultural plants are clean for medicinal use protects a delicate ancient traditional healing knowledge and insures engagement from this community in caring for the forest in perpetuity for generations.

## G. Forest Health and Protection

1. **Animal Control:** Feral pigs are controlled by the local hunters who have hunted generationally in the area for many years. The entire 100 acre property is hunted up to twice a week by the local hunting community. The local hunting method utilizes dogs and does not allow for guns of any kind. The regular presence of dogs in the various reforestation areas largely deters the pigs from rooting around and damaging new plantings. In certain situations, hunters will set box and corral traps, but only in monitored areas that are managed daily. This method of pig control requires more observation of pig patterns and regular communication with the pig hunters, than other methods such as fencing or snares.

The community engagement component of the reforestation work is crucial to the long-term success of the project. This method builds a sense of stewardship and responsibility with the pig hunters, a community committed to the preservation of the forest in Kalihi as demonstrated by their strong advocating (over 30 years) for the 100-acre nature preserve to be protected from development. While the hunters donate their time, KKV incurs costs to communicate, plan and manage gate access to the hunters.

2. **Animal barriers:** Protective barriers are erected around plants of desire to feral pigs. ‘Ulu, kalo, and tapioca are the most desired. We use methods such as, pallets, bamboo, wire and electric fences, logs, and corrugated metal. Horse fencing is the most effective but the most expensive, while bamboo is the least effective and the least expensive.

## H. Trail Construction

Trails connect upper and lower elevation areas and provide a network of safe and functioning access to managed areas. These trails will grow and stabilize over time with increased use. While trails can eventually function as recreation space for hiking and the enjoyment of nature, the initial and primary function of trails will be to provide both forestry staff and community members working access for forest management and education.

Trails are built by hand using picks and shovels after larger trees and branches are cut away with chainsaw and machete. We aim to keep trails at least 3 ft. wide to allow for wheelbarrow access. When necessary, steps are made with cut logs and scored for extra grip and safety. Maintenance of well-travelled trails includes covering of trails with chips in a layer 3 to 5 inch thick to increase safety from slipping and protect against erosion. Trails that are walked daily usually remain clear, while trails that are used less often or seasonally need to be cut back yearly. Up to year 6, HA has completed 4 acres of trails, calculating for a 10ft corridor. Beginning in year 7, we will build 1000 ft of trail yearly.

**Special Consideration:** Steep slopes throughout the property make trail building extra laborious. The slopes also call for extra care to avoid erosion, especially on ridge trails.

High rainfall also contributes to erosion. High levels of fast-growing invasive species make all trails high maintenance.

## **I. Monitoring**

Monitoring includes the cost of staff time to visit and assess areas that have been cleared and planted. Staff assesses the growth of natives, regrowth of invasives, and future needs of areas. For example, some areas require increased planting and/or weeding, while other areas only require routine assessment. Monitoring takes place daily or weekly in the Wao Kanaka areas, and semi-annually in Wao Akua areas. The monitoring of upper areas can take one or two staff members a full day's hike. Monitoring results in quarterly reports that include data and photo-documentation.

Since 2010, KKV/HA has begun to monitor forestry areas using GPS technology. KKV/HA staff participated in GPS and clinometer training provided by DOFAW staff and utilize this training in the monitoring of trails and acreage. Monitoring results in a detailed Koa Aina property map that is used in weekly staff meetings to guide staff assignments.

Since 2013, HA has begun to document forest stewardship training in three areas:

- Volunteer hours spent in targeted areas of our forest are tracked alongside number of natives planted and invasives managed. In-kind donations are assessed. Social media presence is captured.
- Detailed interviews with staff, volunteers and interns about mentorship and stewardship are analyzed to document the rate of forestry skill development and transmission.
- Professional photography of forest stewardship activity is used to document impact.

These three data collection streams are triangulated within an indigenous evaluation system developed by HA called Uluhoku. Uluhoku operates quarterly to generate reports that may be used for grant reporting, grant acquisition, and stewardship training.

## **J. Fencing**

Community engagement at HA requires fencing to control movement of animals to be implemented in one-acre or less increments with moveable and removable fencing materials. Electric fencing, horse fencing, bamboo fencing, and dry-stack stone walls vary in cost for material, installation, and maintenance. Materials have cost between \$1.40 and \$10.00 per foot. Labor for installation has cost between \$0.28 and \$33.60 per linear foot. Finally, labor for maintenance has cost between \$0 and \$25.50 per week. HĀ continues to utilize the various fencing methods depending on the terrain and the available staffing.

Fencing to control the movement of people at HĀ applies to three existing driveway/entranceways whose gates are currently in functioning order

## **5. Human Resources**

To successfully implement this project throughout the ten-year time period, a variety of skilled and unskilled labor is needed. KKV/HA has realized the efficacy and cost effectiveness of employing staff members with skills critical to successful operations and so has invested in highly skilled workers. KKV/HA staff involved in this project include two caretakers with reforestation expertise and the ability to operate heavy equipment and provide arborist services, staff committed to education and volunteer engagement critical for KKV/HA's community

education and engagement approach to forest stewardship, and a program coordinator. These staff members are responsible for coordinating volunteers and school groups, scheduling and organizing work days, purchasing supplies and materials, collecting and propagating seeds, selecting and hiring consultants, record keeping and report writing. Consultants and contractors are required on occasion to provide specialized input, such as for felling extremely large or dangerous trees, providing hydrology or soil assessments, etc.

The majority of site prep work for this project is accomplished by staff. Planting and maintenance is done primarily by the community/volunteers. KKV/HA now engages community members in approximately 13,000 volunteer hours per year at the Kalihi Valley Nature Preserve for structural renovation, site clearing, out planting, and trail building activities. So far, volunteer groups have included the Kalakaua Lion's Club, the U.S. Army, Kuhio Park Terrace Teen Club, the Sierra Club, Hawaii Trail and Mountain Club, Boy Scouts, Kaiser Permanente, Farrington High School biology classes, Radford High School Peace Club and the KKV Chuukese Women's Gardening group, Kalihi and Leeward YMCA, Women's Way, UH School of Nursing, UH School of Architecture, UH Department of Urban Planning, UH Center for Hawaiian Studies, Hands in Helping Out (HiHo), Waiiau Elementary, Dole Middle School, Mililani Middle School, Men's Leadership Hawaii Foundation, Keiki O Ka `Aina, KAUPA, Maryknoll High School, Punahou International Leadership Initiative, Kalihi Waena Elementary, KKV staff, and members of the Kalihi community. Two schools in the area, Halau Lokahi Charter School and Farrington High School, have adopted the nature preserve as a regular site for outdoor science and cultural learning activities. They will continue to be involved in a variety of reforestation efforts, bringing classes of 15-30 students three to four times per week.

The project will also be responsive to opportunities and lessons that emerge for new partnerships and practice areas.

As the site continues to develop as a natural and cultural resource in the community, additional volunteers and schools in the area are anticipated. Publicity continues to grow, support from the Kokua Kalihi Valley Comprehensive Family Services is extremely strong, HA/KKV continues to receive national and international recognition as a model for sustainable food and forest management with community engagement with reciprocal health benefits, and there continues to be a high degree of interest throughout Hawai'i for environmental projects that promote sustainable development and cultural appreciation.

## VI. PRACTICE IMPLEMENTATION SCHEDULE

\*The actual total cost for each practice is much higher than the allowable cost share rate, therefore the state share is on the high end. See "special considerations" for each practice in narrative.

### Year 9

Practice Component		Units	Cost/Unit*	Total Cost	LO Share	State Share
Tree and Shrub Site Preparation		2 acres	\$10,000/acre	\$20,000	\$19,000	\$1,000
Tree and shrub Establishment	Seedling Acquisition	2 acres @ 400 seedlings per acre	\$12/seedling	\$9,600	\$4,800	\$4,800
	Planting	2 acres	\$2,400/acre	\$4,800	\$3,800	\$1,000
Groundcover Establishment		2 acres	\$2,800/acre	\$5,600	\$2,800	\$2,800
Mulching		18 acres	\$400/acre	\$7,200	\$3,600	\$3,600
Weed Control		18 acres	\$600/acre	\$10,800	\$5,400	\$5,400
Nutrient Management		2 acres	\$1,300/acre	\$2,600	\$2,100	\$500
Trail Construction		1000 ft.	\$15.00/ft.	\$15,000	\$10,000	\$5,000
Forest Health and Protection		18 acres	\$250/acre	\$4,500	\$2,250	\$2,250
Fencing		1000 ft.	\$7/ft	\$7,000	\$3,500	\$3,500
<b>TOTALS</b>				<b>\$87,100</b>	<b>\$57,250</b>	<b>\$29,850</b>

### Year 10

Practice Component		Units	Cost/Unit*	Total Cost	LO Share	State Share
Tree and Shrub Site Preparation		2 acres	\$10,000/acre	\$20,000	\$19,000	\$1,000
Tree and shrub Establishment	Seedling Acquisition	2 acres @ 400 seedlings per acre	\$12/seedling	\$9,600	\$4,800	\$4,800
	Planting	2 acres	\$2,400/acre	\$4,800	\$3,800	\$1,000
Groundcover Establishment		2 acres	\$2,800/acre	\$5,600	\$2,800	\$2,800
Mulching		20 acres	\$400/acre	\$8,000	\$4,000	\$4,000
Weed Control		20 acres	\$600/acre	\$12,000	\$6,000	\$6,000
Nutrient Management		2 acres	\$1,300/acre	\$2,600	\$2,100	\$500
Trail Construction		1000 ft.	\$15.00/ft.	\$15,000	\$7,500	\$7,500
Forest Health and Protection		20 acres	\$250/acre	\$5,000	\$2,500	\$2,500
Fencing		1000 ft.	\$7/ft	\$7,000	\$3,500	\$3,500
<b>TOTALS</b>				<b>\$87,600</b>	<b>\$56,000</b>	<b>\$31,600</b>

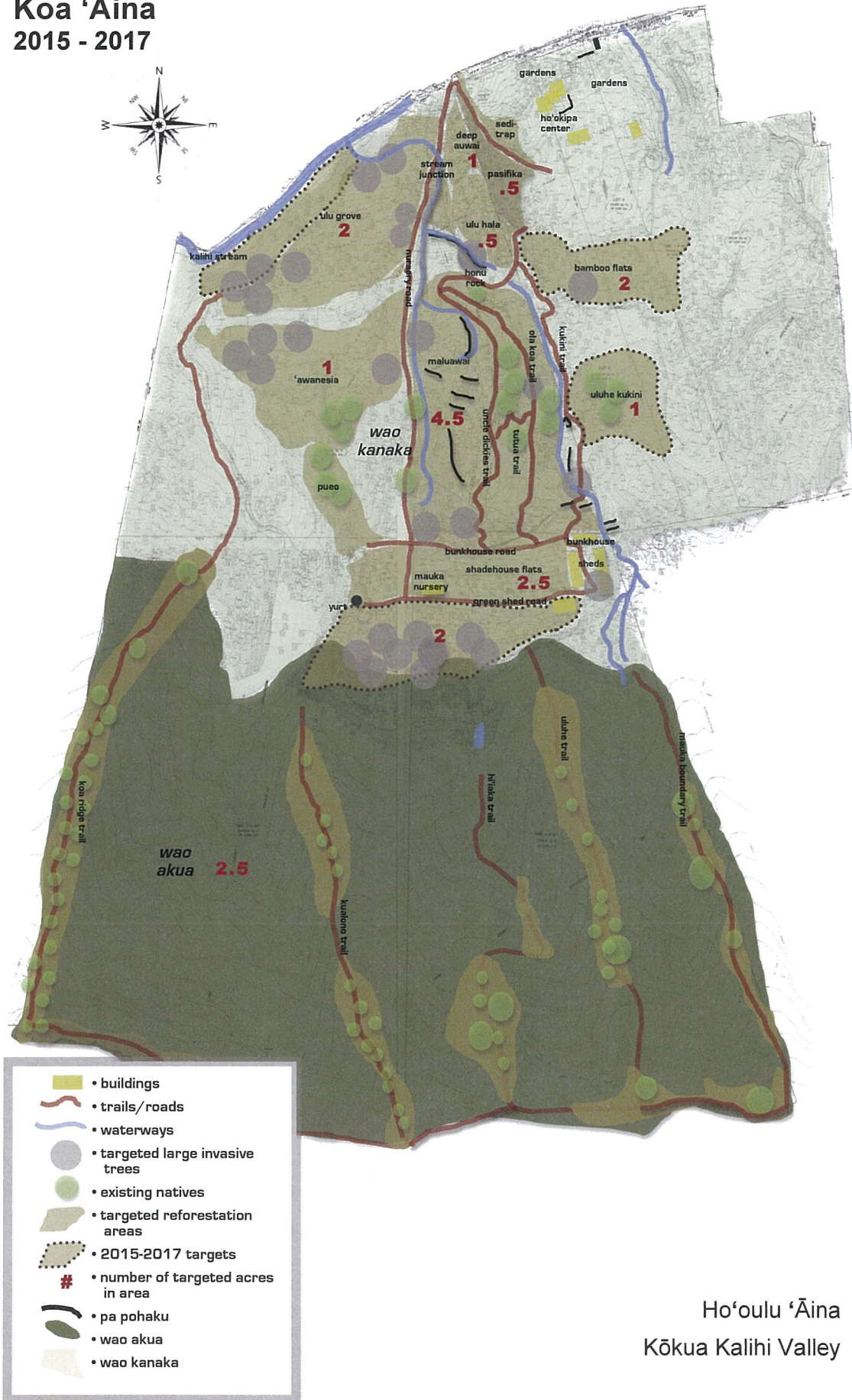
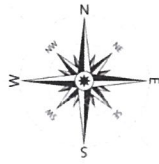
## VII. BUDGET SUMMARY

<b>YEAR</b>	<b>TOTAL BUDGET</b>	<b>LANDOWNER SHARE</b>	<b>STATE SHARE</b>
1	144,845	72,823	72,022
2	105,445	52,723	52,722
3	125,945	62,973	62,972
4	46,445	23,223	23,222
5	46,945	23,473	23,472
6	47,445	23,723	23,722
7	47,945	23,973	23,972
8	48,445	24,223	24,222
9	87,100	57,250	29,850
10	87,600	56,000	31,600
<b>TOTALS</b>	<b>\$788,160</b>	<b>\$420,384</b>	<b>\$367,776</b>

## VIII. ATTACHMENTS

1. **Map of Reforestation Area**

# Koa 'Āina 2015 - 2017



Ho'oulu 'Āina  
Kōkua Kalihi Valley